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RISK OWNERSHIP FRAMEWORK FOR EMERGENCY MANAGEMENT POLICY AND PRACTICE

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Introduction

Risk ownership is the one constant in a highly changeable risk landscape; where there is a risk, there needs to be risk owner. If a risk is not owned, it is very likely not being managed.

To date, government expenditure has shown a bias towards funding response activities over mitigation.

> **'We spend 97% on disaster funding money dealing with the after-effects of things as they occur, and only 3% on mitigating a disaster before it happens.'**
>
> — Michael Keenan, Minister for Justice, Australian Commonwealth Government (*The Guardian*, 2015).

The cost of natural hazard events is increasing and is expected to exceed $23 billion annually by 2050 based on estimates of changing exposure and not taking into account changing hazards (Deloitte Access Economics, 2013). This is driving the need to rethink expenditure, and to invest more deeply in mitigation and resilience to reduce the costs of these events.

Other factors that are also driving the need for change include:

- The changing nature and increasing frequency of natural hazard risk due to social, environmental and economic changes.
- More people living in higher risk areas.
- The need to ensure the best use of limited resources.
- The need to better understand what tangible and intangible values and assets should be prioritised, and by whom.
- The need to better understand how to assess trade-offs between different values and agendas, and different types of strategy (e.g., mitigation, recovery).

The ability to address these challenges requires developing longer term strategic thinking. It also requires an understanding and acceptance of what the risks entail and who owns the associated risk management activities. As many of the current arrangements in the Emergency Management Sector (EMS) have a response-based focus, this provides a substantial challenge because it requires new ways of thinking and acting that go beyond this.

Risk ownership can help inform this process by providing not only a focus for activities, but also by connecting a thread that runs through them – binding both ownership of values and ownership of assets in a way that supports actions rather than disabling them. Mapping, attributing and designating risk ownership is a process that needs to be underpinned by a robust risk culture across the individuals and groups in society exposed to natural hazard risk. They need to understand and

accept the level of risk they own, be able to prepare for and prevent risks in prospect, and respond to and recover from events as they happen.

It is also important for building resilience and undertaking longer term recovery actions that emergency management planning includes ongoing monitoring, reviewing and learning. To do this, organisations will need to be flexible and able to adapt to changes and unexpected outcomes as they occur.

The purpose of this framework is to assist this process with guidance that supports practitioners by providing a starting point for understanding and clarifying risk ownership as part of strategic risk planning. It does this through a framework that outlines:

- What risk ownership is and how it works
- The concepts that need to be understood to work in longer term strategic timeframes and to determine risk ownership across dynamic geographical and temporal landscapes.
- A companion process that can be integrated into current planning activities to develop emergency management plans by government agencies, communities and organisations. Its design is aligned with the *National Emergency Risk Assessment Management Guidelines* (Australian Emergency Management Institute, 2015).

The companion process uses a flexible, values-based approach that shows how to identify the most important values in a variety of settings, to assess how those values are at risk from natural hazards, and to identify and evaluate actions to preserve and recover those values in the face of natural hazard risk. A list of diverse evaluation tools and methods to do this are also summarised. The process is designed to add to, and be integrated into, current risk planning assessments.

Aspects of this framework may be uncomfortable because they challenge established forms of thinking and acting, so it is important for those using this framework to approach it through a change management/transformation lens. What is possible and when will be dictated by situational contexts and available resources. As with all innovation, developing the new skills and knowledge needed will help people understand and accept the changes they may need to make to undertake new and unfamiliar activities.

This type of planning goes beyond surviving an event and rebuilding back to focus on sustaining the values we treasure most. It is about planning for the future we want to have in the face of change.

This framework draws from the following research reports that have been part of the BNHCRC project 'Understanding and mapping bushfire and natural hazard vulnerability and risk at the institutional scale':

- Young, C. K., Symons, J. and Jones, R. N. (2015a). *Whose risk is it anyway?* Desktop review of institutional ownership of risk associated with natural hazards and disasters.
- Young, C. K., Jones, R. N. and Symons, J. (2015b). *Understanding our values at risk and risk ownership.* Workshop context paper.
- Young, C. K., Jones, R. N. and Symons, J. (2016a). *Understanding Values at Risk and Risk Ownership.* Workshop Synthesis Report.
- Young, C. K., Symons, J. and Jones, R. N. (2016b). *Institutional Maps of Risk Ownership for Strategic Decision Making.*
- Young. C.K and Jones. R. N. (2016). *Owning the future: risk ownership and strategic decision-making for natural hazards.*

Understanding
risk ownership

Figure 1 Areas of decision-making for risk ownership.

What is risk ownership and why is it important?

Risk ownership is a term used to define who owns a risk and how they own it. It is important because if a natural hazard risk is not owned, or ownership is not acknowledged or unclear, it is highly likely that it is not being managed. This can lead to greater initial impacts during an event, and also an increase of both risks and impacts over time that can, in turn, increase vulnerability to potential future impacts.

Risk ownership can be determined through either ownership of an asset that is at risk or actions associated with management of a risk and is drawn from the following definitions:

1. ISO 31000 risk standard as being '… a person or entity that has been given authority to manage a particular risk and is accountable for doing so.'
2. The Productivity Commission align risk ownership with assets stating '… asset owners are generally best placed to manage risks to their property.'

Three key areas where ownership of natural hazard risk can be identified are:

- Ownership of the assets at risk from natural hazards.
- Ownership of the risks associated with short to long-term impacts and consequences of natural hazard events (both direct and indirect effects).
- Ownership of actions in relation to those assets (values) at risk to either mitigate, build resilience to, or recover from natural hazard events.

Connecting ownership across these three areas of decision-making (Figure 1) ensures that risk ownership can be identified across the full activity spectrum of a natural hazard event (Figure 2) and includes:

- **Prevention (mitigation)** – where the severity of the hazard is reduced, saving damage and recovery costs.
- **Preparation** – where damage is reduced by pre-prepared actions before or during the event (not including direct response measures to reduce the hazard).
- **Recovery** – measures for improved recovery following the event.
- **Resilience** – non-specific measures to improve resilience not covered by the other three categories.

This makes it possible to assess more clearly the balance of ownership between institutions and organisations to ascertain how sustainable these arrangements are into the future.

Defining how risk ownership is delegated across these decision-making areas as part of a decision process, allows planners to see the chain of ownership across the cause, effect, consequence and risk management natural hazard risk cycle. By mapping delegations, practitioners are more able to ascertain ownership gaps, where ownership arrangements need clarification, and whether levels of ownership are sustainable.
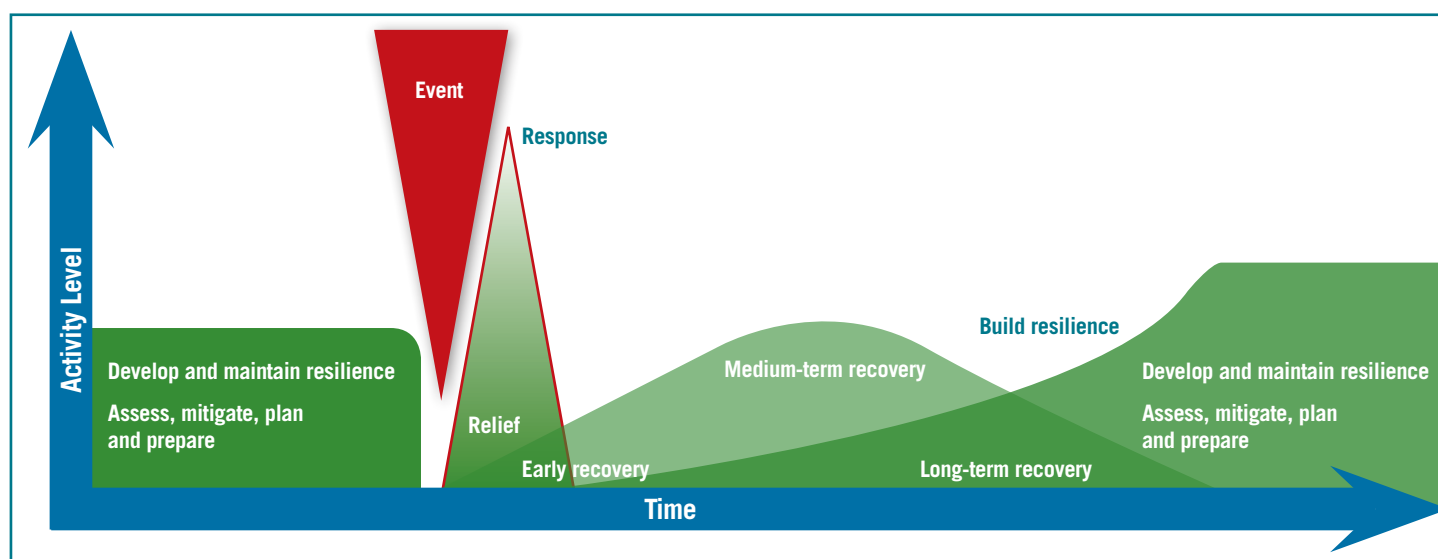
Figure 2 Projected resource requirements for effective integrated natural hazard risk management tasks across time scales (Young, C., et al. 2015a. Adapted from AEMI, 2011).

Complexities

Establishing the ownership of natural hazard risk is made complex by the following characteristics:

- Natural hazards are dynamic in nature. Risk ownership throughout the management cycle is changeable, depending upon context and the event itself.
- Depending on the level of impact, hazards may have several potential owners.
- Different types of hazard may require specific owners who specialise in aspects of that hazard, making the all-hazard approach difficult.
- Differences between the levels of perceived and actual risk associated with these hazards can affect who assumes ownership.
- Incomplete knowledge about natural hazard risks and limited access to information may limit the ability to allocate ownership appropriately.
- Differing expectations of ownership within, and external to, institutions that compete for limited resources, and/or that promote competing agendas.
- Different approaches by state level agencies (e.g., comprehensive, all hazards, all agency, multi-hazard, single hazard).
- Uneven transition of public institutions to being more flexible and collaborative.
- Areas where ownership is not clearly delegated or shared.
- Systemic interdependencies where ownership actions in one area create impacts in another area.
- Related policies and plans that contribute to a specific region, activity or set of outcomes that are being addressed separately (e.g., adaptation to climate change, regional economic development).

Ways of allocating risk ownership

Effective risk ownership, requires establishing **who** the owner is, **what** the allocation is for, **how** it is allocated, and **if** the associated responsibilities can be fulfilled.

The key activities areas through which risk ownership are primarily allocated in relation to natural hazard are:

- Responsibility.
- Accountability.
- Payment.

This is referred to throughout this document as the **RAP Criteria** (see page 9).

Ownership of these activities can be allocated in a variety of ways, such as:

- In relation to a **hazard** – for example, specific authorities and agencies are charged with managing bushfire risk, others manage flood.
- In relation to an **activity or task** required during a given phase of the risk management process (e.g., roles related to preparation, plan, response and recovery).
- Through **formal instruments** such as policy, legislation and regulation, private contracts and agreements (Figure 3).
- Through **informal agreements or social contracts**.
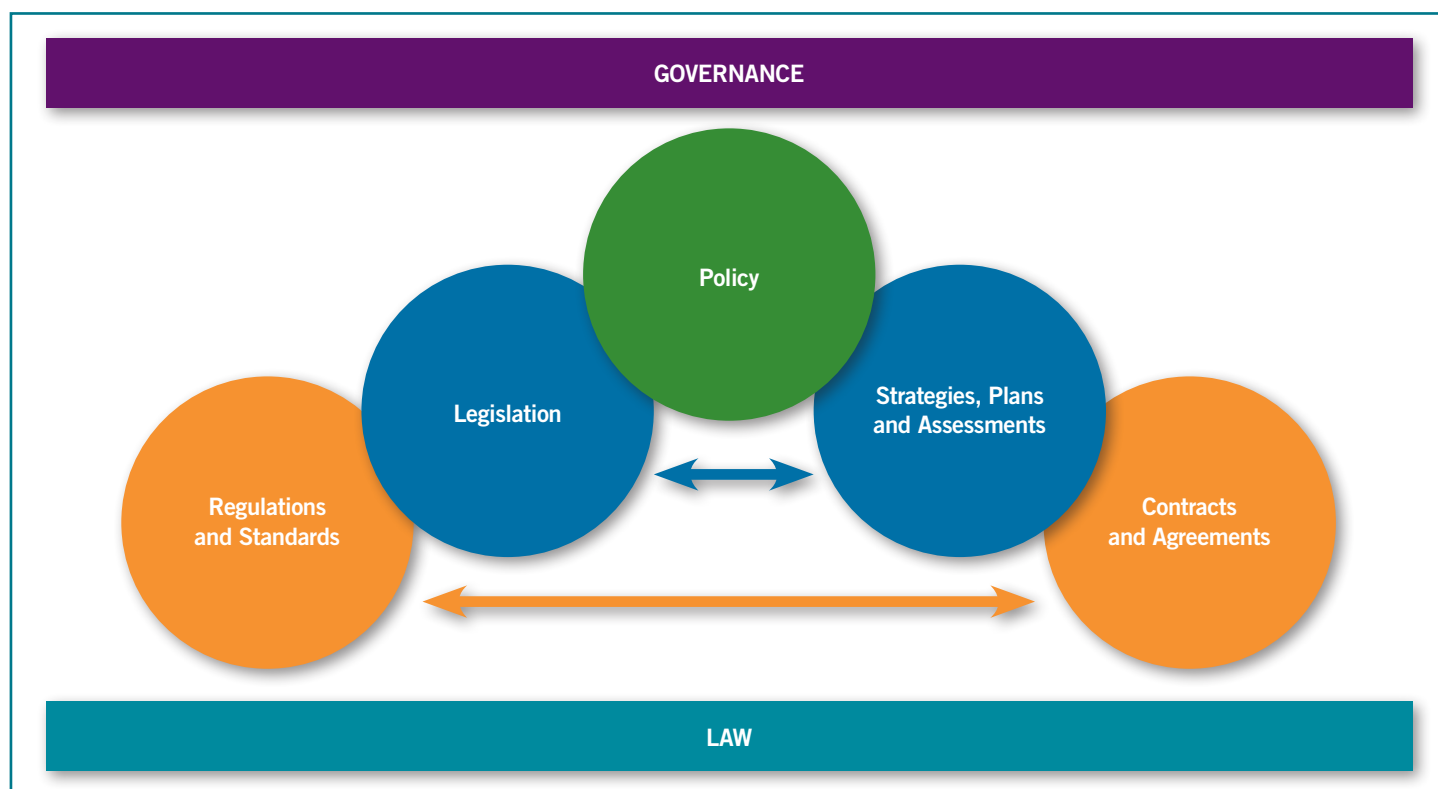
Figure 3 Formal instruments for allocating risk ownership (Young, C., et al. 2015a).

The RAP Criteria

The RAP Criteria provides a basis for achieving this through identifying areas of risk ownership using the three areas that underpin activities.

It is asks the following three questions:

- Who is responsible?
- Who is accountable?
- Who pays?

These three questions can be mapped to different values to establish the chain of ownership across different timeframes. It is also useful for identifying areas where risks are unowned, unacknowledged or unclear and can be particularly useful for clarifying shared arrangements.

Community

Pays potentially higher cost for local product.

Federal Government

Pays for aspects pf recovery in social and built infrastructure.

Possible future welfare costs.

Business and Industry

Pays for insurance.
Responsible for business continuity plan.
Accountable for financial loss.

State Government

Accountable, responsible and pays for aspects of recovery and restoration of public infrastructure and resilience building.

Local Government

Accountable, responsible and pays for restoration of some infrastructure.
Responsible for, and pays for, community support programs.

Tools used to allocate ownership

The primary tools used for allocating ownership are:

- **Policy and strategy** relate to over-arching principles and plans that guide and direct the economic, social and environmental terms for influencing the management and mitigation of natural hazard risks.
- **Plans and assessments** address the development of specific actions and their implementation. Contracts and agreements are elements of this process.
- **Legislation** provides the framework for the legal aspect of policy making, and regulations and standards support the enforcement of these by providing regulatory processes and rules.
- **Governance** provides the frameworks for establishing accountability. The legal system provides the framework through which aspects of this can be tested and enforced. Governance provides the management structure and the law provides the means through which these arrangements are enforced.

- **Social contracts and informal agreements** are implicit arrangements that are not enforced or enforceable, but are often the basis for ongoing activity that is needed to support resilience and recovery activities. Informal arrangements that sit outside of more formal structures are also important, as they are a key aspect of community ownership and essential for resilience.

These formal and informal instruments apply across institutions, organisations and communities in different ways (Table 1).

Who owns the risk?

Risk ownership can lie with a single entity or can be shared. There are three main types of owners:

- institutions
- groups, and
- individuals.

As a result, risk ownership can be assessed at three levels (Table 2).

Table 1 Application of instruments for risk ownership .

INSTRUMENTS	APPLICATION IN ASCERTAINING RISK OWNERSHIP
Policy	All levels of government, industry and business, and aspects of civil society. Includes overarching policy and principles at federal, state and local government levels, and organisational policies in the private sector and community agencies.
Legislation	All institutions, but less so for civil society, compared to government. Includes international, federal and state legislation.
Regulations and standards	All levels of government and industry and business, but less so for civil society. Includes building and planning, consumer protection, official standards and professional codes of practice.
Strategies, plans and assessments	Applicable to most areas of society in the form of risk assessments and response plans at federal, state, regional, municipal, sectoral, community and organisational level. Communities have little accountability in this area but can be allocated roles via specific policies. Also strategies associated with international treaties Australia is a signatory to.
Contracts and agreements	All areas of society covering government, industry and business, and communities. Contracts are a key driver for industry and business. These include vendor agreements, contractual arrangements, commercial law and community arrangements. Includes all international legally binding treaties and agreements.
Social contracts	Social contracts apply across all levels of society. These are arrangements that are agreed upon but have no specific formal structure, and are implied rather than explicit. The basis of these arrangements is often based on understandings or unspoken rules that exist between individuals, communities/organisations or institutions.

Table 2 Levels of risk ownership.

LEVEL	DEFINITION	EMERGENCY MANAGEMENT CONTEXT
Institutional	Formal or informal structures and arrangements that provide 'the rules of the game' (North, 1990) that govern and shape behaviour of a common set of groups and individuals.	Community, state, local and federal government, boundary organisations, business and industry.
Group	Groups of individuals who share a common interest or purpose.	A particular community, organisation, agency or network (this can also be a virtual community).
Individual	Individual person or legal entity.	Risk manager, house owner, property manager.

The institutional level is used for identifying the primary stakeholder groups of risk owners and their level of ownership (see Figure 4). This is important because risk ownership needs to be distributed and managed in the long-term across all levels of society, if society is to be resilient and sustainable. The key institutional categories we have defined are:

- Local Government
- State Government
- Federal Government
- Business and Industry
- Community
- Boundary organisations.

The two other levels, the agencies and organisations that make up these institutions and the individuals who make up those agencies can be used to provide specific detail which support actions. Assessment of these levels can help identify areas of over allocation and operational risk that may result from this. Ownership is also often shared across all these levels and as a result it can easily become confused and lack clarity.

For examples of agencies and roles associated with these institutions, see Appendix A.

An example of how ownership mapping can be communicated in a specific area is the Colac Otway Shire's Maps (Colac Otway Shire, 2016). These maps are spatially represented and use a geographical information system (GIS) to show both risk and ownership. The different areas shown are diverse and include the Wye River/Separation Creek Communities map, which is designed to assist the recovery of those communities from the 2015 fire. The planning overlays assist understanding of ownership of jurisdictional areas, and the 'Whose road is it?' map identifies the roads and who is responsible for them.

Shared ownership

'New models of public/private collaboration need to be promoted to support, finance and deliver immediate assistance and alleviate long-term needs – with business collaborating closely with frontline responders on responsible investment to strengthen state and societal resilience.'

— World Economic Forum, 2016.

Because natural hazard risk exists in a system of the economy, society and the environment, risk ownership is systemic, meaning that the ownership of values and their associated risks are often shared. This is particularly the case with over-arching values (such as resilience) and intangible values (such as community wellbeing) that depend upon multiple stakeholders.

This can be challenging, because many current institutional and organisational structures are not set up to enable or support collaborative arrangements that can accommodate shared ownership. Maintaining accountability in shared ownership arrangements is also challenging – particularly over the longer term, as roles and expectations may change due to the changing contexts and nature of events.

In any plan, it is important to define what aspect of the risk is owned, how it is owned, and by whom. The RAP criteria can be useful in assisting this process.

Documenting informal arrangements that exist in shared ownership arrangements is important, as these are often not enforceable and need different management techniques to ensure that ownership obligations are fulfilled.

It is also important to identify areas of unowned risks, or where partial ownership of risk may exist, so that these can be documented and addressed.

Values-at-risk
Unowned 1%
Fed Gov 9%
Community 21%
State Gov 24%
Business and Industry (B&I) 25%
Local Gov 20%

Risk and consequence
Unowned 5%
Shared 6%
B&I 7%
Community 9%
Fed Gov 6%
Local Gov 27%
State Gov 40%

Risk actions
Shared 4%
Unowned 2%
B&I 16%
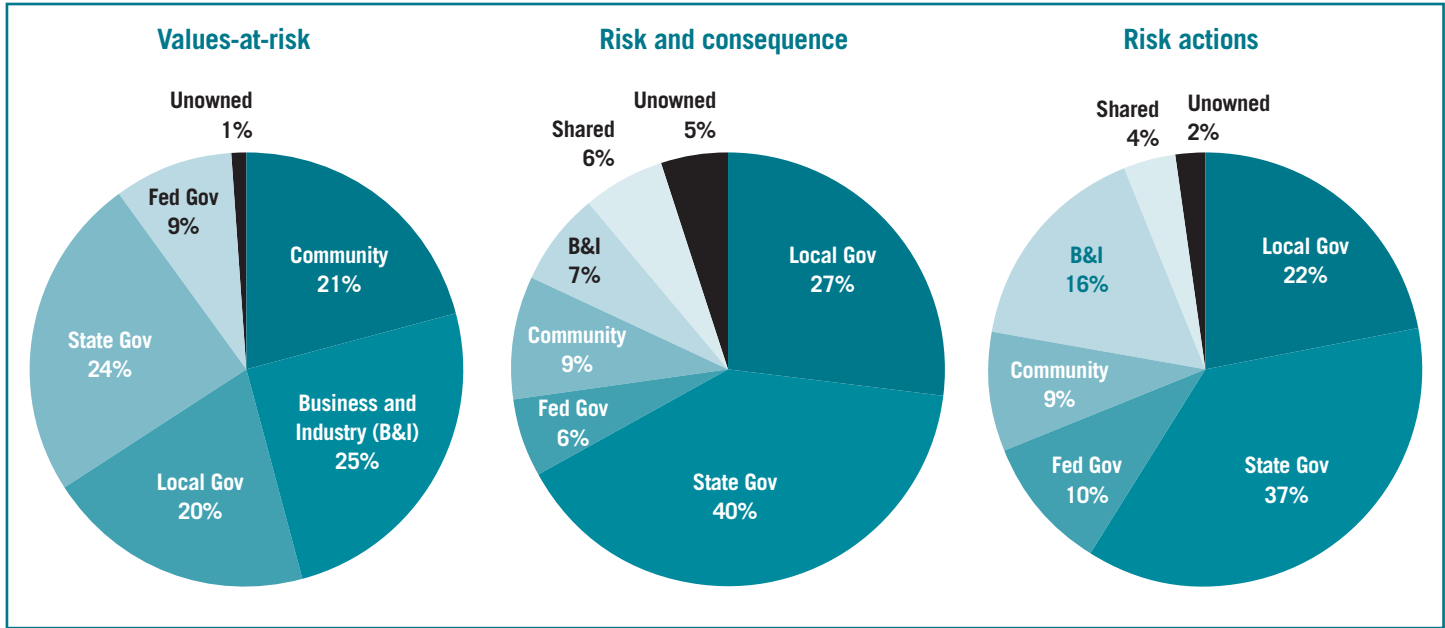Community 9%
Fed Gov 10%
Local Gov 22%
State Gov 37%

Figure 4 Perceived allocation of institutional ownership of values at risk (Young, C., et al. 2016a).

Understanding the dynamic nature of risk ownership

As the nature of our society and the risks it faces are changing, so is our understanding of how these risks are being owned, and perhaps should be owned.

Risk ownership is not a new concept, but its understanding and application has been changing over the last decade, particularly in business and finance. Before this project, the concept has not been systemically applied in the natural hazard area.

Natural hazards, and the contexts in which they occur, are dynamic. As a result, risk ownership can change abruptly. Two of the key ways this can happen are through:

- risk contagion, and
- the exceedance of capacity and prescribed (legal, regulatory) thresholds.

'Risk contagion' is a term most commonly used to describe how impacts are seen to spread across geographical and institutional borders 'like a contagious disease' (Bordo, M. D., et al. 2000), creating a cumulative effect far larger than the initial event. The concept has recently emerged in business models as a way of understanding how different areas of risk can be affected by seemingly unrelated risks particularly in strategic planning. This is particularly relevant to the natural hazard sector where risk ownership is systemic, and may be allocated for direct impacts, but not for indirect, knock-on effects.

The breaching of capacity thresholds can happen at an environmental, social or economic level. This results in the original risk owner transferring the responsibility of the risk to another owner (either by a prior arrangement or by default), because they lack the capacity to address or manage the risk. For **prescribed thresholds**, legal, regulatory or management rules signal a transfer of ownership or change in ownership status.

Identifying whether the nature of the risk is changing through contagion or capacity exceedance can help determine critical points or thresholds at which ownership may be transferred, or where risks may become unowned over different temporal and geographical scales. It can also help identify potential areas of vulnerability and support better long-term management and resource allocation for these risks.
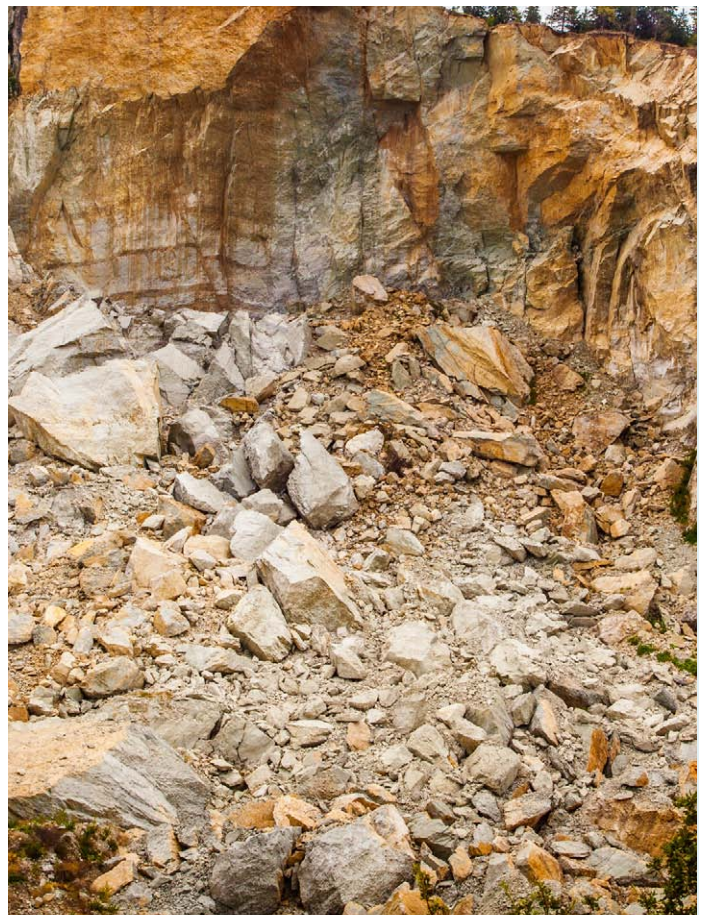
Summary Case Study: Victorian Grampians Landslides, 2011. (Ollerenshaw, A. 2014).

On 12–14 January 2011, 282 mm of rain fell at Hall's Gap in the Grampians. It was the heaviest fall in 72 hours since 1876, and a once in a 100-year event (ending in the highest monthly total on record for January of 297 mm). The downpour resulted in severe flash-flooding and landslides. Relief and recovery was estimated to cost $140 million, while estimated tourism losses of $25.5 to $30.5 million affected the broader Grampians area.

With regards to ownership of risk, it was found that there was no dedicated state agency for landslides, so responsibility for landslide management needed to be adopted in hindsight. Funding from the Australian Government-State Natural Disaster Relief and Recovery Arrangements (NDRRA) was provided involving federal, state and local government. Local government and authorities put in place response and recovery plans afterwards to coordinate responsibilities, thereby taking ownership for future events. There was a lack of connection between tourism, parks and operators during the recovery, though visitor numbers did recover in the second year. Local ownership was demonstrated through people who went above and beyond their roles to assist. Infrastructure was improved to mitigate future damage. (For the full case study, see Appendix B.)

Summary Case Study: Heatwave, southern Australia, 2009

After 13 years of drought and higher than usual temperatures from 27 January to 8 February, southern Australia and northern Tasmania experienced a major, unexpected heatwave with maximum daily temperatures 12–15 degrees above the seasonal average of 28–32 degrees (Jones, R. N., et al. 2014).

Emergency management services who relied on reactive solutions to the emerging impacts were under-prepared for such a disaster, as capacity was exceeded in every service (QUT, 2010, p5). Communication and cross-agency cooperation was inadequate for the overwhelming demands created by this event. Health services were challenged by fatalities and demand for their services, even though The Department of Health emergency branch was coordinating with the media. Ambulance Victoria worked with the hospitals to cope, but it was determined that capacities were breached across all agencies. There were no plans or arrangements for reducing risk, but concerns resulting from the impacts of the heatwave have boosted evaluation of heatwave planning policies, and the development of more comprehensive plans such as the 'Heatwave Plan for Victoria 2009–2101' and the 'Extreme Heat Arrangement Plan' in South Australia (QUT, 2010, p6). (For the full case study, see Appendix B.)

Summary Case Study: Floods, eastern Australia, 2010–2011

The severe flooding disaster affecting central Australia, southeast Queensland, and far northern New South Wales in December 2010 to January 2011, was created by a series of extreme rainfall events.

The impact of the floods was initially felt in local communities, but it impacted the wider region and even the Australian economy. ANZ economists estimated the floods could reduce Australia's GDP by 0.25% in the December quarter of 2010 (O'Sullivan, 2011). More than 78% of the state was affected, with roughly 29,000 homes and businesses flooded, and 33 confirmed deaths (QFCI, 2012, p32). The Queensland Reconstruction Authority estimated the cost in excess of $5 billion, with 2.5 million people affected (QFCI, p32). In Brisbane, 28,000 homes were flooded and 100,000 homes lost power (Carbone and Hanson, 2012). The crisis forced the closure of more than 300 roads, including nine major highways (*Sydney Morning Herald*, 2010). Over 9,000 kms of road networks were damaged, making it the most affected state asset (QFCI, 2012, p251). All taxpayers contributed to recovery through a one-off Flood Recovery Levy worth $1.8 billion to fund the rebuilding of infrastructure after the floods (Wilson, 2011). (For the full case study, see Appendix B.)
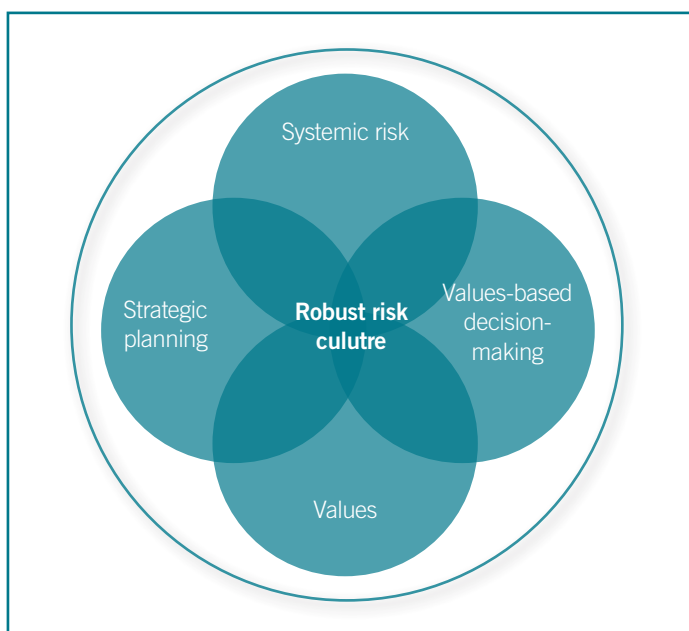
The risk ownership framework

Key knowledge components of the risk ownership framework

Strategic planning in the EMS is being driven by the introduction of resilience as a key policy, however the need to address longer term recovery agendas to support this is still developing as an area of practice. Because strategic planning requires new ways of thinking, it is important to identify core areas of existing knowledge, and to build from that to develop the new understanding and skills required to support practice.

The key components that underpin this risk ownership framework process are **values, systemic risk, strategic planning and values-based decision-making** (Figure 5). It is important to understand these aspects, as they determine the thinking framework needed for understanding how actions are applied in this area.

Risk ownership implementation and practice is ensuring that people understand and are willing to accept a risk, establishing a robust risk culture that monitors, assesses, and is able to communicate and collaborate effectively, and is agile and flexible. These combined actions are crucial to enabling this framework.

Figure 5 Conceptual components of risk ownership framework.

Systemic risk

> '*Unfortunately, in many companies, the CFO is handling financial risk, the CEO is handling strategic risk, and the COO is handling operational risk, but no-one is looking at all those risks as one.*'
>
> — Jim Loucks, Chief Commercial Officer, Aon Risk Solutions.

Natural hazards and the risks they trigger are systemic and can impact on environmental, social and economic systems simultaneously over multiple timeframes. These systems and the risks associated with natural hazards are interconnected and interact with each other (Figure 6, page 15). An impact in one area can affect another and, as a result, conditions that dictate ownership of risk can change abruptly. This type of systemic understanding of risk is already well understood in the natural hazard literature through catastrophe risk (Hewitt, K. and Burton, I. 1971; and Burton, I., et al. 1993).

Drivers such as increases in population, new technologies and climate change are currently changing the global risk landscape by creating new risks that have not been encountered before. It also means that events are happening in ways that have not been experienced before. This makes it important to understand the types of risk which are in the natural hazard landscape and how they interact (Figure 7, page 16).

Ascertaining whether a risk is external or internal to an organisation can help risk owners to determine *how* a risk can be managed and *if* it can be managed, and where they have the most agency to act.

Internally-based risks occur within the boundaries of a system that defines a business, community or organisation. They are more likely to have limited impacts within that system, and are more amenable to controls by risk owners. The effectiveness of these controls often determines the ability of institutions, organisations and communities to manage the impacts of externally-driven risks. Effective management of these internally-driven risks is a key part of building organisational resilience and the ability to proactively respond rather than react to an event with simple damage control.

Externally-based risks are unbounded risks and often are beyond the control of any single organisation or institution. They are usually systemic and highly dynamic and can have multiple owners. The boundaries of these risks are often unclear, spanning multiple areas and timeframes. They can be anticipated and prepared for, but are difficult to forecast, and because of the high level of uncertainty surrounding the future, often have unanticipated outcomes.
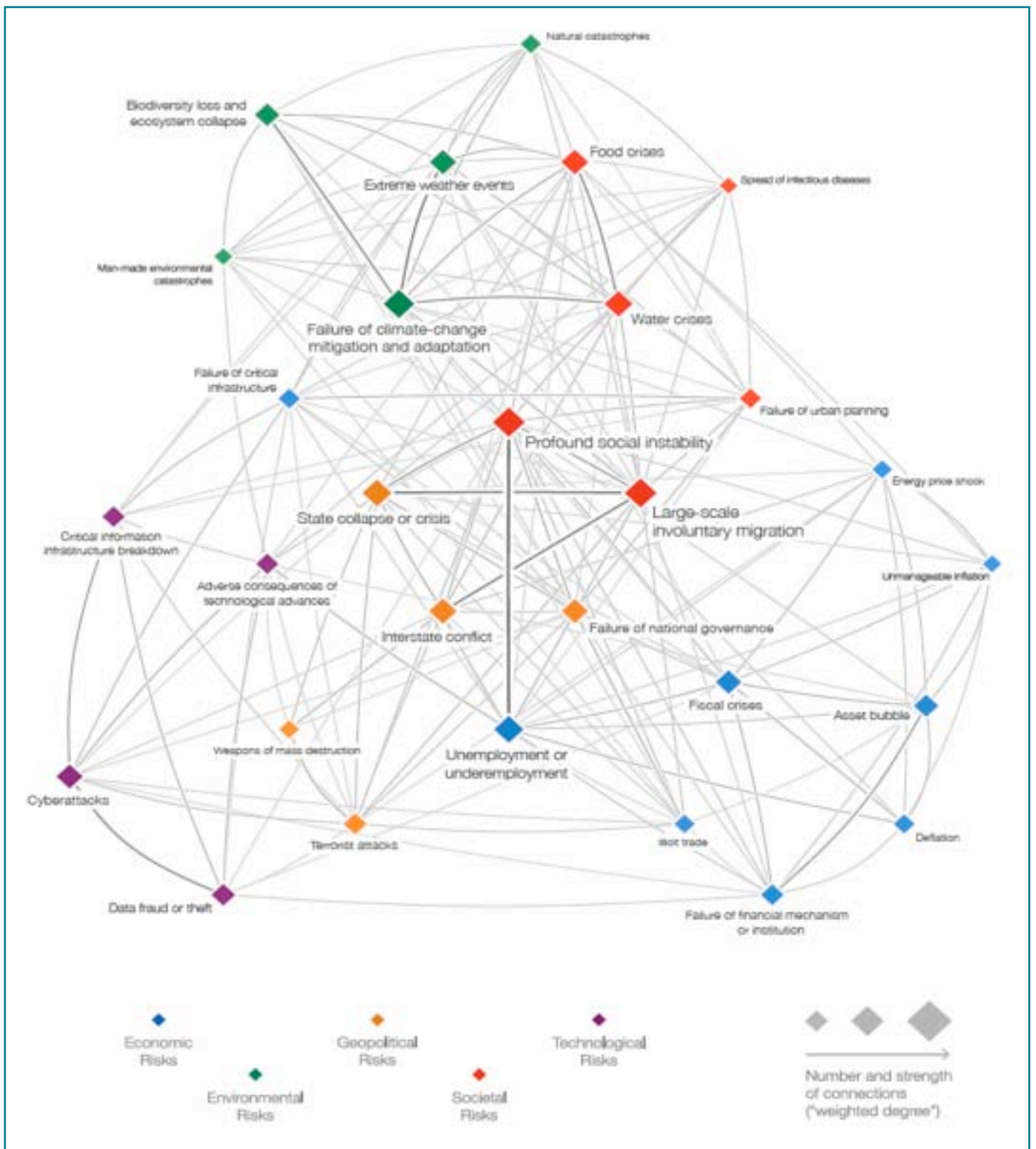
Figure 6 Global risk interconnections map (World Economic Forum, 2016).
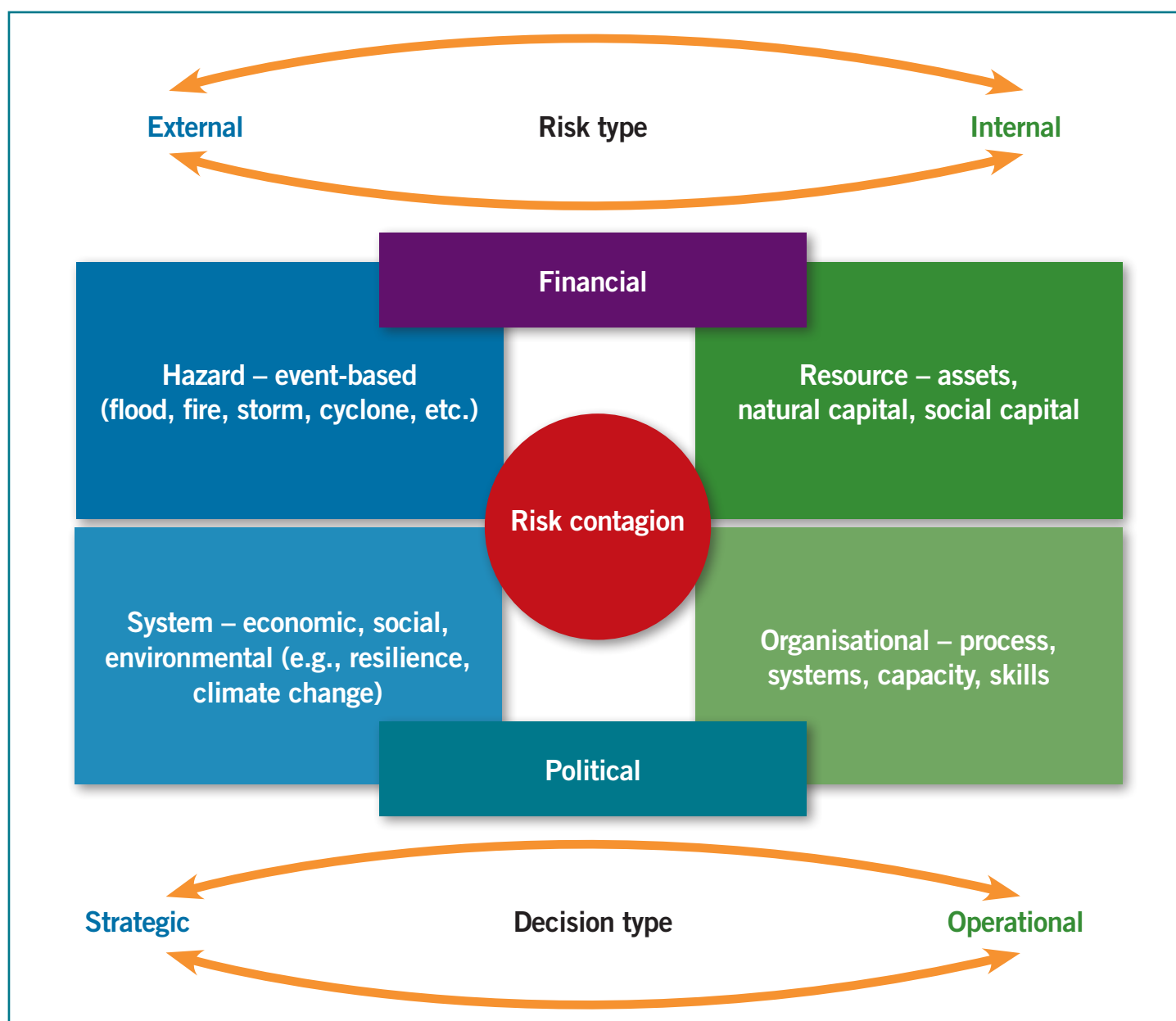
Figure 7 Risk system with internal and external components (Young, C., et al. 2016). Adapted from PCW (2013) and Kambil, et al. (2005).

The strategic management of natural hazard risk also needs to account for political and financial risk. The internal aspects of these risks will influence perceptions and decision-making at an individual scale, all the way up to institutional scales. External risks arise from external policy and financial markets that can influence the level of risk different parties are exposed to.

Examples of some these external and internal risks are shown in Table 3. The basis of risk ownership is established through understanding what forms of governance and approaches are most suited to the nature of the particular risk, and the context in which that risk occurs.

Table 3 Examples of external and internal factors affecting institutional management of natural hazard risk (Young, C., et al. 2015a).

EXTERNAL RISK EXAMPLES	INTERNAL RISK EXAMPLES
Natural hazards (e.g., fire, flood, extreme events, cyclones and heatwaves)	Unclear communication
Lack of resilience in the surrounding natural, social and economic systems	Different levels of risk perception and awareness within institutions
Lack of clear accountability/responsibility in other institutions/organisations who are co-participants	Governance – lack of clear accountability/responsibility within the organisation
Abrupt changes in exposure via changing demography, economy or environment	Lack of adequate resources, capacity, organisational flexibility

Values

What we are protecting and why we are protecting it are the basis for determining what activities need to be undertaken and who needs to undertake them. Values provide the starting point for this by identifying what is important and why it is important in particular contexts.

Values are allocated to things considered important because they are useful or appreciated for their existence. Values can be **tangible** (goods and services with a direct monetary value), or **intangible** (values that do not have an explicit monetary value). Intangible values include environmental and social values such as community connectivity, beauty of a landscape and environmental services such as clear air and water. These values also help to support the economy and, particularly in the case of social values, are crucial for resilience. Sometimes such values can be accounted for in monetary terms, but whether all such values should be monetised is a source of active debate.

Values can be determined by all levels of society – from individual to institutional – and shape how different areas of society prioritise what is important to them. Understanding who owns these values and who benefits from them is a key element of establishing who has a stake in protecting them, and what level of responsibility they should have as a result. Currently, Victoria and New South Wales have asset registers that have tangible values collected from communities. These databases are used to support the states' risk planning processes.

The increasing intensity of some natural hazards and changing demographics is placing many of these values at greater risk. This is driving the need to better understand which values are most vulnerable and how they are vulnerable.

> Values are affected by disasters in two ways: one is through the damage experienced as a result of the shock and the other is as ongoing losses/gains during recovery (Cavallo and Noy, 2010). Losses in some areas of value may never be recovered, while other values may actually be stimulated by the shock or by other measures taken to aid recovery. For example, rebuilding often stimulates the construction and materials sectors as occurred following the 2011 Queensland floods (Hartley, et al. 2011). (Jones, et al. 2015. p8).

Greater understanding of these positive and negative effects and who owns and benefits from them can help improve strategic planning in a way that will support the building of resilience and better use of resources.

As values exist as part of a system, mapping the components and their interactions (Figure 8, page 18) can help to better understand the interactions and where key dependencies lie between the different values. Mapping ownership across these value maps can assist in identification of where vulnerabilities might lie as a result of lack of or unclear ownership.

Building the database for values in Victoria – Country Fire Authority

The Victorian Fire Risk Register – Bushfire (VFRR-B) – identifies assets at risk from bushfire, assesses the level of risk, and records treatments to mitigate the risk.

The register is Victoria's first consistent bushfire risk register, which is facilitated state-wide by the Risk Intelligence team from Country Fire Authority (CFA) headquarters. The process has been facilitated in 66 of the 79 municipalities, five alpine resorts, and French Island. Assets are spatially mapped by workshop participants using a point, line or polygon. Assets mapped include residential areas, schools, hospitals, infrastructure, tourism events and commercial industry, as well as those that are environmentally and culturally significant. The register has recently been updated to a web-based application to improve useability, and offers '… enhanced interaction for users via the mapping of data specific to their region.' (CeRDI, 2015).

Complexities associated with values

A number of complex areas associated with identification and use of values in decision-making have been found during this research (Young, et al. 2016). Key observations were:

- **Values are subjective in nature and defined by who is doing the valuing.** This was particularly apparent across different scales of decision-making. For example, where a community-level appraisal of what is valuable can be different to a higher-level government appraisal.
- **Representation of intangible values in the decision-making process is difficult.** Currently, decision-makers do not have sufficient tools or methods to be able to effectively quantify intangible values, particularly in the social and environmental areas. This can often cause barriers to being able to build business cases to support the longer term investment or the protection needed in these areas. It also makes it difficult to ascertain what the actual cost of trade-offs between different values is.
- **Values exists within a system but are often assessed as individual components.** Often a primary value is identified as important and protected without the values that it depends upon being identified. As a result, this value can inadvertently be placed at risk if one of the supporting values is damaged. It also means that areas of vulnerability are not always clearly identified before the vulnerability becomes apparent.
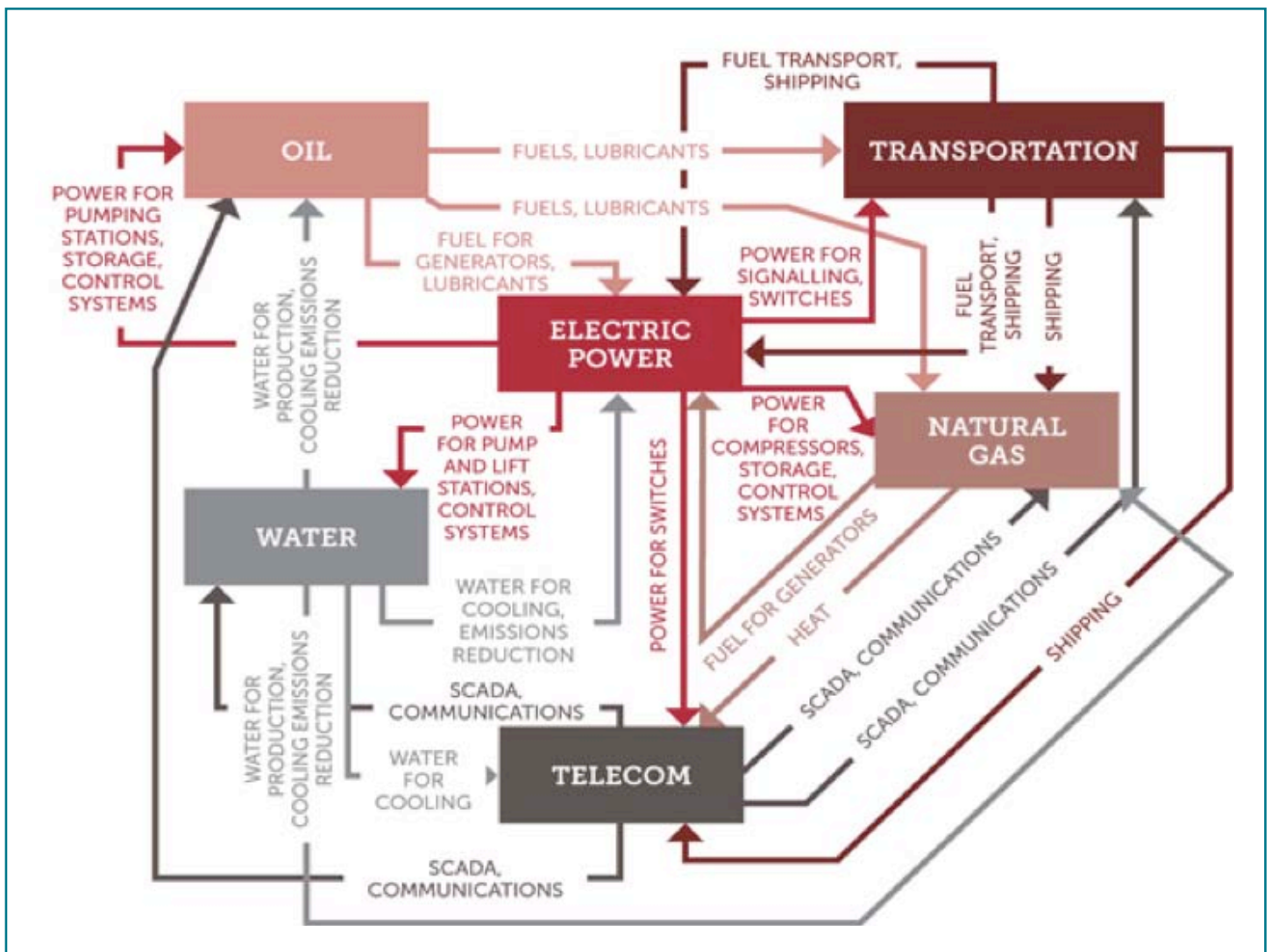
Figure 8 Victorian Critical Infrastructure Framework. Source: Emergency Management Victoria, 2014.

- **What is of value can change.** Because all values exist within social, environmental and economic contexts, what is of value can change as these contexts change.
- **Shared ownership of complex values can be difficult to allocate, particularly if some components are intangible.** Complex values, such as resilience and wellbeing, require identifying specific components of the value and allocating ownership for each of these parts.

How our values shape decision-making

There are three key drivers that shape how people make decisions in relation to natural hazards (Figure 9). These are:

- internal values (social and cultural norms)
- external values (the environment)
- natural hazard risk.

The key determinant for how natural hazard risks and external values are perceived, evaluated and accepted by individuals, organisations and institutions are their internal values. This is because internal values '… act as filters or amplifiers with regard to information about threats to objects of value.' (Slimak, M. and Dietz, T. 2006) and shape the internal processes of
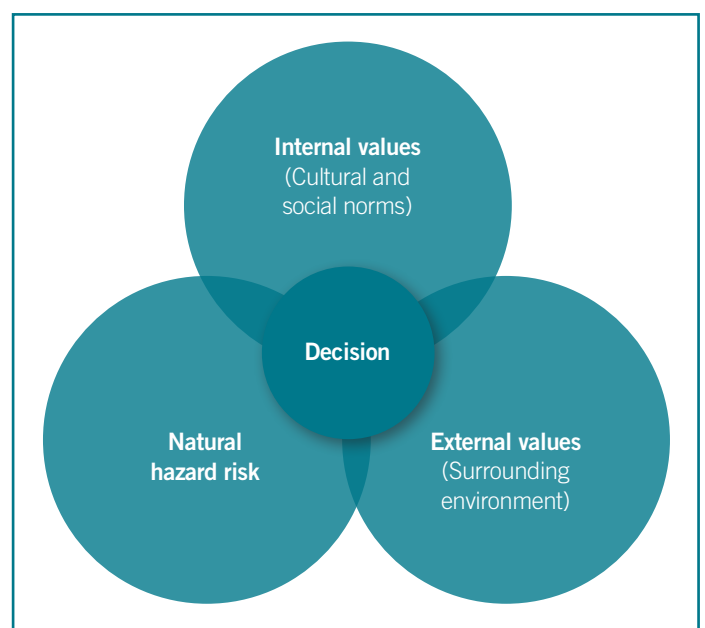
Figure 9 different value and risk components in relation to decision-making (Young, C., et al. 2016).

decision-making. Understanding these values is particularly useful for communication as they can be used to identify areas where potential conflict may occur as a result of conflicting values and also used for framing activities and risk information.

Internal and external values can also interact, so that changes or loss of a value in one area will often have repercussions in the other. Perceptions of the worth of the many different values spanning the monetary economy, human society and the natural environment vary widely, and can also change over time. For example, a resource that has been plentiful that becomes rare is likely to increase in value. This can create uncertainty, which can make it difficult for decision-makers to fully assess trade-offs when using conventional economic tools – particularly intangible benefits over long-term timeframes.

Values-based decision-making

In recent years, use of values-based approaches are increasingly being used in areas of organisational management, particularly in areas of change management. Schwartz's Theory of basic human values and exploration into how these values interact and shape human behavior is the basis of much of this work (Schwartz, 1992).

The need to incorporate values has been driven by the understanding that actions which are based upon what a group of people value are more robust and lead to better and more sustained outcomes. This is because decisions that are aligned with values and attitudes are more likely to support motivation for action as they are the beliefs that determine what is most important, (Schwartz, 2012. p4). This is particularly useful in relation to strategic planning, where activities need to be maintained over the longer term and the benefit from this may be seen as remote.

Values can also be used as a way of prioritising areas of risk, and are a powerful tool for bringing together 'multiple perspectives' in a way that supports decision-making (Hall & Davis, 2007). A key part of values-based approaches are the processes that define important values through meaningful deliberation and rely on a level of consensus between stakeholders. This is particularly useful as it can provide a pathway for negotiating tradeoffs and obtaining shared understandings across different groups and agendas. An example of a values-based approach is Appreciative Inquiry which outlines how values can be used to frame climate change for more effective engagement with different stakeholders based on groups of values identified by Schwartz (Public Interest Research Institute, 2011).

As risk ownership is a 'negotiated process' (Young, C., et al., 2016a) and values can be highly subjective, this process is not without challenges. It requires collaboration and well-structured processes and facilitation to achieve fruitful outcomes. As it is a long-term proposition, maintaining trust is pivotal.
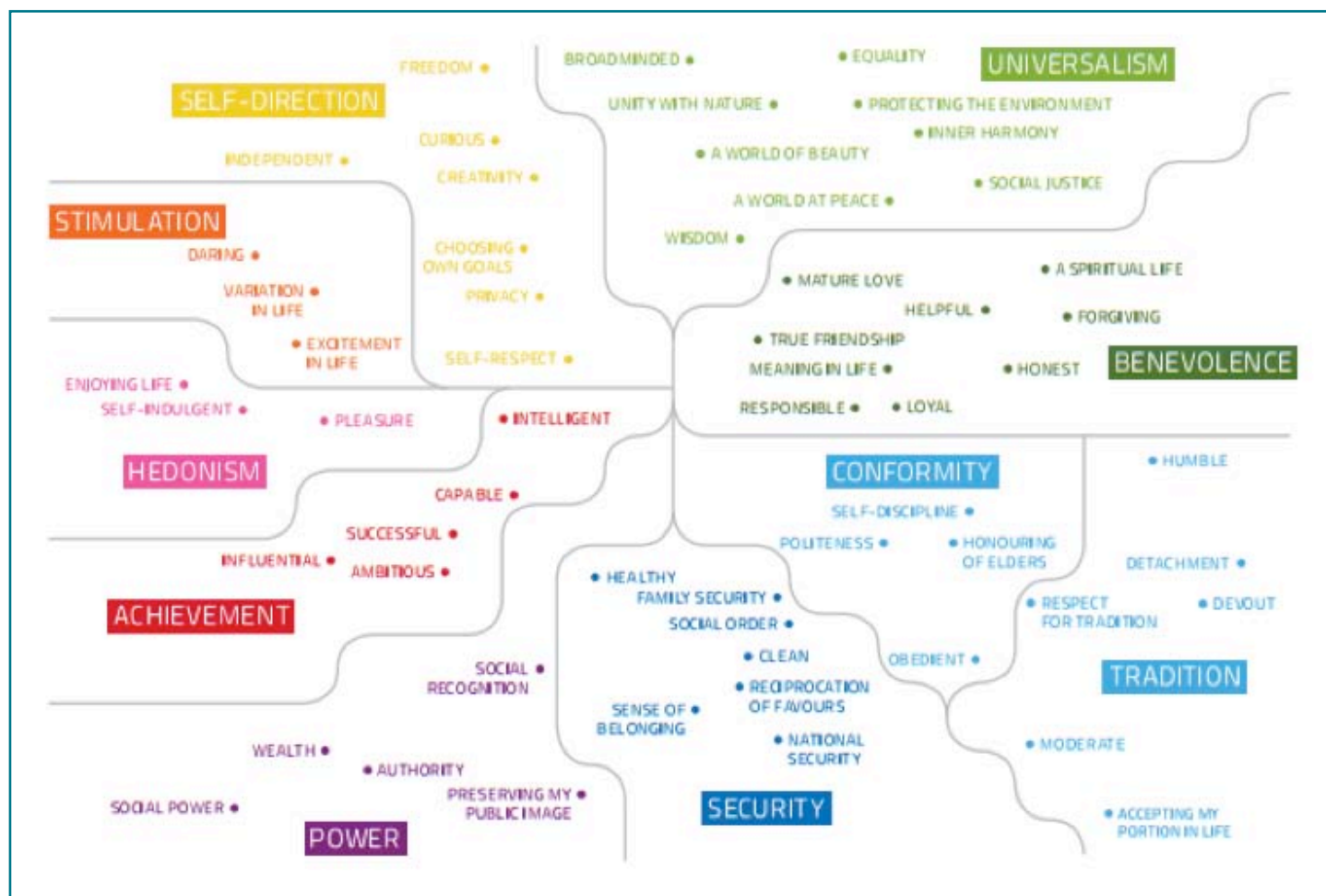
Figure 10 Statistical analysis (dimensional smallest space analysis) of value structure across 68 countries and 64,271 people. *The Common Cause Handbook*, Public Interest Research Centre, UK, 2011.

Strategic planning

> 'You've got to think about big things while you're doing small things, so that all the small things go in the right direction.'
>
> — Alvin Tofler.

Strategic planning is a critical aspect of being able to implement resilience strategies and longer term recovery activities. It is 'the process of envisioning a desired future and translating this into broadly defined goals or objectives and a sequence of steps to achieve them' (Businessdictionary). It is different to response planning, which uses command and control approaches that are tactical and have shorter term objectives and predetermined resources, as it considers multiple possibilities and requires flexible pathways that respond to changes so outcomes can be achieved.

Strategic planning provides the 'destination', which focuses activity pathways so that resources can be used to their full potential. It is a critical aspect of building resilience and supporting the effective management of future natural hazards.

However, the future can lead to 'ambiguous and non-routine situations' (Allan, N. and Beer, L. 2006), creating high levels of uncertainty around strategic decision-making. Exploring these broader uncertainties beyond those associated with event-based risks may present new types of risks for people managing natural hazards. These risks often sit outside operational risk management frameworks and, as such, may be ignored or not properly understood. For example, standard decision-making processes often focus on the most likely risks as a priority. However, systemic risks such as natural hazards that have catastrophic outcomes are often characterised by low frequency, high-impact events (Kambil, A. et al. 2005). In order to respond to and manage these events effectively, the task of building resilience requires the ability to think across multiple possible futures, and be able to plan with these in mind.

Understandings of what strategic decisions are and how they can be applied vary (Young, C., et al. 2016). The two different understandings of the term 'strategic decision-making' currently used in the EMS are:

- Short-term decisions using previously collected strategic information during the response to an event. These decisions relate directly to the event and the immediate impacts that may happen during or following the event.
- Long-term strategic decision-making in planning for resilience and mitigation, and for medium and long-term recovery. These timelines cover the event itself and planning horizons that assess risk for a wide range of assets, across long-term timeframes.

The difference between the two areas of decision-making is that the response-based 'strategic' decision timeframe is generally shorter term, and primarily addresses the minimisation of damage and containment of the event-based risk. It is often undertaken in what is commonly referred to as a 'command and control' mode.

The longer term strategic planning outside of the immediate response to events requires collating information, and analysing how this might influence and impact current and future activities and the key focus is outcomes. Due to the often uncertain and changing nature of the outcomes, this requires ongoing, reflexive operational frameworks where new learnings and feedback are incorporated as they emerge into current and future activities.

> 'Strategic objectives help provide the necessary communication, organisational and implementation imperatives where success comes from having strategy become everyone's everyday job.'
>
> — Kaplan, R. and Norton, D. (2001).

Strategic planning can also assist identifying where values are important in a particular context so that resources can be focused to protect these and support better recovery and resilience building. Developing strategic objectives is a key part of being able to implement strategy at an operational level. This is a long-term proposition, so expenditure on short-term programs can be assessed for their contribution towards the strategic outcomes. This can improve resources use by reducing the projects that do not contribute to this outcome while also ensuring that investment is not wasted through 'piecemeal programs' that only partially address issues.

Mapping the ownership of longer term recovery actions is particularly important if risk is to be managed effectively beyond the time limits of current funding arrangements. This is because in some cases communities or organisations may experience ongoing impacts as a result of an event, taking several years before they recover. An example of this is Black Saturday bushfires, when the thriving town of Marysville (of 700 hundred residents) lost 39 people and 590 homes. Following the event, there was a marked decrease in visitor numbers, which impacted significantly on the town's tourism industry. From June 2009 to June 2013, only 19 properties sold – 12 of those in 2012 to 2013 (Argoon, 2014). Six years later, the population had dropped to 250. (Teague, et al. 2010; Morris, 2015). (For the full case study, see Appendix B.)

Long-term strategic planning of natural hazards is an emerging area of decision-making in the EMS, and the required skills, structures and processes are evolving. Programs working in this area will need to consider what skills and capacity can be built in these areas. Also what may need to change and what will be needed to support this.

Robust risk cultures

> **'Dedicated leadership is needed to grow and nurture a culture of positive risk management.'**
> — Australian Public Service Commission, 2016.

The changing nature of events and future uncertainty as to how these events will eventuate requires a common understanding and acceptance of what natural hazard risk is, and how it works across broader society. To support this, robust risk cultures that are able to communicate, understand, plan and respond effectively to natural hazard events, are needed.

Key attributes of robust risk cultures are:

- A willingness to work with what is unknown, and to accept that there is no one perfect solution or answer. To ask 'What if?' rather than state 'What is'.
- An understanding of current perceptions of how success, failure and risk can impede or enable progress.
- Curious, engaged and proactive people.
- Strength-based approaches to managing vulnerability and weakness.

It will require considerable cultural change in some areas. This is type of change needs to be considered in the context of long-term continuous change, rather than a change with a beginning and an end. This means 'thinking about long-term goals (where we want to be in the future), as well as the short and medium-term (the transitions needed to get there)' (Young, C. 2014. p57). There are multiple different models of change management that can be used and a useful resource for practitioners undertaking these activities is Holger Nauheimer's, *The Change Management Toolbook*.

Key activities needed to support the development of a robust risk culture include:

- A well-articulated culture statement, policies and procedures.
- Embedding strategic risk thinking into decision-making structures and arrangements.
- Continuously reinforcing and instilling the culture through communications and learning.
- Clear definition of roles, responsibilities and expectations.
- Reinforcement of accountability through performance reviews and compensation.
- Constant assessment and monitoring of progress and adjustment.
- Openness and transparency – changing from dialogues around success and failure to what works and what doesn't.
- The creation of safe spaces that support uncomfortable conversations.

It also requires understanding the different types of decisions that are made as part of strategic planning, so that thinking frameworks and leadership are used to support rather than impede the processes. The table below shows key types of decisions used in the EMS. Decisions are categorised as simple, complicated and complex. Categorising decisions in this manner can help delineate how and where these decisions are best used in practice, and what is needed in particular decision-making contexts (Table 4).

There are already programs that have are being piloted in the EMS to support the development of robust risk cultures in communities. Two examples of this are the Victorian Country Fire Authority 'Community Led Planning Demonstration Project' in Violet Town and the Tasmania Fire Service's 'Bushfire Ready Program'. Both of these programs have used evidence-based,

Table 4 Simple, complicated and complex decision-making related to practical application (Young, et al, 2016a. Adapted from [7]).

TYPE OF DECISION	SIMPLE	COMPLICATED	COMPLEX
Characteristics	Linear, actionable, can be solved with one solution. Often static risks with known treatments and outcomes.	Systemic, can be bounded but may require more than one solution to address. Will use a mixture of known and unknown treatments. Dynamic, but usually able to be stabilised over time.	Systemic, unbounded, multiple interrelated actions and solutions required to address the issue. The treatment will often evolve and change over time. Highly dynamic and unpredictable, high levels of uncertainty. Often high-impact low probability.
Example	A faulty piece of machinery.	Containment of a natural hazard event.	Climate change, resilience.
Actors	Individual to organisational – person(s) with allocated responsibility or the asset owner.	Collaborative – parties associated with, and effected by, the event. Shared ownership with delegated areas of responsibility.	Extensive collaboration – a 'whole of society approach'. Complex collaborative ownership that is shared across all areas of society.
Thinking frameworks	Logical, analytical, prescriptive and practical.	Short to medium-term thinking, analytical, responsive. Predominantly prescriptive, but has intuitive elements that respond to changing circumstances.	Long-term, strategic, conceptual, lateral, analytical, creative, reflexive, continuous, flexible.
Leadership actions	Direct and review.	Consult, assess, respond and direct.	Consult, facilitate, empower and direct.

bottom-up approaches to assist the development of preparation plans for natural hazards. These approaches have worked closely with their communities to create greater understanding of the risks to determine what actions need to be undertaken and who should undertake them.

Because strategic risk is a long-term activity, ongoing communication and engagement with organisations and communities is crucial to these activities. One way this can be done is by using a maturity matrix (Table 5) and integrating this into current performance measures. For organisations that already have quality assurance, this can also be integrated into the overall auditing and assessment program.

Table 5 Organisational risk maturity matrix.

MATURITY LEVEL	1	2	3	4	5
Culture	Unaware	Initial awareness in isolated pockets with areas of resistance	Awareness across the majority of the group, minimal resistance	Consistent levels of awareness across organisation, acceptance	A proactive organisation that continues to learn and adjust
Strategic vision	No strategic vision or goals, individual project with no connections	Joined up thinking but still siloed approaches with individual goals	Has strategic vision and goals, but does not include them as part of day-to-day operations	Uses strategic vision and goals as part of operational decision-making to guide activities	Optimises activities and resource use using strategic planning
Governance	No strategic plan or mission statement	Has strategic plan and mission statement	Has policies and plans to support strategy	Uses plans and policies and has dedicated funding to support activities	Flexible, governance that supports refection and adjustment as changes occur
Process and systems	Linear processes and systems that do not relate to each other.	Identifies systems process opportunities and gaps. Siloed processes and systems	Develops integrated and flexible process and systems that allow for ongoing feedback and improvement	Uses integrated and flexible process and systems that allow for ongoing feedback and improvement	Comprehensive ongoing evaluation, reflexion and adjustment of processes and systems
Knowledge	Knowledge is poor and does not support strategic decisions	Understanding of knowledge gaps	Development of new knowledge to support decision-making needs	Integration of new knowledge into day to day decision-making	Ongoing development and integration of new knowledge
Communication and engagement	Fractured communication – poor engagement/ distrust	Mapping and connecting communication across organisation – increasing engagement, understanding	Building connections understanding and trust.	Connected communication that is understood and accepted. Trust established.	Ongoing communication that empowers and engages.
Collaboration	No collaboration	Collaboration between parties within a department	Collaboration between parties across an organisation	Collaboration between diverse stakeholders within and beyond an organisation	Long-term collaborative arrangements between diverse stakeholders

The process

The purpose and aim of this framework

The purpose of this process is to provide a companion process to current risk planning processes, in particular the *National Emergency Risk Assessment Guidelines* (NERAG), where key tasks can either be integrated into current risk assessment and planning processes.

Its aim is to support better strategic management of risks associated with natural hazards. It does this through providing a series of tasks that support the allocation of risk ownership as part of strategic planning activities. This framework is not intended to replace current risk processes but to enhance and add value to what is already there.

Who should use this framework

This framework is intended for use by government, community and business agencies who are part of or work with the Emergency Management Sector (EMS).

Objectives of the framework

Objectives of this framework are to:
- Support more effective strategic planning and management of natural hazard risk through better identification and uptake of risk ownership.
- Identify key risk owners at the beginning of the risk process and include them as an active part of decision-making.
- Provide a companion process that uses values as a starting point for risk assessments to provide a pathway for better management and implementation of systemic risk.
- Assist the development of arrangements that support longer term activities such as the building of resilience and the shorter term activities that support this.
- Support development of new knowledge and the collation of new types of data to support strategic decision-making.

Background

This companion process has been designed as a series of key risk ownership activities that can be used as separate tasks as part of current risk assessment or strategic planning processes.

Ultimately, the aim is for the risk ownership tasks to become fully integrated into the risk assessment process. It is structured to provide a basis for the collaborative decision-making needed to support activities such as the building of resilience.

This document offers guidance and describes key risk ownership tasks and it is not intended to be used in a prescriptive manner. It is a process of conscious decision-making rather than a tick and flick approach to risk. It flexible framework allows practitioners and community members to use it to address their own needs, in their own way with the systems they currently have. What approach, methods and order some of the tasks will be undertaken during a task will be decided by the facilitator of the process.

Before undertaking this process it is important to consider the following:
- Formal mechanisms, such as legislation and regulations that allocate risk ownership in the EMS, as these are often not negotiable and this process should be informed by these arrangements.
- To look at how outcomes from this process may relate to current government plans and pre-existing processes, and identify where outcomes from this could feed into or add value to these.

The process framework has been designed to align with the current NERAG process and has been designed using the principles outlined in this document, (see Appendix C for details). However as it is also designed to be able to be used as a process which can be led by communities and public and private organisations outside of state government, some of the principles have been adapted to allow for different leadership of the process.

This process covers the assessment and planning process for implementation of activities but does not include implementation of activities.

Structure

The risk ownership tasks have been divided across the key phases outlined by the NERAG process (Figure 11, overleaf) but it is restricted to the planning phase which sets up for the implementation of activities.

It draws upon the current suit of Emergency Management Handbook Collection available through the Australian Institute of Disaster Resilience. In particular it draws upon:
- *Handbook 10 National Emergency Risk Assessment Guidelines* (2015)
- *Handbook 10 National Emergency Risk Assessment Guideline; Practice Guide* (formerly Handbook 11, now Practice Guide 10.1(2015)
- *Handbook 6: National Strategy for Disaster Resilience – Community Engagement framework* (2013).

How this process adds value to current processes

Its purpose of this companion process is to add to current risk planning processes and assessments using risk ownership across strategic time lines. Although there are some new tasks that are specific to support risk ownership activities, most aspects of the process follow standard risk assessment processes and principals outlined in the NERAG.
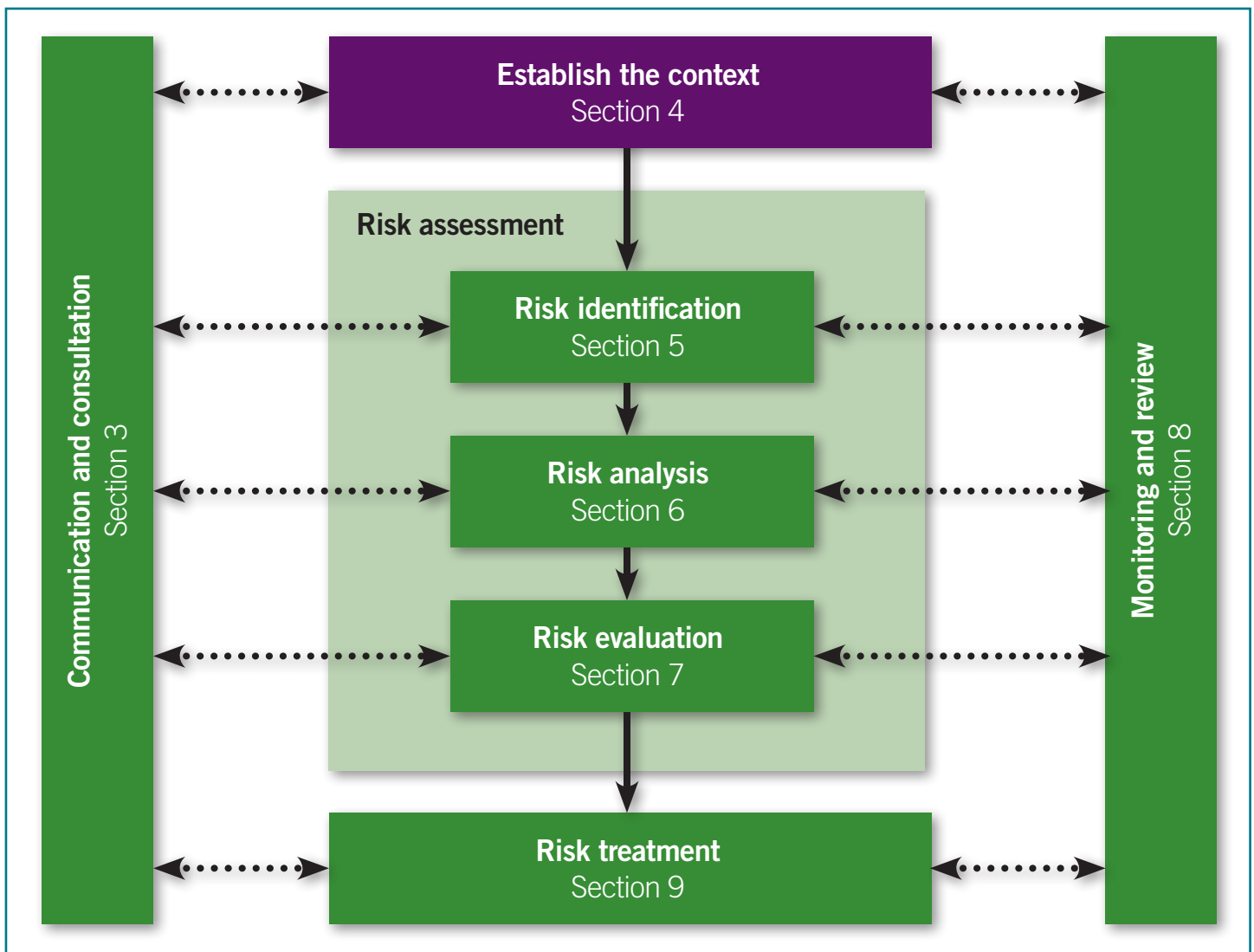
Figure 11 Complete risk management process and corresponding NERAG practice guide structure.

What differs in this assessment is:

- Assesses across strategic (short, medium and long-term) timeframes.
- Explicitly identifies priority tangible and intangible values and ownership of these at the beginning of the process.
- Requires negotiation and consensus as part of the process.
- Can be used to identify areas of unclear, unacknowledged or shared risk ownership which are not currently identified by more formal arrangements.
- Can be used to monitor changes and identify intersections of ownership associated with systemic risk.

The key benefits that can result when undertaking a risk assessment or planning activities using this process include:

- Greater involvement of communities in the risk management process through meaningful engagement and development of user-friendly tools that enable them to participate more fully in decision-making.
- Improvement of management of natural hazard risk through connecting communities and private industry to the ownership of the potential impact, consequences and associated actions of natural hazards.

- Improvement of risk literacy across organisations and society through inclusive processes to support community-led activities and ownership of these.
- It can support collaboration across public/private organisations and communities and identify where it is possible to leverage other agendas such as adaptation to climate change, and the associated funding opportunities.
- Standardising aspects of language and developing common definitions and understandings across the EMS.
- It can help support long-term actions that are sustainable in the face of short-term thinking and political cycles.
- Encourage the development of tools for EMS to support strategic decision-making, particularly in the area of valuation of intangible assets.
- Create better understanding of plausible futures, including the potential of technology, future conditions, resource and people potential.
- Improve resource allocation and management through identification of resources, reduction of duplication, pooling of resources and frameworks to support collaborative sharing of resource in a way that supports the building of resilience.

Table 6 Process value-add and opportunities.

SPECIFIC TASK OR FOCUS OF TASK	VALUE-ADD	OPPORTUNITY
Allocation of risk ownership through ownership of assets as well as ownership of risk management activities.	A more holistic assessment of who owns the risk and how they own it and understand the 'chain of ownership' Better understanding of what is really being traded off, who it matters to and why.	To build databases and knowledge in relation to values that are key to resilience and need to be saved to ensure long-term recovery and resilience-building.
Identification of gaps and areas that lack clarity related to risk ownership across assets effected by events and activities.	Identification areas of potential vulnerability due to lack of, or unclear ownership.	Improve management of events through better understanding of vulnerability.
Assessment of hazards and risk and actions across multiple timeframes – short (2–12months) medium (1–2 years) and long-term (2+ years).	More responsive and less reactive management of risk and allocation of resources prior to and following events.	To improve understanding of longer term systemic risk.
Values-based approach to risk assessment.	To better understand what values are important for future sustainability to a particular group.	To build data bases and knowledge in relation to values that are key to resilience.
Risk owners are engaged at the beginning of the process.	Increases stakeholder buy in and understanding of the risk to these values.	To build deeper longer term trusted relationships across the public/private sector which support collaborative arrangements.
It assesses both monetary and non-monetary costs of events across multiple timeframes.	Increases understanding in relation to the 'real' cost in the longer term of events.	To improve decision-making in relation to trade-offs and strategic management of risk and value of longer term activities.
Negotiation and consensus making are part of the process.	It supports acceptance and uptake of risk ownership though inclusive decision-making practices.	To build long-term trust and working relationships across the public/private sector that support better risk ownership arrangements and understanding of the risk.

Using this framework

The tasks in this process can be used at a number of different levels:

- **Basic:** A workshop process using tasks 1–15, which will provide an indicative assessment of the ownership of priority values, risks and actions across strategic timeframes.
- **Intermediate:** Two workshops:
  — Workshop1 includes tasks 1–12
  — Workshop 2 includes tasks 13–15.

Economic analysis is undertaken between the two workshops and data collected during the exercises is starting to be collated and anlaysed. Aspects of the process have been integrated into risk planning activities.

- **Advanced:** A combination of four workshops which are supported by analysis and activities are fully integrated into the risk assessment process, for example:
  — Workshop 1, tasks 1–5. Analysis and integration of values collated into data systems
  — Workshop 2, tasks 5–8. Detailed risk analysis of priority risks and economic costs where possible. Integration of data into risk data bases
  — Workshop 3, tasks 8–12. Detailed economic analysis of priority actions.
  — Workshop 4, tasks 13–15. Development of business cases to support activities.

Depending on the context and purpose of the workshop, a decision will need to be made in relation to tasks 16 and 17

and whether this part of the process should be undertaken separately with a specific organisation or agency, or whether it needs to be part of the workshop process.

The companion process

This process begins with identifying priority values and their owners. It is designed as a consensus-building process where outcomes are negotiated. This approach was selected for the following reasons:

- These risks are systemic, and a focus on values can be used as a way of focusing assessments into what is most important in specific contexts.
- Identification of risk owners at the beginning of the assessment through ownership of values (assets) and benefits from these can help identify who might need to contribute to the protect the value.
- Values provide a focus for activities and resources-based through prioritising what is important.
- Value-based decisions strengthen commitment to activities, as they can provide the belief and motivation that is necessary to maintain actions over the longer term.
- Many arrangements in the EMS rely on social contracts, particularly in relation to implementation – this is not currently accommodated for in many conventional risk processes.
- Risk ownership can be used to link different levels of ownership (individual, group and institutional) across strategic timeframes.
- The need for an iterative process that supports capacity building and new knowledge.
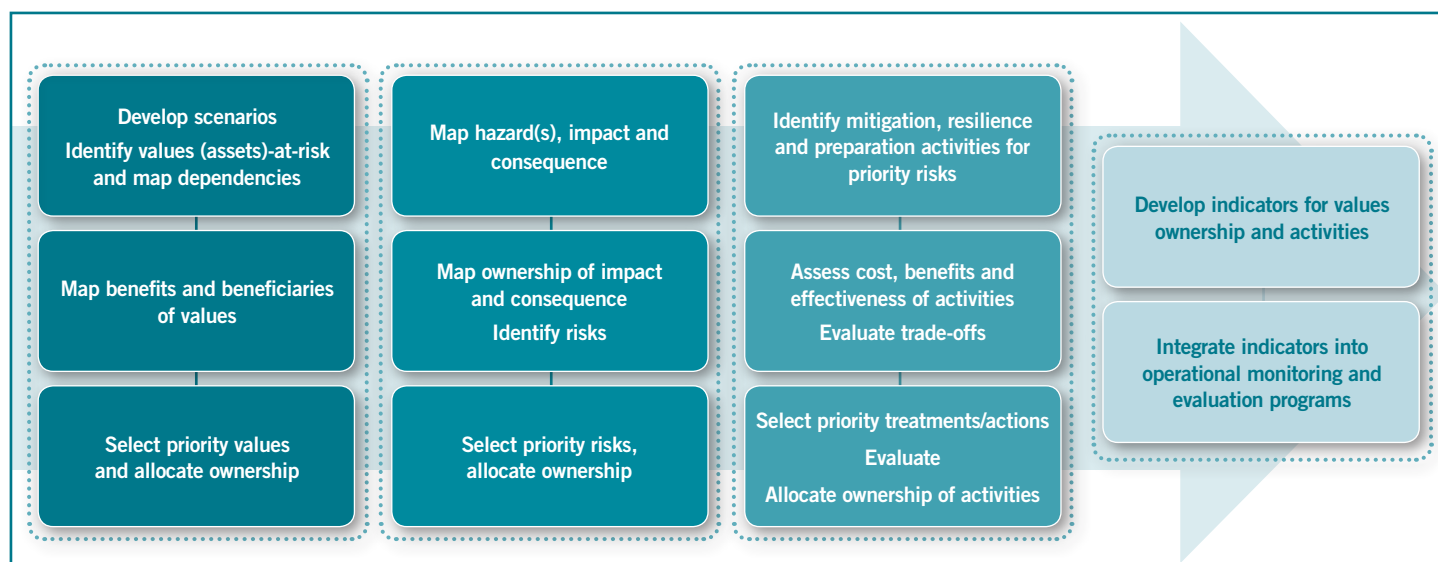
Figure 12 Risk ownership framework process.

Principles for this process

The principles that support this process align closely with those used in the Community Engagement Framework Australian Emergency Management Handbook Series, *Handbook 11, National Strategy for disaster resilience – Community Engagement Framework* (2013). (See Appendix D for details.) This is because this process has a strategic focus which uses consensus and negotiation to achieve outcomes so communication and engagement are central to this.

The three following NERAG engagement framework principals are applicable (see Appendix D), however the focus for application varies slightly in the following ways:

- **Understand the stakeholders and their capacity, strengths and priorities:** Risk ownership requires that participants understand, accept the risk and have the capability to fulfil this. It is also important to understand participants' limitations in relation to skills and experience and agendas that govern their actions to ensure that these are accommodated in the workshop process and expectations are managed.
- **Recognise the complexity inherent in the diversity of the stakeholders:** It is important to respect and consider different values, risk literacy and expertise, and how they inform and influence decisions participants make during the process. It is also important to have mechanisms in place to support understanding and acceptance of the value of different types of knowledge and ways of understanding knowledge to enable activities.
- **Partner with stakeholders to support existing networks and resources.** For risk ownership to be realised, the owners need to have the capability to fulfil this requirement. Collaborative partnerships are important to the building of common understandings and knowledge, and also support implementation of actions where there are shared interests. It is also important to be aware of existing arrangements that pertain to the context and look at what partnerships might be needed to support integration of outputs to ensure that strategic risk ownership becomes part of day-to-day business.

There are, however, some differences as this framework is built around:

- Identifying what is most important to the community or organisation in the assessment area (values).
- Reaching a consensus as a group in relation to this and the selection of activities and ownership of these.
- Accepting ownership of risk and activities that have been allocated.

New principals that apply as result of this are (Kayer, T. A., 2011; Seeds of change, 2012; Young, C., 2015):

- **Commitment to reaching a consensus**. Reaching a shared agreement is not an easy process and sometimes requires difficult conversations, so participants need to be committed to achieving the goals the process is designed to achieve. Consensus is particularly important to enable long-term actions and support decision-making in this area.
- **Testing for consensus**. It is important to ensure that the consensus reached truly reflects the group view and not individual preferences by testing the consensus.
- **An alternative plan if consensus is not reached**. If consensus is unable to be reached, it is important to have a process for dealing with this that is agreed upon at the beginning of the process.
- **Responsibility for decision-making during the process**. All participants need to be prepared to actively participate and be accountable for their decisions.
- **The creation of a safe space**. For this process to be effective it requires commitment to respectful treatment of others, acknowledgement of differences and transparent processes that support honest and open dialogue.
- **Working from what is valued most**. A strategic approach to risk ownership requires that what is determined to be of most value provides the basis for the assessment.
- **Valuing prior knowledge**. Actively valuing and respecting existing knowledge of all stakeholders.

As this process provides a basis for ongoing activities beyond the planning process, the following are important components of the process for facilitators:

- **Manage expectations**. Be careful not to create unrealistic expectations as they can cause distrust and resistance when they are not met. For example, phrases can create the expectation that is if undertake this action you will then be risk-free, which is not always the case.
- **Trust, acknowledgement and respect**. People will not listen or respond to people they don't respect, trust or receive acknowledgement from. Communication needs to be open and transparent and different points of view need to be acknowledged and respected. Using trusted communication sources and people to pass on information generally leads to much better outcomes.
- **Proactively manage discomfort**. Discomfort is part of the process particularly for participants who are not used to this process or strategic thinking. You will need to ensure that you have processes in place that accommodates discomfort but allows participants to work through this.
- **Manage potential conflict**. As engagement in this area involves diverse stakeholders and agendas, it can help to have conflict resolution and knowledge sharing protocols in place prior to exercises to reduce potential conflict.

How values are used in this process

This process uses external values which are economic as the basis for categorising values to identify both tangible (monetary) and intangible (non-monetary) values that are at risk. This is because it is important to be able to articulate different values in a way that allows them to be built into future business cases so that investment needed for activities can be obtained.

It uses the following values categories, which are aligned the NERAG categories, these are:

- social values
- environmental values
- built infrastructure values
- economic values.

By working with these categories, planners and risk managers are able to ascertain if there are specific value groups that may have unusually high or low levels of representation, and what this might mean in the longer term strategic context. Identifying which value groups are likely to make an important contribution to future resilience and recovery is also a priority.

It can help to categorise the external values into two high-level classes of values:

- **Simple values** that, although part of a system, can be assessed as autonomous values for specific assessments – for example, building costs, clean water supply.
- **Complex values** that provide an umbrella for a group of values and encompass social, economic and environmental values; for example, resilience, liveability, cohesion and connectivity.

These categories can be used to help understand the scope of assessment needed to value the costs and benefits of strategic actions, and select the most appropriate tools for the task. Complex values are also more likely to have complex ownership arrangements and have areas where risks are unowned.

Because natural hazard risks and their impacts are systemic and impact across time, they can appear overwhelming and so providing a focus that acts as a boundary is important. This ensures that assessments are doable and are able to achieve the best outcomes with the resources available.

Areas that are often used to determine these parameters and define the assessment scope can include:

- Aspects of risk to be examined (e.g., vulnerability, hazards, exposure, sensitivity, resilience or an integrated assessment combining several aspects).
- Geographical area – region, regional, state, national.
- Jurisdictional level – organisational, municipal, state, national.
- Systems area – social, environmental, economic, built environment.
- The timeline these need to be considered across.

Once these areas are determined the exercise format and scenarios for the exercise are developed and the first phase of the process undertaken. When the priority values are selected these can be used to provide a focus for the next phase and to identify 'value owners' as part of the scoping process so that they can be included throughout the risk assessment process. (For example values, see Appendix F.)

Integrating the process into current risk assessments

Implementing this process is not a short-term activity and will need time, commitment and resources before it becomes a fully established part of operational activities.

The EMS is a diverse community and as a result, how organisations choose to integrate aspects of the risk ownership companion process into current risk planning will vary. What is applied and how it is applied will depend upon the objectives, capabilities and resources of an organisation. For smaller organisations or communities it may start with a basic approach. A well-resourced organisation may wish to start with the intermediate level and work towards an advanced application (refer 'Using this framework', p27).

In relation to the assessment of strategic risk and the associated costs; methods and tools for evaluating this are still developing, particularly in relation to non-monetary values. Some organisations may choose to undertake an assessment to map knowledge gaps and capability to understand what can be currently used and what areas might be need to developed.
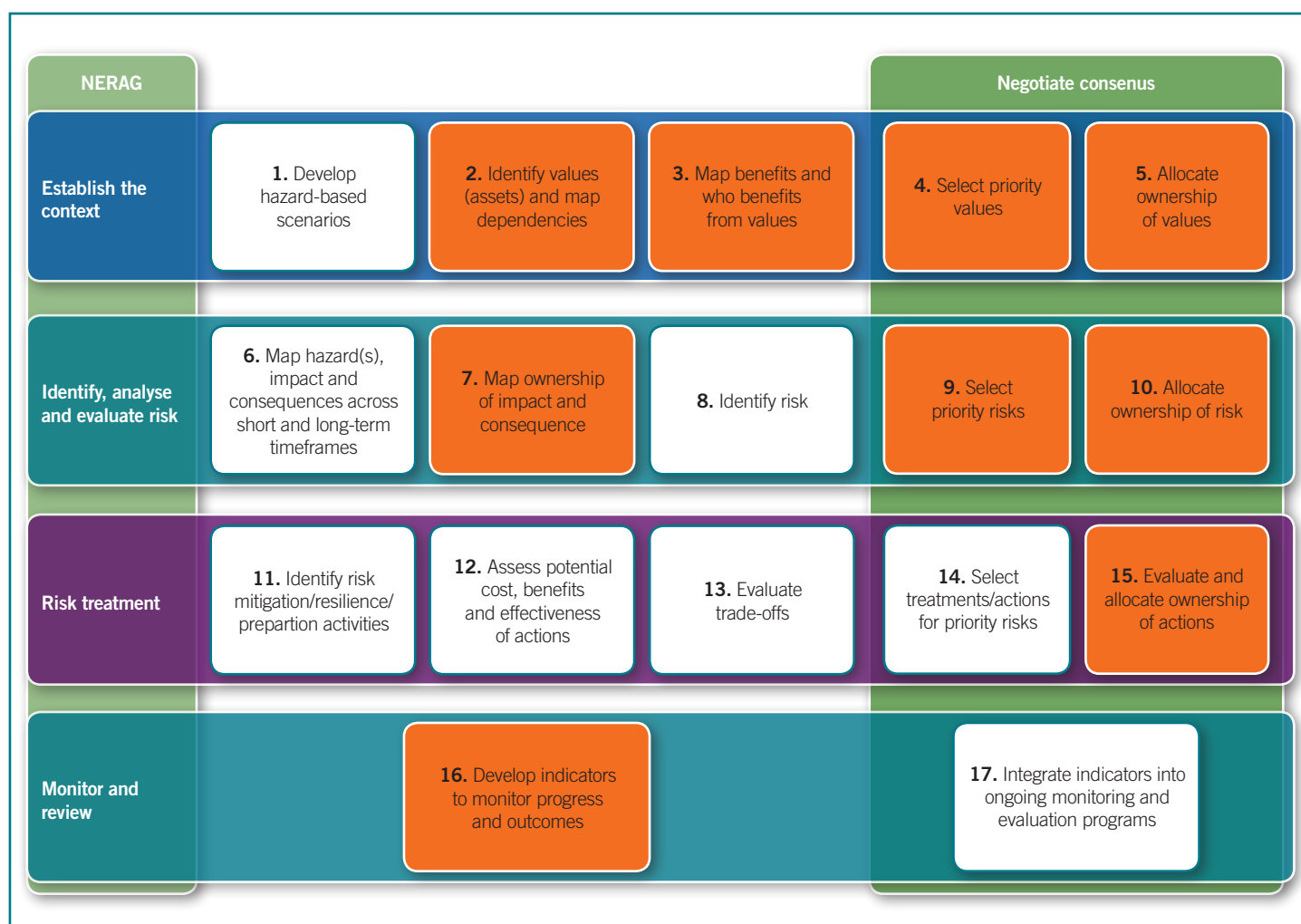
Figure 13 Key phases of the NERAG process with risk ownership tasks included.

As an example of how the key tasks associated with this process can be integrated into the assessment process phases is shown in Figure 13. It illustrates where key tasks are placed within the current phases of the risk assessment process. The orange squares show where there are new steps that need to be included. The white squares show common risk tasks may need to be adjusted to accommodate strategic timeframes and also non-monetary values.

Risk ownership across time

The key objective of this process is to identify where ownership may be imbalanced, nonexistent or potentially unsustainable over time horizons for strategic decision-making.

Risk ownership of strategic risks associated with natural hazards is systemic. This means that assessment of risk ownership will need to be mapped across in a way that allows for evaluation of ownership across the full pre and post-event spectrum and also consider all the different social, environmental and economic values in the area being assessed.

This achieved through mapping ownership across strategic time lines (short, medium and long-term) using the following key areas of ownership:

- Ownership of the assets at risk from natural hazards.
- Ownership of the risks associated with short to long-term impacts and consequences of natural hazard events (both direct and indirect effects).
- Ownership of actions in relation to those assets (values) at risk to either mitigate, build resilience to, or recover from natural hazard events.

Ownership mapping is carried out using scenarios to provide the context and timeframe for the planning activities. These exercises can help identify potential areas of vulnerability and weaknesses due to:

- Under or over-allocation of ownership
- Lack of clarity – particularly in relation to shared ownership
- Unanticipated changes in ownership
- Ownership gaps.

(See Figure 4, p11, for institutional mapping outcomes or changes in ownership).

These exercises will also help to ascertain if the current ownership arrangements are sustainable over the longer term and where adjustments might be needed if is ascertained the owner is not capable of fulfilling the ownership allocated to them.

Allocating ownership can be done across three different levels: institutional, group (community, agency or organisation) or individual (see Table 2, p10). What level is used will depend upon the purpose of the assessment and the desired output. For example, if the purpose is to establish a broad brush stroke picture of ownership (Table 7) in a particular geographical

area, you may choose to allocate institutions only for this task using the RAP criteria. If more detailed picture is required by a specific organisation or community an activity may be undertaken that looks at all three levels of ownership to identify specific areas of ownership needed for activities.

Where ownership is shared it is important to understand how the different owners own the risk and who the lead owner is.

Table 7 RAP exercise output (Young, et al. 2016).

VALUE AT RISK FROM FIRE	UP TO 12 MONTHS	1–2 YEARS	2+ YEARS
Social **Social dysfunction**	R – Local Government addresses identified, State coordination A – State Government P – State Government funding, depends on scope	Same as before	No owner
Environmental **Water quality**	R – State Government A – State Government P – State Government	Not applicable	
Economic **Loss of income**	R – No owner A – Business and Industry (B&I) P – B&I	No owner Community, B&I	No owner Community, B&I

Process phase and
key task summary

NERAG Phase: Establish the context

Risk ownership activities in this phase: Mapping and identifying ownership of values at risk

Objectives of this phase in relation to risk ownership:

- Identify what values at risk are important for maintaining and sustaining the selected community/communities.
- Scope time line for scenario and information needed.
- Map the benefits of these values and who benefits from them.
- Select priority values and identify who owns them.

Considerations

This phase can be undertaken in various ways. Options include collecting values at risk using surveys, questionnaires, targeted interviews either prior to or following the scenario exercises. (See Appendix D for a list of evaluation tools and methods.)

Structured workshop processes in which people identify the values most relevant to them are also particularly useful for identifying and mapping broader stakeholder-based interactions. As this process is designed for strategic decision-making, hazards-based scenarios that would lead to serious downstream consequences if left unmanaged are used. These provide a focal point for participants and a pathway to the next phases of the assessment that address strategic risk and ownership.

Identifying ownership of these values can also help to identify areas of vulnerability that can include lack of, unacknowledged or unclear ownership of values and support their better management. Identifying benefits associated with those values can also be used to assess the flow of benefits within an area of interest. Beneficiaries may not necessarily be the owners of an asset or value at risk but may be partial owners or stakeholders in solutions if those benefits are threatened.

How outputs are collected, communicated and used, needs to be determined prior to undertaking this phase and take into account other stakeholders who may need to use this output.

Alternative use for this phase: This phase can also be used as a singular process to collect qualifiable data related to values for evaluation and to build data and knowledge in relation to values in a specific area. If there is no prioritisation of values required then the consensus aspect of this exercise does not need to be applied.

Short-term goals

- Develop methods and processes that identify, collate and document priority values and their ownership.
- Evaluate the benefits of values and identify beneficiaries where possible, and note where this is not possible. Beneficiaries may be potential new stakeholders.

- This phase establishes what baseline information is needed for further analysis (e.g., economic assessment of impacts and consequences, and evaluation of treatment options).

Long-term goals

- An established database of monetary and non-monetary values and their owners that can contribute to strategic planning and day-to-day decision-making.
- Understanding the priority values for different stakeholder groups and who owns these.
- Established processes and methods for evaluating vulnerability/benefits for a comprehensive range of values.

Task 1. Develop hazard-based scenarios

This is a part of the scoping activity provides the basis for the first two phases of the assessment. The purpose of the scenarios is to provide the strategic information needed to be able to consider values and how they are at risk. The key components of this are:

- The types of hazards to be used
- The time line and how this is to be represented across the short, medium, long-term
- The geographical area and the social, environmental and economic systems within this
- Key drivers such as or projected changes in demographics or development that may influence the potential values or the risk over the specified time line.

It is important the all scenarios developed are based upon credible evidence and provide the participants with a pathway to understanding the potential futures. Constructing a narrative to support this scenario is very important as these provide the Also to consider how these scenarios will be presented. For example, will they be written in a short narrative which is then discussed in small groups with a facilitator. Alternatively will they be presented using an experiential approach where the participants walk physically through a place and asked to imagine impacts in specific contexts, which is then supported by guided conversation where additional information is presented.

Key questions

- What information needs to be represented in these scenarios?
- Who has this information?
- What hazards and narrative are relevant to this context?
- How should these scenarios be presented to the group and who should present them?

Task 2. Identify values at risk and map dependencies between values

The collection of values at risk from natural hazards is generally best undertaken in group exercises, however surveys or questionnaires prior to the workshops can assist this process. Scenarios provide a way of focusing the exercises and also provide a level of consistency across the assessment process. For example if you are considering a context where a substantial increase or decrease in a particular demographic is projected. This part of the process can also be used separately to collect data identifying current values.

Once the values have been identified, interactions between values can be mapped through identifying the following:

- Where one value supports another value.
- Where a value is dependent upon another value.
- Where values are mutually dependent on each other.

This value 'network mapping' is important because it can help identify key values and those values that support them. This analysis contributes to the prioritisation of values through understanding which values either support or are supporting by other values.

Key questions

- What values are important for the target area and communities within them to function?
- What values are dependent upon other values to sustain their function?
- What values support other values to maintain their function?
- What values are mutually dependent in order to maintain their function?

Task 3. Map benefits of values and beneficiaries

Who receives the benefits that values provide is an important part of determining whether a party is potentially responsible and how they could exercise that responsibility. It is important to note that being a beneficiary does not automatically mean that someone is responsible or has an ability to fulfill ownership.

Evaluating benefits, particularly from intangible values, can be difficult and is a more advanced aspect of this exercise. Some methods and tools that can assist with this process are detailed in Appendix L.

Values are subjective in nature and, particularly in relation to communities, it is important to ensure that agreement is reached across the group as to what values are the priority values.

Key questions

- What are they key benefits (e.g., social, environmental, economic)
- Who are the beneficiaries?
- Are we in agreement about this?

Task 4. Select priority values

Values are subjective in nature and, particularly in relation to communities, it is important to ensure that a consensus is reached across the group as to what values are the priority values and also to understand why and how these are important to the particular community future sustainability.

It is particularly important to identify if there are specific values that are critical for supporting other values. An example of this is clean water which is needed to health, wellbeing and also in the case of agriculture, aspects of the economy. Also which values are needed for

Key questions

- Which value provides the most benefits and to whom?
- Which values support the function of multiple values?
- Which values are needed to ensure future sustainability and to build resilience?
- Is there an agreed upon criteria for establishing priority values?

Task 5. Allocate ownership of values

Allocating ownership can be done across three different levels: institutional, group (community, agency or organisation) or individual (see Table 2, p10). What level is used will depend upon the purpose of the assessment and the desired output. For example, if the purpose is to establish a broad brush-stroke picture of ownership in a particular area, you may choose to allocate institutions only for this task. If you wish for a more detailed picture you may choose to evaluate across agencies and into individual allocations of who is responsible.

Some values – particularly social and environmental values – have multiple owners. In cases where multiple values are owned, it is important to ensure that a primary owner is identified and the different ownership roles of other stakeholders notated:

- Who owns these values?
- Are there gaps in ownership?
- If there are multiple owners of a value, who is the primary owner?

NERAG Phase: Identify, analyse and evaluate risk

Risk ownership activities in this phase: Mapping and identifying ownership of the impact, consequence and risk of event across short, medium and long-term timeframes.

Objectives of this phase in relation to risk ownership:
- Identify who owns the impacts and consequences across strategic timeframes
- Identify how this risk is owned
- Identify where ownership may change over time
- Identify areas where risks are unowned or where ownership is unclear.

Considerations

A number of well-established risk assessment processes can be used as a basis for this phase. The key difference with this approach is that it explicitly looks at risk ownership over strategic timeframes (short, medium and long-term) requiring the use of scenarios to manage the inherent uncertainties that emerge.

The part of process requires:
- Appropriate time allocated
- A well-designed process that is well facilitated
- Stakeholders with different areas of risk expertise
- Identification of impacts and consequences, and the allocation of ownership to the various risks that arise.

It is important to ensure that you have a well-planned process that has appropriate facilitation and have allocated enough time. This is needed to support people who may not be familiar with strategic risk exercises, and also to allow for appropriate deliberation during the tasks and also to resolve any conflict that may arise as a result of this. Also because it is about projecting into the future to see what *might* happen not predicting what *will* happen, it is important to manage expectations that may arise as a result of this.

Some areas of risk in these exercises may be unfamiliar to some practitioners or communities. As a result, it may be necessary to undertake educational activities prior to this exercise so that all participants can be part of the conversation.

Using templates (See Appendix G for example) at this stage is useful to ensure that there is consistency across exercises, and that outputs from group activities are able to be analysed and used.

Costing of impacts is a complex activity which can be resource intensive and as a result it is important to consider the level at which this can be accommodated by the facilitating organisation. Generally costings will undertaken to support the understanding of consequences and available information can be included as part of the scenarios or given as an additional information prior to the task being undertaken.

When undertaking any costing exercises it is important to consider how non-monetary costs can be made visible or quantified during the process as this is key to understanding what the comprehensive cost is and who pays that cost. This can also inform the later task of discussing trade-offs when prioritising risk actions. (For further information, see Appendix L for details).

The RAP criteria can be a useful way of identifying different areas of ownership during this phase.

Criteria for how strategic risks are assessed can be different to standard risk assessment criteria, and it may be necessary to review or develop new criteria for prioritising risks as a result.

Alterative use for this part of the process: This process can be used as a standalone exercise to map systemic risks and help evaluate how they interact across time lines and different value groups. This can then be used as basis for mapping projected costs in this area and estimating avoided losses to support business cases. In these cases the consensus aspect of the exercises is optional and its use dependent upon outcomes.

Short-term goals
- Develop processes and methods that support comprehensive evaluation of monetary and non-monetary costs of events across short, medium and long-term timeframes so ownership can be allocated.
- Map interaction between natural hazard risks and internal and external risk areas across different timeframes and where ownership may change.
- Develop understanding and awareness as to where risk ownership may be unacknowledged or unowned.

Long-term goals
- A comprehensive map of risk ownership of who is responsible, who is accountable and who pays across short-, medium- and long-term timeframes.
- Understanding of systemic risk impacts and consequences across multiple timeframes.
- Understanding of where ownership can change, is unacknowledged, or is unowned, with strategies/policies in place to address this.

Task 6. Map impact and consequence

This task is usually undertaken as a scenario planning exercise (see Appendix E for details), but can also include expert analysis following the activities or the provision of information prior to activities.

Impacts and consequences are mapped across value areas and different timeframes so that the system of risk is identified. As with all exercises the four value groups of social, economic, environmental and built infrastructure are used, (see Appendix G for example template and Appendix H for examples of exercise output).

It is also important to identify where consequences, impacts and costs may spread to other value areas over the longer term as this may result in a high level risk. For example, if an event destroys an area of high cultural or environmental significance this is a social and environmental cost such as the rainforests in Cairns which are a major source of income for the area, this will impact the local and potentially state economy, which may result in the breakdown of a communities ability to function and a reduction in biodiversity. The accumulated social, environmental and economic costs across time are likely to be substantial as a result.

Not all consequences will be negative and, in some cases, might benefit (e.g., wetland ecology and recreational fishing) from flood. It is important to these note positive consequences as they can assist the assessment of risk and also help manage the opportunities that can arise from this in a way that supports better recovery.

Facilitators may also choose to allocate low, medium or high levels to consequences and impact to areas as part of the exercise. If this is undertaken, a criteria will need to be developed prior to this exercise.

After mapping impacts, consequences, some values may not be at risk as first thought. In these cases, participants may elect to revisit their list of values from the phase one exercise and select another value for assessment.

Key questions

- What are the likely impacts/consequences/risks of these hazard scenarios?
- How do these impacts, consequences/risks impact across (short-, medium-, long-term) timeframes?
- Do they change over different timeframes (e.g., increase or decrease?)

Task 7. Map ownership of impact and consequence

Mapping ownership of impacts and consequences is used to identify potential ownership and also to identify potentially vulnerable groups of owners, particularly those who 'own' significant areas of value using the RAP criteria. It is also important to see how the ownership of this can change over the longer term if a consequence is not attended to as this

may determine the priority of an action. It is important to note points where ownership may be transferred and where impacts, consequences and risks may become unowned or where ownership is unclear.

As with all values-based exercises the four value groups of social, economic, environmental and built infrastructure are used.

Key questions

- Who owns these impacts and consequences
- How are they owned (who is responsible, who is accountable who pays – monetary and non-monetary?)

In some cases costs will be mapped as part of the impacts and consequence mapping but in some cases the consequences may result in specific risks. For example: A high level social cost can pose a financial and resource risk. This task is to ensure that all risks are identified from the process for the next stage.

It is also important to identify where consequences and impacts may spread to other value areas over the longer term and what the potential area of cost lie. For example, if an event destroys an area of high cultural or environmental significance this is a social and environmental cost such as the rainforests in Cairns which are a major source of income for the area, this will impact the local and potentially state economy, which may result in the breakdown of a communities ability to function and a reduction in biodiversity. The accumulated social, environmental and economic costs across time are likely to be substantial as a result.

The RAP criteria can also be useful for understanding where areas of high consequence may or may not pose a high level of risk. For example, if there is high level of damage to residents' houses, how severe the consequences are for this will be dependent upon aspects such as levels of insurance and economic circumstances.

Key questions

- Who owns the impact and consequence and how do they own this?
- Does ownership affect the level of impact and consequence?
- What area of values are most at risk?

Task 8. Identify risks

When combined with the ownership map impact and consequence are used to identify risks. In some cases consequences will be considered risk. For example, loss of biodiversity. It is important to view the consequences across the strategic timeframes as some impacts and consequences may increase in a way that creates a specific risk. For example, the emotional trauma that a community may suffer which may result in increased conflict, health impacts and community disconnection over the longer term which are social risks which are owned by the community, state and local government. This may result in increased health and welfare costs, welfare losses and lost productivity which are economic risk. The risk that arises from this could be a dysfunctional community and increased costs for government.

The ownership mapping previously undertaken can also be useful for understanding where areas of high consequence may or may not pose a high level of risk. For example, if there is high level of damage to resident's houses, how severe the consequences may be will be dependent upon aspects such as levels of insurance and economic circumstances.

However, in some cases it may be found that the impact and consequence is primarily during and immediately after an event and that levels do not increase over time and are considered manageable.

Expert review of workshop outputs is often undertaken at this point to:
- verify the outcomes from the workshop
- ensure that key risks are not missed
- develop cost profiles for impact and consequence across value areas.

The effort expended on any analysis will depend on the resources and capacity of the organisations involved.

Key questions
- Does ownership affect the levels of impact and consequence?
- What criteria is being used to ascertain levels of risk?
- What value area (social, environmental, economic and built infrastructure) are most at risk?

Task 9. Select priority risks

As risk priorities will differ across groups, it is important to have a clear criteria and process for how risks will be prioritised prior to the process. Guidance relating to criteria for prioritisation can be found most risk processes but it is important to ensure that strategic risk is accounted for. Also to consider how risks that may be a low priority in the shorter term can spread or increase if not attended to and what the long-term effect of this is.

Stakeholder groups may prioritise different risks at this point of the process and there will need to be mechanisms in place to resolve any conflicts that may arise as a result of this. For example, if a community group selects a different priority risk to the risk professionals present it may be necessary to revisit or introduce new information so this can be discussed. If the community still makes the same decision and it resides within their jurisdiction to make this decision, they will also need to accept the possible consequences of this.

Key questions
- Does the criteria for prioritising risk you are using accommodate strategic risk?
- What risks increase over time?
- Does the risk spread other areas of risk or endanger different values across time?

Task 10. Allocate ownership of risk

Ownership allocation can be particularly contentious in this task and requires appropriate time and a well thought-out process. The RAP criteria can be a useful tool for this part of the process for mapping how the risk is owned for individual and shared ownership. In cases of shared ownership, identifying the lead owner is also useful.

It is also important to identify where ownership may be transferred and how it is transferred to different parties across the different timeframes, and also where ownership gaps currently exist. This is useful in two ways:
- It can help identify areas that are potentially vulnerable because of lack of ownership or unclear ownership of risks.
- Can help the development of strategies and plans to better manage the impacts and consequences of these risks.

Key questions
- Who owns the risk?
- How do they own this (responsible, accountable, pays)?
- If there are multiple owners, who are the lead owners in the above areas of responsibility, accountability and payment, and who is the primary owner in each area?
- Is further economic costing work to inform workshop results required?

NERAG Phase: Risk treatment

Risk ownership activities in this phase: Identification of short and long-term actions and who owns these

The key objectives of this phase in relation to risk ownership:

■ To identify short and long-term mitigation, resilience and preparation activities
■ Evaluate if owners are able to fulfil allocated ownership
■ Allocate ownership.

Considerations

In determining what actions need to be undertaken and who should own them, it is important to have an idea of what the longer term goal or outcome is, for example it could be to build resilience or is it increase risk ownership in a particular area of the community? This provides a basis for assessing and measuring how effective actions and activities are likely to be.

It is common in strategic planning to establish and define the desired outcome first and then to work backwards or 'backcast' to see what activities are needed to achieve this. A schematic and guide for characterising different types of risk action is shown and discussed in. This shows how the different types of actions relate to hazard risk and the broad type of associated benefits (e.g., reduced damage, faster recovery).

The four major areas for actions are:

■ **Prevention (mitigation)** – where the severity of the hazard is reduced, saving damage and recovery costs
■ **Preparation** – where damage is reduced by pre-prepared actions before or during the event (not including direct response measures to reduce the hazard)
■ **Recovery** – measures for improved recovery following the event
■ **Resilience** – non-specific measures to improve resilience not covered by the other three categories.

Strategic outcomes require thinking beyond short-term gain so you have look at the bigger picture as to what is being traded off now and what that actually means in the future for the people and communities who will be living there. Sometimes taking a low cost option can have a high cost result.

As activities such resilience building are systemic and involvement of multiple parties, this approach can also be used to map multiple activities that contribute towards a common goal.

Different approaches will be appropriate for specific tasks. It is important to select an action that will provide the best outcomes for the task being undertaken with the available resources. There are also a number of different approaches to how this part of the process may be undertaken, as the order in this

phase in not fixed. For example, some groups may choose to select some priority actions earlier in the process and focus on comprehensive costings and benefits, whereas others may prefer to look at all risk actions and get a broad brushstroke of potential costings and perceived benefits prior to prioritising the list and then undertake comprehensive costing of the priority risk actions.

Data limitations and information about the level of future damage and loss may be difficult to obtain and this may limit some aspects of the evaluation, especially for in the area of non-monetary costs. For intangible benefits that may not be able to quantified, it is important to list benefits as part of any business case (see Appendix L).

In cases where there are multiple owners for an activity, lead risk owners should be identified and the activities for which they are responsible clearly defined.

Alternative use for this assessment phase: Economic aspects of phase can be applied to current activities to support aspects of business case development and ensure that non-monetary costs are also considered and included. When being applied, the consensus aspect of the process may not be applicable and depends upon the context and purpose for undertaking this exercise.

Short-term goals

■ Identification of pre-event, short and longer term recovery and resilience actions and owners
■ Evaluation of current levels of ownership of actions
■ Assessment of current risk ownership allocations to ensure they can be achieved and are sustainable in the longer term.
■ Development of finance processes that support the inclusion of longer term non-monetary costs as part of business cases to support longer term investment.

Long-term goals

■ Comprehensive map of risk actions and ownership across short, medium and long-term timeframes
■ Dedicated lines of finance to support longer term projects
■ Business cases that include long-term of both monetary and non-monetary costs and benefits and processes that support this.
■ Practitioners who are able to think strategically and act operationally.
■ Risk owners who are aware of their obligations and work collaboratively to achieve outcomes.

Task 11. Identify risk treatments/resilience activities for priority risks

This part of the process can have a series of stages that involve workshops and independent expert analysis. It is important to map activities to see where activities are short-term and can be carried out as an independently and where activities will need to be longer term to obtain the desired outcome For example, a lack of knowledge regarding a particular hazard may be identified as a major risk which requires ongoing treatment because the hazard is projected to increase substantially into the future. (See Appendix I for further examplesof exercise outputs.)

This can also help separate the 'low-hanging fruit' activities from those that require sustained longer term investment, particularly in poorly-resourced localities. It allows activities to be undertaken whilst activities to plan and secure finance for longer term activities is undertaken. So a community may decide that free installation of fans in vulnerable residents houses would be a priority action for the next two years to mitigate the risk of extreme heat but they may also select a longer term activity to reduce the overall effect on a community through changing planning requirements or increasing trees and green spaces to reduce the urban heat island effect.

Key questions

- Can this risk be prevented or mitigated? If not, how will ownership be negotiated with the owners of that risk?
- What actions are needed in the short-term?
- What actions are needed in the longer term across what timeframe?
- What shorter term activities support longer term resilience and recovery?

Task 12. Evaluation of costs and benefits and effectiveness of actions

A key part of strengthening risk ownership is evaluating who benefits and who pays. Assessing who benefits from reduced losses and improved outcomes helps to determine who should bear the responsibility of ownership.

Ownership allocation should not be always be considered in terms of the primary beneficiary being automatically allocated as the primary owner. In some instances, it is reasonable to suggest that those who benefit should pay – in other instances for reasons of equity or efficiency, governments may bear the cost. Assessing actions for their potential to produce long-term social returns and to provide self-funding for future actions are two important criteria.

Evaluation of the cost, benefits and effectiveness of actions is often undertaken by specialists and can be complex. The level at which this is undertaken will depend upon the nature of the assessment and the available resources.

Key questions

- What criteria are being used to determine effectiveness of the identified treatments?
- What are the benefits and costs in the short-term?
- What are the benefits of long-term actions?
- Who benefits and who pays?
- What is the potential cost if no action is taken?

Task 13. Evaluate trade-offs

Undertaking trade-offs is one of the most complex parts of the strategic planning process, as it requires comprehensive evaluations of the following areas:

- The cost and benefit (monetary and non-monetary) of pre-event actions contrasted with post-event recovery with both short and long-term returns
- Weighing up the cost (monetary and non-monetary) of undertaking or not undertaking an action in the face of future uncertainty
- Trading off between monetary and non-monetary benefits that may have quite different and sometimes incompatible measures of value.

Not all values that are considered important will be able to be protected, so a key part of this is understanding values that may be lost or where risk may be increased as a result of undertaking one activity and not another.

It is important in this exercise to look beyond the immediate needs for this and ascertain if the result of action will result in losses in the longer term and what these might be. For example, if urban development is protected at the expense of the natural environment, is the future loss of amenity and environmental health and acceptable price to protect this value? (For further information see Appendix L.)

Key questions

- What values are being traded off over the longer term, what is the consequence of this and who pays?
- What is the legacy of this action (e.g., multiple short-term actions can support a longer term goal such as building resilience)?
- What is the long-term monetary and non-monetary cost of an action or no action and who pays for this and how do they pay?
- Who gains the most benefits from these actions and how do they benefit?

Task 14. Select treatments, mitigation and resilience actions

The processes used for selection of the activities can vary, and very much depends upon who is involved and what the desired outcome of the overall assessment is and the criteria that is being used for assessment. In some cases facilitators may where facilitators have chosen to prioritise certain risks in earlier tasks this phase may focus on producing a detailed business case for selected treatments.

The main difference with this area of the assessment is that specific consideration needs to be undertaken in relation to:
- Long-term risk impacts
- Long-term activities that may be needed to mitigate these impacts
- Strategic goals organisations/communities may already have such as building resilience.

In cases where community-owned or privately-owned sector are involved, this may take a series of activities before consensus is reached as to what the priority might be and who is likely to be responsible for that agenda. For example a community may want government to pay for a levy to reduce flood risk but it may not be in their jurisdiction to make decisions regarding large infrastructure projects of this nature and may be reliant on other areas of government to manage and pay for this. In this case, if the other less costly activities may be more appropriate. Alternatively, it may be selected as a longer term activity and broken down into smaller tasks which are then actioned in different stages.

A number of different types of methods can be used to support this process (see Appendix K).

Key questions
- What is likely to be the most effective, resource efficient option for both the short and longer term goals?
- What the residual risk of actions and who owns this?
- What is the future risk of not undertaking an action – will this create a greater risk and who is likely to own that risk?
- What is doable now with the resources and capability of the group? What is important and should be noted for future action?

Task 15. Evaluate and allocate ownership of actions

When allocating risk ownership of actions, it is particularly important to ascertain if a risk owner or their representatives are capable of fulfilling the ownership role allocated to ensure outcomes are actually able to be enacted.

Areas for consideration include:
- The capacity and skills of allocated owner/s
- Resources available to address the risk

- Key connections the primary owner depends on to deliver outcomes
- Identified interdependencies between the different values and areas of risk, and the possibility of contagion from one risk area to another
- The nature of the systems (social, environmental and economic) that surround the risk.

In cases where there are multiple owners for an activity, lead risk owners should be identified and the activities they are responsible for clearly defined. The RAP criterion is a useful tool for this task, and it is best to work with either electronic or paper templates to ensure consistency in data produced.

Key questions
- Who is the obligated owner and how is this obligation placed upon them (e.g., policy, contract, asset or ownership, legal requirement, social contract)?
- How do they own the action (e.g., RAP criteria)?
- If there are multiple owners, who are the lead owners in the above areas of responsibility, accountability and payment?
- Do the obligated risk owners have the capacity and resources to be able to fulfil the allocated ownership?
- If the selected risk owners cannot fulfil their ownership obligations, are there other ownership options available?
- If there are no other options available, are there strategies or plans that can be put in place to ensure ownership is achieved or that the risk posed by this ownership gap is mitigated? If this is not able to be resolved, what is the most likely outcome that will result from this?

NERAG Phase: Monitor and review

Risk ownership activities in this phase: Identify indicators for measuring condition of values, levels of ownership and strategic progress. Integrate these indicators into current operational plans and processes.

The key objectives of this phase in relation to risk ownership:

- To identify indicators that can be used to monitor values, levels of risk ownership and progress of strategic activities.
- To support integration of risk ownership into operational frameworks through the inclusion of specific risk ownership measures into ongoing monitoring and evaluation programs.
- To identify who should be undertaking these activities and where outcomes of this activity may need to feed into other organisations M&E programs.

Considerations

Sustainable risk ownership and management of strategic risks require the development of indicators that are able to be integrated in operational systems to ensure ongoing assessment as part of day-to-day operations.

This is particularly important for the following reasons:

- Longer term actions and activities and ownership of these may alter across timeframes due to changes in a particular context and this allows for ongoing assessment and adjustment.
- Natural hazard risk is highly dynamic and the risk and ownership of it can change rapidly as a result.
- It is new area of practice and it needs to be integrated into operational systems to ensure that it is sustainable into the future.
- In many cases it will require the building of new data sets and methods.

As the context surrounding these events is highly dynamic, it is important to be able to capture changes as they occur and also to be able to adjust longer term strategic activities in response. It is also important to ensure that data collected as a result of activities is robust and that these indicators measure something that is relevant for the organisation or community context.

There are different types of monitoring and evaluation and numerous tools and methodologies that can be used (for further details see Appendix K). It is important to select what is going to help you as an organisation manage the risk and to avoid 'interesting indicators' that do not support operational activities.

In some cases the amount and type of monitoring needed may be limited due to the available resources and also capabilities of the organisation. In these cases it may be useful to consider if there is potential to collaborate with outside agencies such as other government or research organisations. It is also important to ensure that there is cohesion between these activities in areas across the EMS and to identify where established M&E that is relevant to these activities already exists. For example, state and local government bodies may already be monitoring social values and built environment values that have been identified as part of the process. Identifying where it is possible to collaborate and feed into pre-existing monitoring and evaluation can help consolidate resources, reduce duplication and support consistency across EMS areas of practice and policy.

Alternative use for this assessment phase: This phase can also be used as a separate activity to support ongoing integration and development of monitoring and evaluation. In this case consensus is only required if it necessary to support integration activities.

Short-term goals

- Development of ongoing monitoring, evaluation and indicators that assess project performance in context of strategic aims and outcomes.
- Development of indicators to evaluate changes in the state of the priority value.
- To identify where the opportunities to integrate current monitoring and assessment into current systems are.
- To build collaborative data sharing that support monitoring and evaluation capacity across the EMS.

Long-term goals

- A fully integrated monitoring and evaluation system that supports longer term strategic decision-making and goals.
- Working collaborative data sharing across different levels of government and the community that support a more comprehensive system of monitoring and evaluation to enable better strategic decision-making.

Key questions

- What do we need to know?
- Why do we need to know and why do we need to know it?
- What data will need to be collected to answer this question?
- Who will need to collect it?
- What are we able to do?
- Who should be responsible for this – community, local, state government, private organisation?
- Who might be already responsible for this?

Task 16. Develop indicators to monitor progress and outcomes

Evaluation is a central part during and following the process as is important that strategic goals are integrated into operational frameworks through both short- and long-term actions. Because of the nature of the natural hazard risk, the diversity of contexts and the need to assess multiple actions in relation to long-term strategic outcomes, indicators will need to be developed to support both formative and summative evaluation. (See Appendix J for details.)

Formative evaluation aims to understand what makes a project work (process), as well as improving it while it is being implemented. Programs or projects are usually assessed during their development or early implementation to provide information about how best to revise and modify for improvement. This type of evaluation often is helpful for pilot projects and new programs, but can be used for progress monitoring of ongoing programs.

Summative evaluation looks at the effectiveness of the entire program cycle and considers short to long-term outcomes. Programs or projects are assessed at the end of an operating cycle, and findings typically are used to help decide whether a program should be adopted, continued, or modified for improvement.

Indicators will need to be developed to measure the following:
- Values – changes in condition and also levels of different types of values
- Levels of risk ownership across key event areas
- Effectiveness of actions in relation to long-term strategic activities such as building resilience.

These indicators will form the foundation from which to develop an ongoing monitoring and evaluation in this area. It is worth noting that for some organisations it may be necessary to build capacity to achieve this.

As there a number of bodies already undertaking monitoring and evaluation in the EMS sector it can be useful to ascertain if they may be a more appropriate body for monitoring and evaluation a particular indicator or sets of indicators. If there is, it is important to discuss this prior to undertaking the process to ensure that there is appropriate coordination and continuity so that outcomes from the workshop can be fed into these programs.

Key questions
- What types of monitoring and evaluation need to be undertaken?
- What indicators are needed these types of monitoring and evaluation and why do we need them?
- How will they help our organisation?
- Do we have any indicators in our current monitoring M&E program that are relevant and could be used?
- Are these indicators likely to be used by any other organisation (e.g., state, local government or associated agency)?

Task 17. Integrate indicators into ongoing monitoring and evaluation program

Integrating risk ownership and strategic activities into ongoing monitoring and evaluation is an essential part of ensuring that strategic goals and the activities associated with these become part of day-to-day operations. This supports longer term goals that may be associated with strategic aim such as the building of resilience and also allows for adjustment if the situation changes in either a positive or negative way. For example, if one of the key activities reaches it goal early this may allow for the instigation of other activities. Alternatively if there is a perverse outcome this can be detected and management of this undertaken.

It is very important to assess where there are opportunities to build into or add on to current decision-making mechanisms and to start with these. For example, inclusion into quality assurance and risk management processes or inclusion of relevant items on organisational meeting agendas or capital expenditure or grant forms.

Key questions
- What are the limitations of current monitoring and evaluation systems and processes?
- What current monitoring and evaluation systems and processes do you have where these indictors could be integrated into?
- Do you need to establish new systems, processes and data collection.
- Is there another body who may be already undertaking monitoring and evaluation in this area who could become a custodian of specific indictors or set of indictors?

Support notes
for facilitators

Introducing the process

How this process is undertaken will be determined by the context it is being undertaken in, the purpose of the assessment, the resources available and the participants attending. It is important to consider what approach and tools are most appropriate and will support the type of process you want to undertake achieve the outcomes you need. A summary list of useful methods and approaches is listed in Appendix L.

When undertaking this process it is important to ensure the following:

■ Stakeholders with diverse expertise and experiences attend to fully represent the different values and agendas of an organisation, group or community.

■ To be mindful of potential bias that may occur during different tasks, and to account for these.

■ That a consistent method for capturing outputs is established to ensure that data obtained is robust.

■ There is a clear and transparent process and facilitation to support this activity that works with and through complexity and uncomfortable conversations and situations.

Outcome and use

It is important before undertaking this process to look at how the expected outcome and outputs relate to broader context into which they will be used.

Areas that should be considered are:

■ Current EMS plans and strategies that apply to the context.

■ Current formal allocations of ownership through legislation/ regulations or legal mechanisms that apply to the organisation/area for assessment.

■ Current strategic plans that relate to the context.

■ Other agencies that monitor and evaluate values, risk and planning.

This is will help determine:

■ Who needs to be communicated with and included to ensure that this activity is not happening in isolation or in competition to other areas of planning or risk management.

■ Identification of possible information resources that can be used to support this process. For example, state government spatial mapping of projected population growth may be useful for assessment of social risk.

■ Clarity regarding already pre-existing areas of risk ownership that formally allocated that may not be negotiated but can be used to inform parts of the process.

Consensus and negotiation

> **'Decisions that are reached through participatory processes increase the support for the decisions.'**
> — Arvai, J. L. 2003.

Allocation of risk ownership does not guarantee uptake of ownership; the risk has to be understood and accepted before this can happen. As a result, consensus and negotiation are important for the following reasons:

■ It ensures that values, risks and activities selected are supported and are more likely to be sustainable in the longer term

■ It allows for identification, reflection and discussion of areas of ownership that lack clarity so that resolutions can be reached

■ It ensures that all people involved in the assessment process are accountable for their decisions

■ It makes visible areas where informal arrangements exist and provides a way of recording this

■ It can support decision-making in other institutional areas, such as state and local government

■ It builds trust and assists the development of long-term collaborative arrangements.

Consensus provides a way to formalise an agreement that has been reached by the group through a structured process where participants are active in the decision-making process. Consensus can be across a small group of representatives or multiple stakeholders in a workshop, but it has to involve the whole group. This should not be confused with reaching an agreement that is less formal and is part of most individual exercises. For example, you may have a number of groups who work individually to come to an agreement as to what the priority risks are for their table. All the priority risks may then be brought together so the group can reach a consensus as to what the top three priority risks are.

This is important because many risk activities, particularly at community levels, are dependent upon informal arrangements such as social contracts and cannot be enforced, so negotiation and consensus are used to provide a process that can accommodate this and formalise aspects in a way that supports the ongoing activities needed. It is important to document all informal outcomes from this process, as it acts as a record for future reference.

It is also important to determine what level of agreement is needed to reach a consensus prior to undertaking an exercise and also how voting will be undertaken. For example, in some consensus exercises, 80 percent of the participants will need to agree for consensus to be reached. This can be uncomfortable and challenging at times, and requires well-structured processes and facilitation as it can be uncomfortable and challenging for some participants. Facilitators will also need to ensure that there are appropriate conflict management and knowledge sharing protocols in place.

It is suggested that facilitators read Seedforchange's *Consensus Decision Making* (http://www.seedsforchange.org.uk/consensus. pdf), which provides specific advice on how undertake and manage consensus exercises.

Communication and engagement

> **The key purpose of any risk communication is to build understanding and respect for the risk, not fear.**

The communication for this process uses the same components as those outlined in the Community Engagement Framework (Figure 15) from the *Australian Emergency Management Handbook 10.1 National Emergency Risk Assessment Guidelines: Practice Guide*. Their application differs slightly with this process, as it requires consensus at key parts of the decision-making process, and state government bodies may not always lead the process. Although many of the expectations related to these components remain, there are also some differences in the expectations as a result of this (Table 8, overleaf).

Strategic risk ownership requires being able visualise risks in a future context that may be very different to the current, and how you approach the task of communication will differ from some risk exercises for the following reasons:

- There will be a higher level of uncertainty, more complexity and aspects of this will be unfamiliar.
- Participants have varying degrees of risk expertise and experience. In particular, if participants have experienced a hazard it may lead to set assumptions as to how future risks may play out, or they may need specific support if they have suffered trauma as a result of an event.

PRINCIPLES

Purpose and context

Participation
Building connected networks and relationships, ownership and trust through active involvement

Consultation
Sharing information, questions or positions to obtain ideas, feedback, knowedge or an understanding of objectives and expectations

Information
Sharing information between communities and agencies to come to a mutual understanding. Everyone is informed and able to take responsibility for decisions and actions.

Collaboration
Partnering with communities to support action, including developing alternatives and identifying a preferred solution

Empowerment
Individuals and communities have capacity to understand risk, accept responsibility and implement initiatives
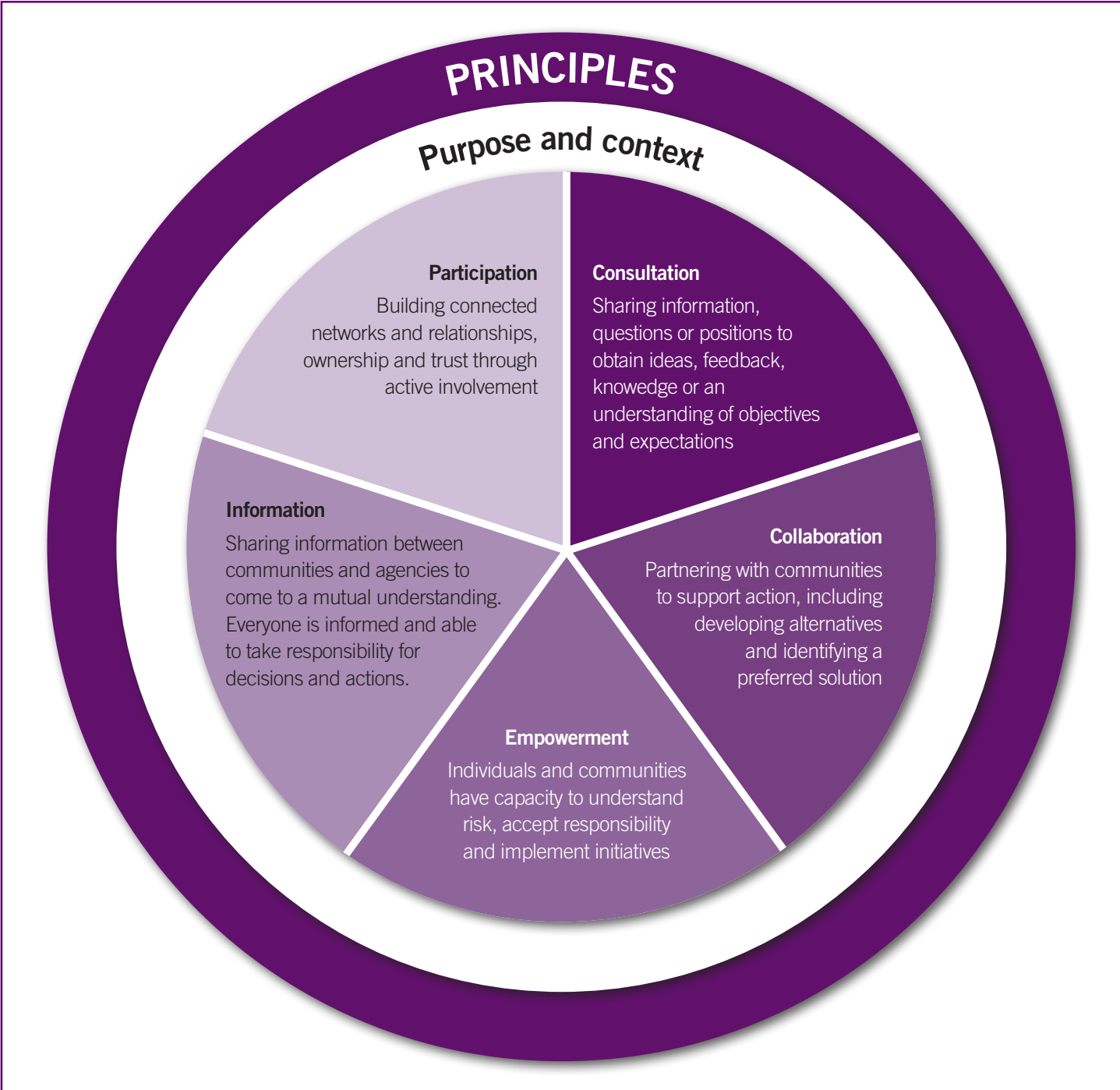
Figure 15 Adapted from Community Engagement Framework, *Australian Emergency Management Handbook Series, Handbook 11*, National Strategy for disaster resilience – Community Engagement Framework (2013).

COMPONENT	GOAL	EXPECTATIONS
Information	To share information between participants to come to a mutual understanding. Everyone is informed and able to take responsibility for decisions and actions.	■ You will keep participants informed throughout the process. ■ Information will be relevant, accurate, targeted, credible and consistent. ■ Information is broadly accessible and provided through a variety of channels. ■ Participants will not be expected to respond unless they wish to. ■ You will ensure participants understand where they have jurisdiction to make decisions and where they do not.
Consultation	To share information, questions or positions to obtain ideas, feedback, knowledge or an understanding of objectives and expectations.	■ You will allow sufficient time for participants to consider an issue and provide input. ■ You will keep participants informed. ■ You will ask for feedback, and listen to and acknowledge concerns. ■ Your decisions and actions will be guided by participants' feedback. ■ You will communicate how participants' input influenced the stage of the process.
Participation	To build connected networks and relationships, ownership and trust through active involvement.	■ Participants will be an active part of the decision-making process in decisions or actions that potentially affect or interest them. ■ You will use a variety of ways to involve participants. ■ Participants will have an opportunity to connect with each other. ■ You will be inclusive and accommodate diversity ■ Participants will be expected to commit to reaching an outcome based on consensus. ■ You will communicate how participants' input influenced the stage of the process.
Collaboration	To partner with participants to support action, including developing alternatives and identifying a preferred solution.	■ You will look to participants for advice. ■ You will seek participants' input to creative solutions. ■ You will incorporate participants' advice and solutions to the maximum extent possible. ■ You will tell participants how their input has influenced the stage of the process. ■ Participants will recognise their influence on the process. ■ Achieving common understandings and consensus will be central to this process.
Empowerment	To establish the capacity of participants to understand risk, and accept responsibility and implement initiatives.	■ You will accept the consensus reached by the participants. ■ Participants will accept responsibility for the consequences of the consensus of their decisions. ■ You will act on the advice of the participants. ■ You will consider and respect the different values that inform the different types of decisions participants make during this process ■ You will facilitate a negotiated outcome between participants, if needed.

■ People have 'hardwired' responses to risk and the ownership of it. As a result, longer term risks may seem distant or unlikey and ownership may be harder to obtain. Some participants also have inbuilt responses to risk (e.g., women are generally more sensitive to risk [Eckel, C. C. and Grossman, P. J. 2008).

■ There is a high likelihood of conflict being created if the exercises are not properly structured, or if participants become sidetracked by focusing on details.

This means that facilitator and communicators throughout this process need think about what the key purpose is and how to present information in a way that does not overwhelm participants and also allows for learning.

Understanding your participants

This has been adapted from *The Problem Solution Framework for Adaptation Practitioners* (Young, C. 2015)

The outcome of the communication used during this process is shaped by how people feel, what they think and what motivates them. Having an understanding of these aspects prior to undertaking this process can help identify areas that may need to be managed and ascertain what the best form of communication may be for different parts of the process

Stepping through the following questions for each area can be useful to clarify what the potential impact of different types of communication may be on your participants. In particular, it helps to know what their specific needs are, what they value, and what their key point of interest is.

Emotion: how do you want these people to feel?
■ What could this information mean to this person and how could it make them feel?
■ How do you want them to feel?
■ What are the cultural and social contexts that determine how this should be spoken about?

Intellect: what do you want these people to understand?
■ What do they know?
■ What do they want to know?
■ What do they need to know?

- What language do they use?
- What is their point of interest?
- How do these people communicate?

Will: what will motivate these people?
- What can these people do?
- What do these people want to do?
- What do these people need to achieve this action/outcome?
- What is their capacity to achieve this?

It is also important to think how the scenarios are framed and whether there is a need to use a specific framing to help participants think forward in their own contexts (see Case Study: Wagga Wagga Council). Values can be a useful tool in understanding how best to frame and work with different stakeholders. Useful documents for understanding are included as 'Practitioner support resources' at the end of this section.

Language

Communication of risk relies upon the ability of communicators to translate between different languages, social tiers and agendas to create a common language, understanding and purpose.

Language needs to be specifically tailored to each audience. Often you will find that people will have different ideas or don't know what a term or a word means. This means it is often necessary to define the terms you are using upfront to ensure you have a common understanding.

Three key factors that will dictate what type of language your audience uses:
- Their chosen profession. Each profession has its own language so try and ensure that you use terms that are meaningful for the group.
- Their cultural background. Cultural background will often define how they hear the information and dictate responses. It is particularly important to be aware of cultural sensitivities and to seek solutions to issues with the target audience, and the way they communicate.
- Their tolerance and experience of certain types of risk.

What medium to use

How risk data and information is presented will have a direct effect on how well it is understood by a particular audience. Community members can sometimes be overwhelmed or confused by risk information, particularly if they have a high sensitivity to risk or there are different levels of literacy. It is important to ascertain how best to communicate risk information in a way that will make sense of the risk in their context.

Most people have a primary sense through which they communicate (Figure 16). Identifying this can help practitioners decide which medium is going to be most effective for the communication tasks. These media can also be used creatively to enhance materials produced and can support experiential learning in a way that allows for collaborative visions to be developed and shared among diverse stakeholders.

Case Study: Wagga Wagga Council

Wagga Wagga Council wanted to create a document that outlined what the community wanted now. They also wanted it to be a strategic plan to define how they wanted to grow in the future, which could also act as a guide to achieving these goals.

To do this, they needed to engage with something that was central to their community so they developed a series of communication activities using two imaginary children, Oscar and Ruby (the most common baby names used in the area in 2011). They felt that these two children were the perfect vehicle for representing 'who we are now and who we will be in the future' as they allowed the community to think outside of themselves through a lens of what was most important to them and related to them on an emotional, intellectual and motivational level.

AURAL	Radio, skype, telephone
KINETIC	Experiential learning, peer-to-peer communication
WRITTEN	Books, articles, websites, Twitter, Facebook
VISUAL	Film, pictures, photographs
EMOTIONAL	Art, trusted people
ORAL	Focus groups, presentations

Figure 16 Communication mediums.

Using data

Data is not a means to an end, it is something that needs to make sense to the viewer and be relevant if it is to be useful in the decision-making process.

How data is used during this process to convey aspects of risk or future development needs to be considered carefully as participants will often have different ways of interpreting the data presented and this can lead to confusion or disengagement.

Key areas that need to considered include (adapted from Young, C., et al. 2016):

- **The level of risk expertise in the room:** How people interpret data will depend on the factors outlined above and the key distinction between participants will be different types and level of expertise and the tools that participants are accustomed to using. As digital technology and use of data is changing rapidly it is important to ensure that where outputs from models and data maps are explained and ensure that there is a common understanding of what is being discussed.
- **The use of color:** As what color is used on a map can lead to assumptions (for example, red means danger, green indicates something environmental) make sure you have clear explanation of what different colors mean on spatial maps particularly if they have been used on other maps differently. Also consideration needs to be made for participants who are color blind.
- **The scale at which data provided will need to be to support this assessment:** As many of these assessments are likely to happen at a local level it is important that data matches the task at hand. For example data that represents state level areas may lack the necessary detail for a local community.
- **How the data is presented:** There are many different ways to present data that can make it more accessible to a particular group of participants. An example of this the use of infographics on maps to highlight key points. Experts can also be used to support understanding of data presented but need to be selected carefully to ensure that are able to engage with the participants effectively.
- **The relevance of that data to the context and purpose of the task.** There is a lot of very interesting data available and facilitators will need to be careful to ensure that the data selected is specific to the purpose and does not cloud the agenda with interesting facts which can confuse participants or sidetrack the focus of the exercise. It is also very important to select only what is needed to avoid overwhelming or disengaging participants. It is far more useful to have less data fully understood than a large amount of data poorly understood.

Top tips for communicators

- **Be accessible.** Use terminology and phrasing that is understood and common to your audience. Where you cannot do this, ensure that clear and simple explanations of terms and words are provided. Avoid using jargon or highly-technical language and terminology.
- **Keep information simple but not simplistic.** You need to convey the facts in a way that is accessible to your audience without simplifying it to the point where the message is lost. Try to respond to and ask questions rather than over explain information. Don't ignore or downplay the complexities of the issues or seriousness of the risks being presented.
- **Explain, don't embellish.** Allow the facts to speak for themselves. Embellishing facts or placing strong emotional overlays can cause people to focus on what they feel and confuse the issue you are trying to communicate.
- **Make it relevant.** Use imagery and narratives that can help the audience relate to the problem in their context. Understanding internal values of organisations and individuals can also be useful for understanding how to most effectively frame exercises. For example, if it is a community context, you would use inclusive language and images of people and places, whereas in a business context you would use neutral language and commercial images.
- **Maintain integrity of the research and data.** Research and data should not be adjusted or presented out of context to support a particular agenda. This is likely to lead to poor decision-making and confuse understanding. It can also potentially lead to poor outcomes.
- **Collaborative dialogue.** Values-based approaches require input and buy-in from the beginning of the process. Ensuring that you have mechanisms in place where you can create the communication through collaborative mechanisms is important.
- **Allow for feedback and response.** Because this information may confuse or concern some people, all communication should allow for some form of feedback or response throughout the process to avoid creating unintended resistance, confusion or disengagement. Active listening is a key part of this, and communicators need to work with and negotiate across different points of view.
- **Let the pictures do the talking.** Images are useful for assisting with understanding, they can also be used to emphasise key aspects of information. Images need to be carefully selected as some images can demotivate participants. Images are also useful in complex documents as they create a different space in the document where the reader can 'rest' and consolidate what they have read.
- **Be mindful of their experience.** Risk is something people experience and respond to differently and so it important to understand what level of experience the participants have to with the different hazards being applied so that the workshop can be tailored towards their needs. In cases where communities have experienced a catastrophic event, it may be necessary to consider if additional support may be needed during this process.

- **Develop shared understandings.** As there are multiple understandings about the types of risk assessments and varied understandings of strategic planning, it is important to ensure that key stakeholders have a shared understanding of the task they are undertaking from the onset.
- **Establishing clear expectations** clearly upfront in relation to outputs from the process – particularly when communities and private industry are part of the process – can reduce misunderstandings and potential conflict.
- **Be respectful when using local knowledge.** In cases where knowledge from specific cultural groups or private industry knowledge are to be used, it is important to discuss how this knowledge will be solicited and used, and ensure that any cultural sensitivities or intellectual property issues regarding use of this knowledge are addressed prior to activities being undertaken. It is also important to consider how the knowledge will be collected and where it may need to be verified.

Practitioner support resources

The Common Cause Handbook, Public Interest Research Centre, UK (2011)
http://publicinterest.org.uk/the-common-cause-handbook/

Consensus Decision Making Seedforchange (2011)
http://www.seedsforchange.org.uk/consensus.pdf

Values-based decision-making. Making good decisions that last. Participant Guide.
library.tephinet.org/system/files/vbdmparticipantguide.doc

Handbook 10 National Emergency Risk Assessment Guideline: Practice Guide (formerly Handbook 11, now Practice Guide 10.1ADIR (2015)

Handbook 6: National Strategy for Disaster Resilience – Community Engagement Framework AEMI (2013)

Manual 45 Guidelines for Development of Communication Education Awareness and Engagement Programs AEMI (2010)

International Association for Public Participation
https://www.iap2.org.au/Home

Using economic tools as part of this process

> **'If we do not recognise the fundamental difference that exists between price and value, then we are doomed.'**
> — Sylvain Raynes, Financial Analyst.

Aspects of the risk ownership process require economic methods and tools to support the decision-making process. As this process requires assessing both tangible (monetary) and intangible (non-monetary) values and costs, what is used and how it is used during this process will be dependent upon the:
- desired outcome of the workshop
- format used
- resources available
- skills of the participants.

Economics in this process can be used to provide metrics in the following areas:
- The business-as-usual baseline
- Costs (both monetary and non-monetary) of damage and loss from impacts and downstream consequences
- Benefits of reduced damage and loss, and increased recovery
- Benefits of measures such as risk spreading (e.g., insurance), incentive schemes (e.g., rates reductions for emergency management planning)
- Ancillary or co-benefits of measures taken, especially for improved resilience.

There may not be a need to calculate all of these measures in an assessment, but they are important for supporting both the decision-making process and the development of business cases needed for investment in the longer term.

Evaluating who benefits and who pays is a key part of strengthening risk ownership. Assessing who benefits from reduced losses and improved outcomes can help to determine who should bear the responsibility of ownership. Ownership allocation should not be always be considered in terms of the primary beneficiary being automatically allocated as the primary owner. In some instances, it is reasonable to suggest that those who benefit should pay – in other instances for reasons of equity or efficiency, governments may bear the cost. Particularly in cases of vulnerable communities, capacity and capability to fulfil ownership obligations will need to be evaluated and the overall benefit to the immediate community and government bodies. Creative solutions are also possible (e.g., where actions may produce a cash flow, investors may privately fund strategic actions).

Recovery also provides opportunity for added future benefits (such as building back better) which can help reduce avoided future economic losses (see case study below). Some benefits may increase or decrease over time. For example, urban forests can reduce the impacts of urban heat island and improve air quality and wellbeing of communities. As trees grow, the benefits from this asset will reach a maximum point after which a constant benefit can be obtained.

Costing natural hazard events across a strategic timeframe has an advantage over conventional methods for costing natural hazard events because it extends beyond the direct impact caused by an event and traces consequences across the affected systems. The timeframe in these exercises extends beyond short (2–12 months) to medium (1–2 years), to longer term (2–7 years) frames. Timeframes may vary depending on context and extend from a few decades in the case of community planning to a century in the case of major infrastructure or natural ecosystem.

Most economic costings will need to be undertaken outside of the workshop, but findings from this can be included in the format to support decision-making. Any prioritising of values undertaken during workshops will be carried out using knowledge and expertise of the participants and can be used to identify which areas may need further assessment.

Complexities

Understanding the economic impacts of residual risk what this may mean for a community who depend on high value intangibles that face considerable residual risk (e.g., high value but vulnerable natural areas used for tourism). In most cases, this will simply be expressed in terms of risk only.

Representing and evaluating benefits that do not have a monetary value (such as improved community morale), against more tangible benefits (such as roads) that have a known value. Part of the issue lies in that many current decision-making models focus on financial return, and structures are not in place to support proper evaluation in these areas. Some methods are also time consuming and expensive and require highly specific expertise. Other evaluation methods (detailed in Appendix D) can also be used to provide more qualifiable information of value (e.g., 70% of citizens think this value is significant).

Moving from single events to strategic planning horizons that account for multiple hazards requires being able to think and work systemically. The size and frequency of future hazards and the order they may occur are unpredictable and events can combine to produce new risks with potentially catastrophic events that have unknown costs.

(For full list of methods and explanations, see Appendix L.)

Case Study: Queensland Reconstruction Authority betterment avoided costs summary

Ganyah Water supply intake – North Burnett:
- Severely damaged in 2011 and re-built ($1.2 million), before being re-damaged in 2013 ($2.7 million restoration)
- Relocated the water intake above the Claude Wharton Weir, built a new submersible style pumping station and a new raw water rising main to the Water Treatment Plant
- Functional through two significant events since completion – Tropical Cyclone Marcia (2015), and Central QLD Surface Trough (2016).

Gayndah Water Supply Intake – Project details:
- Restoration: $2,704,360
- Betterment: $843,713
- Council contribution: $50,000
- Avoided losses over two years: $5,408,720.

Appendices

Appendix A: Institutional categories and agencies

Some examples of agencies and roles that can be allocated ownership associated with these institutions are listed below:

Table A1 Institutions and agencies involved in the natural hazard disaster risk process. (Adapted from Productivity Commission and Young, C., et al. 2015b.)

INSTITUTION	EXAMPLES OF AGENCIES INVOLVED	INDIVIDUAL
Federal Government and associated agencies	Individual Federal Government departments COAG Australian Maritime Safety Authority Air Services Australia Australian Defence Force Attorney-General's Department Emergency Management Australia Centrelink	Minister Risk Manager Director Controller Commander
State and Territory Government and associated agencies	Individual State Government departments Ambulance services Environmental agencies Fire services Health services Police force Providers and regulators of essential services State coroner Volunteer organisations State Fire Authority State Emergency Service Natural resource management bodies (e.g., water authorities) Road management and transport authorities	Minister Risk Manager Premier Director Controller Chief Fire Commissioner Volunteers
Local Government	Individual municipal councils Regional Organisations of Councils Local Government peak bodies	CEO Risk Manager Volunteer Officer
Industry and Business	Individual companies and organisations Insurance and finance sector Critical infrastructure providers and operators	CEO Director Business Owner Risk Manager Land Lord Strategic Manager
Community	Community organisations, groups and networks Community Volunteer organisations	Home owner Land owner Coordinator Director
Boundary organisations	Non-government organisations Not-for-profit organisations Regional development bodies Industry and government peak bodies	CEO Coordinator Risk Manager Director

References

Productivity Commission. (2014). *Natural disaster funding arrangements, draft inquiry report*. Canberra.

Young, C. K., Symons, J., Jones, R. N. (2015b). *Whose risk is it anyway?* Desktop review of institutional ownership of risk associated with natural hazards and disasters. Bushfire and Natural Hazards Cooperative Research Centre, Melbourne.

Appendix B: Case studies

Case Study 1: Floods Eastern Australia, 2010–2011

The severe flooding disaster affecting central Australia, southeast Queensland, and far northern New South Wales in December 2010 to January 2011, was created by a series of extreme rainfall events. One was the La Nina event, the strongest on record since the late 1800s, with record high rainfall (BOM nd). It was the 'wettest December on record for Queensland and for eastern Australia as a whole', and the disaster culminated with Cyclone Tasha (Category 1), one of the strongest to hit Queensland, which made landfall on 24 December (BOM nd). Many of the catchments were already saturated from 'Australia's wettest July to December on record' that year (BOM, 2011, p2). The highest rainfall recorded in the period was 1,200 mm in the Mackay area and north of Brisbane, and 800 mm in the coastal areas between Cairns and Townsville and from Gladstone to Brisbane (p5).

The impact of this rain event created flooding that 'in terms of extent, impact and severity, was amongst the most significant in Australia's recorded history' (BOM, 2011, p2), with the most destructive floods occurring in the second week of January in southeast Queensland. The Brisbane River peaked at 4.46m on 13 January (Carbone and Hanson, 2012), the second highest level in the last 100 years (BOM 2011, p6). Numerous flood heights records were recorded in the region such as the Dawson (18.81 mts), Nogoa (18.16 mts), Burnett (16.34 mts), and the Condamine (17.82 mts) (BOM 2011, p28). A Commission of Inquiry was established on 17 January 2011 (QFCI 2012).

The impact of the floods was initially felt in local communities, but it impacted the wider region and even the Australian economy. ANZ economists estimated the floods could reduce Australia's GDP by 0.25% in the December quarter of 2010 (O'Sullivan, 2011). More than 78% of the state was affected, with roughly 29,000 homes and businesses flooded and 33 confirmed deaths (QFCI, 2012, p32). The Queensland Reconstruction Authority estimated the cost in excess of $5 billion, with 2.5 million people affected (p 32). In Brisbane, 28,000 homes were flooded and 100,000 homes lost power (Carbone and Hanson, 2012). The crisis forced the closure of more than 300 roads, including nine major highways (*Sydney Morning Herald*, 2010). Over 9,000 kms of road networks were damaged, making it the most affected state asset. (QFCI, 2012, p251). The SES responded to 2,366 calls for help across the state on in the 24-hour period of 28–29 December (Calligeros, 2010). In Brisbane, many electrical underground substations were closed down after flood warnings, causing loss of power even to those not affected by flooding. Even so 'damage occurred at all levels of the supply system' (QFCI, 2012, p248). In total, 300,000 people lost power in Brisbane. In north Queensland, 220,000 people lost power during the cyclone. In terms of railways, over 3,000 kms of rail tracks were affected or closed, and the Toowoomba Range line was washed away (QFCI, 2012). Railway line closures and flooded mine sites affected coal exports (Fickling and Brindal, 2010; O'Sullivan, 2011). Other impacts included delayed grain shipments, falling share prices, and damage to agriculture production and prices (O'Sullivan, 2011).

Multiple organisations were involved in the response, starting from government at all levels (QFCI 2012, p32), communities and disaster management services. The Australian Army deployed 1,900 personnel in Operation Queensland Flood Assist, with on the ground cleanup and helicopters rescuing people from roofs and cars (Australian Army, 2015). The Federal Government stepped in and all taxpayers assisted, when on 1 July 2011, a one-off Flood Recovery Levy worth $1.8 billion was introduced to fund the rebuilding of infrastructure after the floods (Wilson, 2011). The tax applied to all Australians with a taxable income over $50,000 (excluding those directly affected). The Federal Government also required, by changing the Natural Disaster Relief and Recovery Arrangements, that all states and territories take out disaster insurance, stating they should 'create their own disaster funds or take equivalent measures to stop a flood levy being needed again' (news.com.au 2011; PC, 2015). The Red Cross assisted more than 14,600 people in evacuation centres when the floods peaked, with 1,400 staff and trained volunteers assisting flood affected people for most of 2011 (Australian Red Cross, 2011). They also helped people of all ages recover and cope with the crisis. In terms of ownership, boundaries were crossed across multiple domains.

References

Australian Army. (2015). Operation Queensland Flood Assist 2011. Canberra.

Australian Red Cross. (2011). Queensland floods 2011. Melbourne.

Bureau of Meteorology (2011). Frequent heavy rain events in late 2010/early 2011 lead to widespread flooding across eastern Australia, Special Climate Statement 24, National Climate Centre, Bureau of Meteorology, Canberra.

Bureau of Meteorology nd, The 2010–11 La Niña: Australia soaked by one of the strongest events on record, Canberra.

Calligeros, M. (2010, 29 December). Flooding could last 'weeks, not days'. *Brisbane Times*.

Carbone, D. and Hanson, J. (2012, 8 March). Floods: 10 of the deadliest in Australian history. *Australian Geographic*.

Fickling, D. and Brindal, R. (2010, 30 December). Rains hit Australian coal mines. *Wall Street Journal*.

news.com.au (2011, 22 March). Parliament passes flood levy.

O'Sullivan, M. (2011, 4 January). Losses and delays in flooded state. *Sydney Morning Herald*.

Productivity Commission. (2015, October). Reforming funding arrangements for natural disasters. *PC News*. Canberra.

Queensland Floods Commission of Inquiry. (2012, March). *Queensland Floods Commission of Inquiry: Final report*. Brisbane.

Australian Associated Press (AAP). (2010, 28 December). Hundreds of roads closed in flooded Qld. *Sydney Morning Herald*.

Wilson, L. (2011, 23 March). Gillard's flood and cyclone levy wins vote. *The Australian*.

Case Study 2: Heatwave Southern Australia, 2009

From 27 January to 8 February 2009, after 13 years of drought and higher than usual temperatures, southern Australia and northern Tasmania experienced a major, unexpected heatwave with maximum daily temperatures 12–15 degrees above the seasonal average of 28–32 degrees. The extreme heat led to power brownouts, public transport network failure, crop and livestock losses, and the severe, extensive and prolonged heat exposure resulted in people suffering heat stress (Jones, et al. 2012, p7). Melbourne experienced a new daily maximum temperature of 46.4 degrees and Adelaide 45.7 degrees. Adelaide had eight consecutive days over 40 degrees, and Melbourne recorded three days over 43 degrees (QUT, 2010, p1). The heatwave was predicted three to seven days before, but such severe conditions were not anticipated (p2). The heatwave cascaded into another critical disaster, the 'Black Saturday' bushfires from 6–8 February.

This heatwave had widespread impact on the individuals and communities, overwhelming emergency services and leading to major disruptions. There was a rise in heat-related illness and deaths among vulnerable groups lacking capacity to avoid the heat. In Melbourne, 374 more people died (in excess of what was expected for the period of the event), with 50–150 estimated heat-related deaths in Adelaide. There were more than 3,000 reports of heat-related illnesses (QUT, 2010, p14). Impacts on infrastructure were across the electricity, roads and train systems. On January 30, up to 24% of trains were cancelled. A heat-induced shutdown of Bass Link occurred while operating at full capacity, with high demand for power and transformers failing, leading to power losses across Victoria. 500,000 customers lost power on the evening of 30 January (p4). Financial losses from power outages, transport disruptions, and response costs were estimated at $800 million (p4).

Emergency management services were under-prepared for such a disaster, as capacity was exceeded in every service, who relied on reactive solutions to the emerging impacts (QUT, 2010, p5). Communication and cross-agency cooperation was falling short of the demands from overwhelming situations. Health services were challenged by fatalities and demand for their services. Even though The Department of Health emergency branch was coordinating with the media, Ambulance Victoria and the hospitals to cope, it was determined that capacities were breached across all agencies. There were no plans or arrangements for reducing risk, but concerns resulting from the impacts of the heatwave have boosted evaluation of heatwave planning policies, and the development of more comprehensive plans such as the 'Heatwave Plan for Victoria 2009–2101' and the 'Extreme Heat Arrangement Plan' in South Australia (QUT, 2010, p6). Better strategies to identify and manage the hazards and risks specific to such events and who owns such risks should be in place for future events.

References

Jones, R. N., Young, C. K. and Handmer, J. (2012). *Beyond the mean: valuing adaptation under rapid change*. Climate Change Working Paper No. 17. Centre for Strategic Economic Studies, Victoria University, Melbourne.

Queensland University of Technology. (2010). *Impacts and adaptation responses of infrastructure and communities to heatwaves*, report for the National Climate Change Adaptation Research Facility, Gold Coast, Australia.

Case Study 3: Victorian Grampian Landslides, 2011

On 12–14 January 2011, 282 mm of rain fell at Hall's Gap in the Grampians. It was the heaviest fall in 72 hours since 1876 and a one in a 100-year event (and ending in the highest monthly total on record for January of 297 mm). The downpour resulted in severe flash-flooding, and landslides. The heavy rain caused flooding in 95% of the Northern Grampians Shire, impacting 800 roads and 423 properties. The landslides occurred within the Grampians National Park, many extending up to three kilometres in length, cutting three arterial roads, and damaging many more roads, walking tracks, 11 vehicle and 21 pedestrian bridges and other infrastructure. The park was almost totally closed, halting the major local tourism industry. Relief and recovery was estimated to cost $140 million, while estimated tourism losses of $25.5 to $30.5 million affected the broader Grampians area.

There were no injuries or death, and impacts on individuals were short-term. However, many businesses, private property, and government and civic buildings and infrastructure were severely damaged. An estimated $140 million spent on rebuilding road, path and bridge infrastructure translated into flow-on economic benefits for the region of $340 million (ten times tourism losses), but the beneficiaries were largely a different group to those experiencing tourism losses. Impacts on local water supply and environment damages to the areas affected have not been assessed for their economic effects. Lake Bellfield, the region's main water supply, having been affected by fires in 2006 and floods/landslides in 2011, is still unfit for drinking.

With regards to ownership of risk issues, no-one remembered such an event occurring in the past so it was completely unexpected. It was also found that there was no dedicated state agency for landslides, so responsibility for landslide management needed to be adopted in hindsight. Funding from the Australian Government-State Natural Disaster Relief and Recovery Arrangements (NDRRA) was provided involving federal, state and local government. Local government and authorities put in place response and recovery plans afterwards to coordinate responsibilities, thus taking ownership for future events. There was a lack of connection between tourism, parks and operators during the recovery, though visitor numbers did recover in the second year. Local ownership was demonstrated through people who went above and beyond their roles to assist. Infrastructure was improved to mitigate future damage. Lastly, it was found that story-telling and celebration was important for closure and community strengthening.

Reference

Ollerenshaw, A., Dalhaus, P., McDonald, K. et al., (2014). *Understanding the 2011 Grampians Natural Disaster, addressing the risk and resilience*, Centre for eCommerce and Communications, Federation University, Ballarat.

Case Study 4: Black Saturday bushfires, 2009

On 7–8 February 2009, the extreme heatwave conditions in southern Australia culminated in one of Australia's worst natural disasters, the Black Saturday bushfires in Victoria. Authorities had previously warned forests and grasslands were the driest since the Ash Wednesday fires in 1983. On 7 February, temperatures reached 46.4 degrees in Melbourne (the highest since records began in 1859), with 2% humidity. Storm force winds and a late wind change in the afternoon of 7 February altered the direction of fire, and the fire front spread and extended. The CFA and DSE attended 316 scrub or forest fires on that day alone. Power lines in Kilmore North fell in high winds sparking the deadliest fire. On 9 February, the Victorian Premier announced the establishment of a Royal Commission of inquiry (Teague, et al. 2010. p1). The Commission produced 67 recommendations covering everything from bushfire warning systems to the 'stay or go' policy.

The most serious consequence of the fires was the death of 173 people (compared to 75 in the Ash Wednesday fires). Over 400 people were injured, 2,056 homes destroyed and 400,000 ha burned (CFA nd). There was enormous damage to properties, infrastructure and the environment, including loss of livestock, hay and grains. The royal commission estimated the total cost to be more than $4 billion, of which $1.3 billion was covered in insurance payouts (Teague, et al. 2010). The health sector's service delivery was struggling, with 414 people suffering mostly with fire-related injuries needing care. Hospitals, emergency services and ambulances were stretched beyond capacity, and even a taxi had to rescue a disabled person from her burning home (Flitton, 2009). Ageing electricity assets contributed to three fires. The Commission reported that, '… continuing fires, inaccessible roads and loss of power and telecommunications hindered relief efforts and interfered with communication and mobility. This stress on the system brought into focus some community concerns about initial relief and recovery processes.' (Teague, et al. 2010. p16).

Long-term impacts included loss of businesses and loss of jobs in the entire region. The thriving tourism town of Marysville, who lost 39 people and 590 homes, has seen a dive in tourist numbers. From June 2009 to June 2013, just 19 properties sold, 12 of those in the past two financial years (Argoon, 2014). Six years later, the population has dropped to 250 from the 700 recorded before the fires (Teague, et al. 2010; Morris, 2015).

Shortcomings identified by the Royal Commission included the fact that no single agency or individual was in charge of the emergency. Not only were geographical boundaries crossed, but institutional coordination, command and control was beyond any single institution. The Royal Commission stated, 'The number of fires that needed to be tackled simultaneously, and their intensity, created enormous challenges and risks for firefighters on Black Saturday. At times, conditions were chaotic on the fireground, communications were difficult, and supervisors and crew leaders were required to manage in extreme conditions.' (Teague, et al. 2010. p10). Capacity of services in all areas were overwhelmed.

References

Argoon, A. (2014, 30 January). Marysville rises from the ashes five years after Black Saturday. *Herald Sun*.

Country Fire Authority (CFA). About Black Saturday. CFA Website. Melbourne.

Flitton, D. (2009, 9 February). Molly flees the scene of 61 good years in a cab. *The Age*.

Morris, M. (2015, 13 January). Black Saturday rebuilding led to 'underutilised' infrastructure that pushed rates higher, residents say. ABC News.

Teague, B., Mcleod, R., and Pascoe, S. (2010). *Final report: summary*. 2009 Victorian Bushfires Royal Commission (VBRC), State of Victoria, Melbourne.

Appendix C: Emergency-related risk management principles (NERAG)

A number of principles underpin and support effective emergency-related risk management. These principles are articulated in AS/NZS ISO 31000:2009 and are applied to emergency management below. In applying the risk assessment methodology, governments, organisations and communities need to remain mindful of the importance of these principles, ensuring that emergency-related risk management:

- **creates and protects value** – risk management contributes to the wellbeing, sustainability and resilience of human health, the environment, the economy, public administration and social setting
- **integrates into all organisational processes** – risk management is a mainstream activity that is most effective when integrated into standard business practices of organisations, governments and communities
- **informs decision-making** – risk management supports informed decision-making and prioritisation of scarce resources for risk reduction activities
- **explicitly addresses uncertainty** – risk management recognises and accounts for uncertainty of supporting data and information when undertaking risk assessments
- **is systematic, structured and timely** – consistent, reliable and comparable results are achieved when risk management is systematic, structured and timely
- **is based on best available information** – best available data and information on risks, hazards, exposure and vulnerability are applied from a variety of sources, including historical data, forecasts, modelling, spatial atlases, metadatabases, observations, community input and expert judgement. Decision makers can still derive useful results despite the limitations of data, modelling and the possibility of divergent opinions among experts
- **is tailored** – the approach is fit for purpose and aligned with societal needs, the context and risk profile
- **considers and takes account of human and cultural factors** – the capabilities, perceptions and intentions of individuals, stakeholders and the risk study team should be taken into account in emergency-related risk management processes
- **is transparent and inclusive** – risk management includes stakeholders and, in particular, decision makers in an appropriate and timely manner
- **is dynamic, iterative and responsive to change** – risk management responds to changing risk profiles and emerging information on hazards, exposure and vulnerability. When monitoring and reviewing of risks is effective, this process can identify when risks emerge, change or disappear
- **facilitates continual improvement** – effective risk management relies on the development and implementation of strategies that improve a government, organisation or community's risk management maturity. Such an approach underpins a resilient and an adaptive community.

Consistency with these principles is integral to effective risk management. As part of using NERAG, and on an ongoing basis, organisations should ensure that their approach to risk management is consistent with these principles. Technical report *ISO/TR 31004:2013 Risk management – guidance for the implementation of ISO 31000* contains advice on implementing the principles of risk management.

Appendix D: NERAG engagement framework principles

The follwing is an excerpt from Handbook 6.

There are three fundamental principles for effective community engagement in the emergency management context. Each of these principles is supported by some key actions.

1. Understand the community: its capacity, strengths and priorities

The knowledge, experience and shared history of communities are invaluable resources that emergency management practitioners should draw upon. They know how they functioned pre-disaster and what they aspire to post-disaster. They can be trusted to identify solutions to mitigate against the risks they face.

Understanding communities is the first step in harnessing this knowledge and effective engagement. Practitioners need to recognise this and take the time to appreciate the environment they will operate in. This involves identifying and understanding networks and relationships, and working in partnership with existing and emerging community groups and leaders. Developing understanding involves putting time and effort into creating trust and building relationships across all phases of emergency management: before, during and after an event. It recognises that community engagement in the emergency management context is a long-term process and, to be most effective, must take place well before an event occurs and continue long after it is over. It is a two-way communication process where each participant can learn and benefit from the knowledge and experience of the other. People will get involved and stay engaged if their input is respected and valued.

Understanding the community involves:
- respecting and using local knowledge and experience
- tapping into existing networks
- identifying and acknowledging community capability and sharing resources
- appreciating the risks faced by communities
- assessing risk and levels of community awareness and preparedness.

2. Recognise complexity

Effective community engagement recognises the inherent complexity in engaging with the community. It embraces community diversity, including groups or individuals with specific vulnerabilities, and formulates strategies to engage in meaningful, inclusive and culturally appropriate ways. To be effective, practitioners will seek to understand the needs of the community, taking into account gender, age, culture, ability, and challenges such as geographic isolation, inadequate services or infrastructure, transient populations, accessibility issues and entrenched disadvantage. Practitioners must also recognise that in any community there will be differences of opinion, experience, knowledge, resources and capacity.

Community engagement that recognises complexity involves:
- embracing and respecting difference and diversity, including different perceptions of risk
- using genuinely respectful and flexible approaches
- identifying and addressing barriers to engagement and making participation accessible to all
- recognising that communities evolve and change over time.

3. Partner with the community to support existing networks and resources

Every community has networks, structures and ways of working that are familiar and meaningful to its members. The formation of partnerships that connect with and reflect these characteristics is crucial to effective community engagement. Partnerships should be based on mutual interests, values and goals for increased disaster resilience, creating a sense of shared responsibility, and a commitment to coordinated planning and response. Partnerships are about community members being 'at the table', being listened to, and being able to influence and make decisions on issues that affect themselves and their community. Often the most complex and pressing problems are resolved through engagement with local knowledge, experience and capabilities.

Partnering with the community to support existing networks and resources involves:
- building and maintaining partnerships
- fostering relationships with community leaders
- respecting community choices
- aligning emergency management activities to build on existing social capital
- identifying and employing strategies that empower local action.

Appendix E: Using hazard-based scenarios

Scenarios are a tool developed to undertake strategic planning in an environment facing multiple risks. They have been developed for situations where uncertainty is too large for conventional forecasting tools to be used. They are not a predictive tool that will inform what the future *will* be, but one that uses credible knowledge to show what the future *might* be. Use of scenarios by certain sectors, such as the military and business, is well-established. Scenarios are widely used to gain the understanding needed to develop strategies to manage risk and to assist planning and actions of possible future events.

Scenarios have two main uses:

1. To explore the effects of uncertain changes on a future situation using a sound evidence base for making projections. Several scenarios may be used to explore a plausible range of uncertainty covering key drivers of change. These are known as exploratory scenarios.
2. To explore what may happen if different sets of rules, values or goals are imposed on a situation. For example, to explore the effect of policies designed to increase sustainability, resilience or pathways for economic development. These are known as normative scenarios.

Scenarios exploring hazards or disaster/catastrophe scenarios are concerned with how one or more events may affect a system. To address risk ownership, a scenario needs to contain one or more events that cascade though the system of interest and have long-term consequences. In terms of severity, this places events at the high end of plausible risk, which aligns well with the need for disaster risk analysis to plan for events up to and including the worst case.

Constructing scenarios

Scenarios need to have a narrative or storyline. Situations and events represented within the scenario need to be plausible with a sound evidence base. Situations can be 'stretched' beyond conventional understanding if there is a sound case for doing so (e.g., proposing events more severe than the event of record based on a theoretical understanding of how climate may change).

The elements of a hazard-based scenario require an event or events, a description of the key elements of exposure covering the major values put at risk, a social and physical description of the area of interest and, if needed, a backstory describing conditions preceding the event (e.g., a severe flood following a long drought) and any external factors needed to round out the scenario (e.g., social, economic or political factors coming in from outside). The scenario can be undated (e.g., an event happening any time) or dated, allowing projected changes in events and/or exposure to be quantified.

When workshop participants come from different locations and the workshop focus is not location-specific, the area being investigated should be fictitious but familiar. The scenario location is modelled on one or more familiar places but different enough to not be identifiable as any specific place. This allows the participants to leave their baggage at the door but bring their experience to the table. If the assessment is focused on a specific location (e.g., town, suburb, region or community), then the physical situation can be described faithfully, but the social settin needs to be noticeably different; e.g., by placing the event in the future and making the people involved different to incumbent community. This will also allow changes in exposure to be included in the narrative.

Specific numbers attached to events or drivers of change may not be needed unless they will have a meaning for most of the participants. For example, providing depth of floodwaters, number of properties at risk, severity of bushfire may be very helpful if it provides focus without requiring technical skills to interpret. If the workshop group is technically adept, then the scenario can be more quantitative. This may also apply if there is an opportunity to do live simulations with computer models.

Scenarios prepared beforehand need to be put together by a skilled scenario writer who has some experience of scenario use within a workshop situation.

Applying scenarios

The scenarios used by the project to explore risk ownership were designed as part of a workshop program that is fully described in the workshop report (Young, C., et al. 2016). This was a guided exploration into values at risk and their ownership, impacts and consequences and risk actions. The template for the impacts and consequences exercise is shown below. The scenarios themselves described a region and its setting, a design event (flood, bushfire or heatwave) and key vulnerabilities.

As methods for strategic planning for natural hazards are still under development there is a great deal of potential for the development and use of scenarios throughout the planning process. The scenarios described here are hazard-based and exploratory but potential areas for expansion include:

■ Experiential or role-play scenarios where participants 'act out' a particular storyline to gain greater understanding of how they would respond in certain situations. For example, appointing different people as risk owners in a scenario where ownership is shared, competing and ambiguous provides insights into the relationships between different types of ownership and how it is shared and transfer is negotiated.

- Scientific scenarios provide a greater level of quantification than most and are often used where some form of modelling or formal analytical assessment is likely to take place. These are prominent in climate change impacts and adaptation assessment and are being further developed to assessing changing climate-related hazards. These can be presented in many formats: such as visual, aural or written. Scenarios of changing exposure, through population growth and development pathways may also contribute.
- Gaming-based scenarios where issues are explored or examined through a structured game (e.g., war games, disaster simulations).
- Issues-based scenarios where a specific issue will be focused on and examined through a number of lenses. For example, a regional economy can be 'shock-tested' to see how resilient productivity across key sectors is to sequences or combination of events.
- Capacity-building scenarios where various actions and qualities such as resilience are explored for their ability to reach specific goals through the improved management of natural hazard risk (e.g., building 'safe' futures and resilient pathways).

Table E1 Scenario exercise phases.

PRIOR TO SCENARIO EXERCISE (Divergence of ideas)	DURING THE SCENARIO EXERCISE (Exploration of ideas)	COMPLETING SCENARIO EXERCISE (Convergence of ideas)
Unmanaged uncertainties Multiple perspectives Confusion Unrestrained ideas	Investigation Analysis Visualisation Clarification	Clarification New learnings New perspectives Insight

Example scenario: Forested upland region (risk of firestorm)

This is a hilly, mountainous and forested region of the central uplands. Sixty-five percent is forested. The region also contains horticulture requiring winter chill, numerous boutique wineries and is an area of winter sports-summer recreation with bike-riding becoming more popular. The regional population is 25,000, mainly in small towns and villages. The region also contains important water catchments feeding the capital city and rural towns, in addition to some irrigation supply. Hydro power generation is critically important within the region.

Most of the regional income is from agriculture, tourism including food tourism and forestry. Both local timber milling and high volume pulp export take place. However, the region is also a very important water source, although little of it is consumed in the region.

Transport is mainly by road, but due to the mountainous terrain over half of the region is not highly networked, meaning that many areas are only fed by one or two routes.

Design event: the region is most vulnerable to firestorm conditions occurring during catastrophic fire danger conditions. Modelling has indicated which areas are most at risk of burning and where likely refugia occur, but also points to the potential that if a high proportion of vulnerable areas went up, available resources would be exceeded and a high degree of 'triage' required.

Worst case would see several communities devastated from an out of control fire, with major disruption to local infrastructure and commercial activities. Increased event frequencies and other hazards (e.g., flash flooding) could upset long-term recovery

Key vulnerabilities:
- A number of towns and villages are vulnerable.
- The dispersed population in the region means that in the worst case, many people who remain in high fire danger areas would be fending for themselves.
- Flash flooding following firestorm events, with debris flows, etc., has been recognised as a threat to water supply, especially of potable water.
- Quadruple whammy effect on food, forest, fun and water (smoke tainted wine, water quality loss, tourism interruptions and forestry resources).

Appendix F: Values-at-risk examples

EXAMPLE OF VALUES IDENTIFIED DURING MAPPING VALUES AT RISK EXERCISE	
VALUE	**CATEGORY**
FLOOD	
1. Micro economy (boutique)	Economic
2. Manufacturing	Economic
3. Livelihoods	Social
4. Agriculture	Economic
5. Tourism	Economic
6. Climate high level forest and environment	Environmental
7. Emergency services and management agencies	Social
8. Levee, bridges infrastructure (roads, lifelines, communication, irrigation, railway)	Built infrastructure
9. Welfare and wellbeing	Social
10. Homes and placement	Social
11. Faith, values and placement	Social
12. Waterways	Environmental
13. Schooling and education	Social
14. Sports and recreation, community activity	Social
15. Heritage	Social
16. Security	Social
17. Governance and leadership, strategic planning	Social
18. Social cohesion	Social
19. Amenities	Built infrastructure
20. Social cohesion	Social
21. Cultures and community diversity	Social
HEATWAVE	
22. Economic wellbeing	Economic
23. Law and order	Social
24. Health services	Economic
25. Health	Social
26. Isolation (connectivity)	Social
27. Communication	Social
28. Fire risk	Environmental
29. Flood risk	Environmental
30. Water	Environmental
31. Transport	Built environment
32. CALD communities	Social
33. Economic wellbeing	Economic
34. Social needs	Social
35. Parks and reserves	Environmental

FIRE	
36. Income	Economic
37. Tourism	Economic
38. Local business	Economic
39. Recreation and sport	Social
40. CALD (refugees/asylum seekers), tourists?	Social
41. Human health (physical and mental)	Social
42. Life	Social
43. Death	Social
44. Quality of life	Social
45. Health services	Economic
46. Pickers	Economic
47. Mentally unwell	Social
48. Old people	Social
49. Homeless people	Social
50. Tourist and caravan	Economic
51. Low income	Economic
52. Community connectedness	Social
53. Community cohesion	Social
54. Roads	Built infrastructure
55. Native plantation	Environmental

Appendix G: Example scenario exercise template

IDENTIFICATION OF IMPACT AND CONSEQUENCE			
RISK	**POST-EVENT – 12 MONTHS**	**12 MONTHS – 2 YEARS**	**2 YEARS +**
Social			
Environmental			
Economic			
Built Infrastructure			

Appendix H: Example mapping of risk and consequence outputs

VALUE	HAZARD	RISK CATEGORY	2–12 MONTHS	1–2 YEARS	2 YEARS +
Livelihoods	Fire	Economic	■ Loss of income and income potential ■ Lack of local skills/tech expertise ■ Decrease in property value ■ Risk decreased potential investment	■ Loss/disruption of tourism and primary production ■ Increased costs to rebuild and reinsure ■ Risk skill erosion	■ Loss of economic, social environment ■ Risk ghost town
Livelihoods	Fire	Built environment	■ Disruption of essential services ■ Loss of built environment (home and shelter) ■ Damaged road infrastructure and loss of supply network ■ Risk fracturing social community	■ Loss of services due to lack of trust in government and agencies ■ Risk inability to sustain services due to lack of built environment	■ Increase of insurance costs ■ Risk of lack of affordable housing for locals
Livelihoods	Fire	Social	■ Community discombobulation (falls apart) ■ Fracturing social community ■ Movement of people, relocated ■ Grief risk withdrawn, disconnection, disruption ■ Risk of breaking trust with government and agencies and between community members	■ Resentment conflict ■ Risk fracturing social/community ■ Domestic violence/breakdown of families ■ Risk government agencies not able to service the community ■ Influx of new individuals into community	■ Risk of increasing inequity ■ Loss of continuity ■ Loss of long-term trust ■ Loss of community ■ New communities at higher risk due to not understanding the risk ■ Risk of increasing inequity ■ Loss of continuity
Livelihoods	Fire	Environmental	■ Risk loss of species ■ Mortality of plants and animals ■ Disruption of ecosystem services	■ Loss of environmental productivity and ability to support economic life ■ Loss of community	■ Loss of economic, social environment ■ Risk ghost town

Impacts: Metro Peri-urban

Timeframe

Institutions: Federal Government · State Government · Local Government · Community · Business and Industry

Immediate (0–2 months)

- Emergency funds
- Coordination emergency response
  - ■ Relocation cooordination
  - ■ Fresh water provision
- Local hospital capacity – access to hospital effects patients, employees
- Relocation of people
- Road and transport infrastructure
  - ■ Damaged ports, roads
  - ■ Public transport
- Elderly people – lack of services
- Dead and injured people
- Emergency services to community
- Environmental health: food quality and health risks, water quality effected provision of fresh water, food shortages
- Tourists and local people stranded
- Utilities – blackouts, secondary issues of loss of food and potential health issues
- Logistics and businesses interruption
- Tourism industry loss/interrupt ports
- Damage to business assets
- Crime and looting
- Managing those with chronic health issues

Short to medium-term (2 months–2 years)

- Funding for infrastructure
- Prearranged contracts
- Changes to planning and regulatory schemes
- Pressure for development on high ground
- Infrastructure changes economic (e.g., port closes)
- Changes in demographic
- Pyschological impacts
- Insurance increase in premiums flow-on effects
- Increased costs
- Business closures
- New opportunities (e.g., construction)
- Devaluing of some properties, increase in others
- No insurance, disputes, indemnity

Long-term (2 years and beyond)

- Improved construction standars
- Loss of forest – changed catchment
- Hydrology – potentially more flooding
- Increased preparedness
- Increase of family break-up and domestic violence
- Degraded environmental

Adapted from Jones, et al. (2013). This mapping exercise output shows a visual representation of impacts mapped from the response phase across a strategic timeframe.
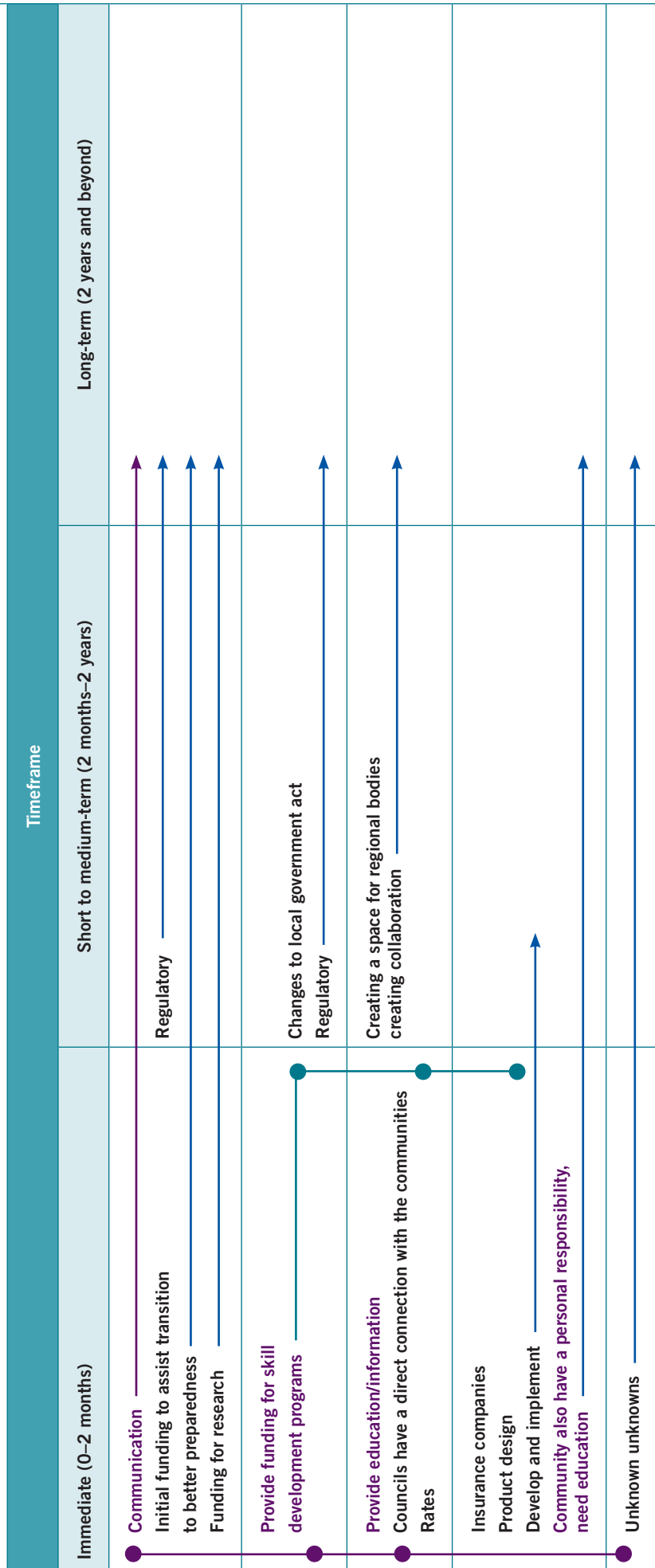
Appendix I: Example short and long-term activities outputs

SHORT AND LONG-TERM RISK ACTIVITIES		
HAZARD	**SHORT-TERM**	**LONG-TERM**
Flood	1. Public flood plans publicised seasonally 2. Floodwatch seasonal planning 3. Flood warning, social media, phone trees 4. Floodsafe for vulnerable people, house ready and evacuation plans 5. Strategic prep, pre-flood (planting, weed control) 6. Levee bolstering 7. Levee stabilisation 8. Develop code for rebuilding, damaged buildings	1. Education on weather and floods 2. Community involvement in local emergency management committees 3. Actions that help build strong harmonious cohesive communities 4. Community driven preparedness strategies 5. Environmental management and flows program for extreme events 6. Siting of caravan parks (problem of who pays, existing use rights) 7. Flood insurance clarity, legal reform, planning support 8. Business continuity planning 9. Develop code for rebuilding, damaged buildings
Fire	1. Community preparation campaigns 2. Community street meetings 3. Facilitatory knowledge exchange 4. Contextualise risks in a personal context 5. Evacuation emergency planning plans 6. Strategic prep, pre-flood (planting, weed control) 7. Identification documents – company awareness of how to respond strategies 8. Accessible insurance essentials 9. Contract preparation arrangements for accommodation within the community for areas affected 10. Encourage facilities (e.g., aged care to network and share resources to temporarily accommodate residents, establish networks) 11. Building infrastructure, retrofit campaign, hazard management 12. Pre-incident planning and response capability 13. Reduced insurance premiums for built environment resilience measures	1. Recontextualise risk around loss of livelihood 2. Run research on social demographic to understand cultural vulnerability 3. Pre approve access to low interest loans to cover costs 4. Alternative work options ready to activate, recovery planning 5. Adaptive management of parks and forests 6. Land use planning and conservation offsets 7. Fire impacts on catchment hydrology research 8. Encourage participation in community Bushcare programs 9. Encourage community investment in natural areas 10. Business continuity planning 11. Diversify economic sectors 12. Land use planning controls 13. Building controls 14. Project management for reconstruction to reduce costs 15. Regulation to protect vulnerable people, build local economy, use local leverage, stop profiteering 16. Plans in place for facilitating development approvals

Metro Peri-urban risk: lack of preparedness of local government

Who is responsible for developing and implementing actions?
What resources do you need, and who provides these?

Priority areas of action: funding, information, coordination, skills development and communication

Timeframe

Immediate (0–2 months)	Short to medium-term (2 months–2 years)	Long-term (2 years and beyond)
Communication		
Initial funding to assist transition to better preparedness	**Regulatory**	
Funding for research		
Provide funding for skill development programs	Changes to local government act **Regulatory**	
Provide education/information		
Councils have a direct connection with the communities	Creating a space for regional bodies creating collaboration	
Rates		
Insurance companies		
Product design		
Develop and implement		
Community also have a personal responsibility, need education		
Unknown unknowns		

Adapted from Jones, et al. (2013). This mapping exercise output shows a visual representation of impacts mapped from the response phase across a strategic timeframe.

Appendix J: Evaluation

What is evaluation?

Evaluation is the periodic and systematic gathering and study of data to make judgments about the worth of City of Melbourne's work and affect decisions and learning with useful feedback.

Monitoring refers to setting goals and targets for an activity and then systematically gathering and studying data to track progress, achievements and whether inputs are producing the planned outputs over time. It checks whether the project is consistent with the design.

The goal of evaluation is to influence learning and decisions by giving useful feedback to people who will apply it.

The planning-evaluation cycle

Evaluation and monitoring is often considered part of a larger planning and evaluation cycle (Figure J1).

The first stage is the planning phase. It is designed to understand the problem or issue to address and select the best approach from the alternatives available.

The evaluation (do) phase can also include the formulation of the major objectives, goals, and hypotheses of the program, implementation of the evaluation, study of the data, and the use of the results (review).

Types of evaluation

Formative evaluation

Formative evaluation can more qualitative than summative evaluation. It is often process oriented because it happens in the lead up to a project and during its implementation and is used for program development. It aims at understanding what makes a project work (process) as well as improving it while it is being implemented.

Questions for formative evaluation can include:
- What is the need, how great is the need, and what might work to meet this need?
- Who are the target recipients of the program?
- Who are the key stakeholders for this activity and what is their role?
- How feasible is this activity?
- What is the process for delivering this activity?
- How well is this being delivered?
- Is it meeting expectations, if not why?
- What is working and what isn't?
- What adjustments can be made to improve the program?
- What are the learning for this process so far and who do we need to share these learnings with?
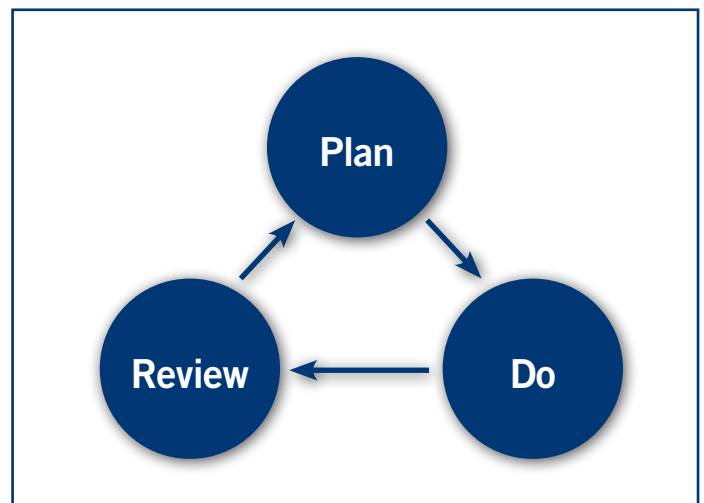
Figure J1 The planning-evaluation cycle.

Summative evaluation

Summative evaluation looks at the entire program cycle and considers short to long-term outcomes. It takes place during and after a project's implementation, uses more objective, quantitative methods and aims to show if it worked. The key tasks for this type of evaluation are:

Summative questions can include:
- How well did the project meet its objectives/goals?
- What has been its impact on future objectives and goals ?
- How efficient was the program?
- How effective was the program?
- What changes has this program produced any changes and if it has, what were those changes?
- Has the project resulted in any unintended outcomes and if it has what were they?
- What worked and what didn't work and what lessons did you learn from this?
- What were the benefits of this program (monetary and non monetary)?
- Did the program deliver value for money?
- Is this program or are aspects of the program sustainable for the future?
- Should the program continue?
- What recommendations emerged about where to from here?

Formative and summative evaluation can be carried out concurrently as they can inform one another.

Evaluation models

The four broad research models from which evaluation approaches borrow are:
- Scientific-experimental models emphasise impartiality, accuracy, objectivity and validity of the information collected.
- Management-oriented models are designed to serve the needs of decision makers. They emphasise comprehensiveness, placing evaluation in the context of the organisation's objectives and activities.
- Qualitative/anthropological models use observation and subjective information. Approaches often place fewer constraints on evaluators and use multiple techniques including participant observation, interviews, focus groups, and textual analysis to get a description of the issue being studied.
- Participant-oriented models use many different sources; don't follow a standard plan; and include approaches such as inductive reasoning (reasoning from experience, sense perceptions, and observations to form conclusions); involvement and/or training of intended users.

References

Trochim, W. M. *The Research Methods Knowledge Base*, 2nd Edition. http://www.socialresearchmethods.net/kb (Version current as of May 20, 2013.)

Murray, Aylward, Cooke, Martin and Sidford. *Planning and Evaluation Wizard*. South Australian Community Health Research Unit. www.sachru.sa.gov.au (Version current as of May 20, 2013.)

Nan, S. E.. (2003). *Formative Evaluation, The Beyond Intractability Project*. http://www.beyondintractability.org/essay/formative-evaluation. (Version current as of May 28, 2015.)

Sweeney, D and Pritchard, M. *Community Sustainability Engagement Evaluation Toolbox* ('The toolbox'). National Centre for Sustainability, Swinburne University of Technology. http://evaluationtoolbox.net.au (Version current as of May 20, 2013.)

Stufflebeam (1971, 2000; Stufflebeam & Shinkfield, 1985). CIPP Evaluation Model.

Talyor-Powell, E., and Renner, M. (2009). Collecting Evaluation Data: End of Session Questionnaires. http://learningstore.uwex.edu/assets/pdfs/g3658-11.pdf University of Wisconsin. (Version current as of 9 August 2013.)

Appendix K: Summary of process support tools

This list (adapted from a 2016 internal document by Nick Casey, City of Melbourne), is intended list some of the tools that can be used to as part of the process or to add additional support to decision-making during this process. The tools are divided into three categories:

- **Facilitator tools** are approaches or methods that can be used to undertake part of or all of the process
- **Expert tools** relate to methods or approaches that can be undertaken to support the provision of information or types of assessment that might be undertaken to support decision-making during the process.
- **Facilitator/expert tools** are methods or approaches which can be used as either part of the process or to support decision-making.

What tool is used and is appropriate will depend upon the context and purpose of the workshop, the participants attending, and also the resources available.

Please note: although these tools can be used to support aspects of risk assessment, specific risk evaluation tools are not included in this list as guidance pertaining to these are outlined in the NERAG.

Category	Tools/methodologies	Summative (assesses outcomes)	Formative (strengthens program)	Definition	Quantitative	Qualitative	Efficiency	Effectiveness	Outcomes	Potential application to risk ownership process
		Types			**Type of data collected**		**Evaluates**			
Facilitator	Brainstorming/café style processes		✓	Brainstorming is a method for developing creative solutions to problems. It works by focusing on a problem, and then having participants come up with as many deliberately unusual solutions as possible and by pushing the ideas as far as possible.		✓		✓	✓	Planning and identifying strategic actions
Facilitator	Brain writing		✓	In a group setting, all ideas are recorded by each individual who thought of them. They are then passed on to the next person who uses them as a trigger for their own ideas.		✓		✓	✓	Can be used to develop portfolio of risk actions
Facilitator	Citizen juries	✓	✓	Participants are engaged as a representative sample of citizens with no formal alignments or allegiances, rather than experts. They are briefed in detail on the background and current thinking relating to a particular issue, and asked to discuss possible approaches.	✓			✓	✓	Focuses on structured consensus-making, aspects useful for part assessment or for the whole assessment. Upskills participants
Facilitator	Consensus conference		✓	A consensus conference is a public meeting, which allows ordinary citizens to be involved in assessing an issue or proposal.		✓		✓	✓	Applicable to all assessment activities
Facilitator	Dartboard		✓	The evaluation dartboard is a quick and simple method for participants to rate the delivery of a workshop, training session or similar activity using sticky dots or a marking pen to place a mark on the dartboard based on a rating scale.	✓			✓		Applicable to all assessment activities
Facilitator	Deliberative opinion polls	✓	✓	Opinion polls in which participants are informed via briefing notes and access to experts on a particular issue and have time to consider the issue in detail.	✓	✓		✓		Can be used to support consensus-making
Facilitator	Design charrettes		✓	A design workshop in which designers work intensively on an issue and present their findings in a public forum.		✓		✓	✓	Development of risk actions and assignment of ownership
Facilitator	Fishbowl/Samoan circles		✓	An inner group of participants in a roundtable format involved in a decision-making process that is 'witnessed' by a larger group who have the opportunity for input and questioning.		✓		✓		Can be used to support reflection and decison-making during the process

Role	Method			Description						Application notes
Facilitator	Footprint calculations	✓		Footprint calculators provide a tool to calculate deemed savings based on answers to a set of questions. Theoretically, a footprint calculator can be used to evaluate a participant's footprint before and after an intervention.	✓				✓	M&E implementation of actions to determine whether they deliver benefits
Facilitator	Future search conference		✓	A two-day meeting where participants attempt to create a shared community vision of the future. It brings together those with the power to make decisions with those affected by the decisions to try to agree on a plan of action.		✓			✓	Can be applied to all assessment activities, especially to test attitudes of risk owners and risk sharing arrangements
Facilitator	Nominal group techniques	✓		A group problem solving and decision-making process involving problem identification, solution generation, and decision-making. It can be used in groups of many sizes, who want to make their decision quickly by a vote, but want everyone's opinions taken into account. Vote tallying involves ranking.	✓	✓		✓	✓	Can be applied to all assessment activities
Facilitator	Outcome hierarchy	✓		A part of project design used to clarify the program logic. As an evaluation tool it can be used in formative evaluation for future project design, allowing stakeholders to participate and build their own capacity.		✓		✓	✓	Development of risk actions (pre) and assessment of effectiveness (post)
Facilitator	Photovoice, video and film documentary		✓	Photovoice is a process of collecting information and expressing issues and concerns through photos and film documentary through documenting voice and actions		✓		✓	✓	Documentation, communication and engagement, particularly useful if there are literacy or language issues with participants
Facilitator	Population accountability/future conference		✓	A process of planning that connects community goals and aspirations, data on the state of the community, partners with a role to play in making improvements and recommended strategies we know can work.	✓	✓		✓	✓	Can be applied to all assessment activities
Facilitator	Prioritisation matrix/ group ranking methods	✓	✓	A technique used to achieve consensus within a specific group of participants about an issue. The matrix helps rank problems, issues or values (usually generated through brainstorming or other techniques) by a particular criterion that is important to the project, as defined by the participants.	✓	✓		✓		Consensus-related activities
Facilitator	Scenario testing	✓		Scenarios are a way of developing alternative futures based on different combinations of assumptions, facts and trends, and area where more understanding is needed for your particular scenario project.	✓	✓			✓	Can be applied to all assessment activities
Facilitator	Speakout/soapboxes		✓	A speakout is an event where a group of people give testimony about a particular issue.		✓		✓	✓	Can be used to support understanding of specific issues during the assessment process
Facilitator	Storytelling	✓	✓	A means to obtain information on a project's outcomes from participants' experiences and viewpoints and it generally brings out memorable or momentous experiences.	✓	✓		✓	✓	Communication, engagement and prior to during and following the process
Facilitator	Study circles		✓	The study circle is a simple process for small-group deliberation comprising 10–15 people.		✓	✓	✓	✓	Can be applied to all assessment activities
Facilitator	Visioning	✓	✓	Visioning exercises are used to define and help achieve a desirable future.		✓	✓	✓	✓	Identification of future values and risk management actions to achieve them
Facilitator	Workshops		✓	A structured forum where people are invited to work together in a group (or groups) on a common problem or task. The goals are to resolve issues and build consensus for action.		✓		✓	✓	Can be applied to all assessment activities
Expert/ facilitator	Backcasting		✓	Backcasting is a method of analysing alternative futures. Working backward from a desired future end-point or goals to the present to determine the feasibility of that particular future and the policy measures required to reach that end point. End-points are usually chosen for 25–50 years in the future.		✓			✓	Planning and identifying strategic actions based on goals and targets

Role	Method			Description					Application
Expert/ facilitator	Concept mapping		✓	Structured conceptualisation often involves a diagram that shows relationships between concepts. It can be used as a descriptive and interpretive tool for understanding results from evaluations and applied social research programs. It can combines group processes with multivariate statistical analyses.		✓			✓	Communication and engagement. This also describes the ownership-mapping process
Expert/ facilitator	Structured conceptualisation		✓	A concept map is a diagram that shows relationships between concepts. It is a graphical tool that designers, engineers, technical writers, and others use to organise and structure knowledge.		✓				Communication and engagement. This also describes the ownership-mapping process
Expert/ facilitator	Focus group	✓	✓	A focus group is where a group of people (from around 4–12) are asked questions about their experiences and opinions on particular topics.		✓		✓	✓	Can be applied to all assessment activities, especially to support gathering of information and building a shared narrative. Focus groups can also assess and test ownership perceptions and experience
Expert/ facilitator	Indepth interviews (structured/semi-structured)	✓	✓	Interviews are lengthy, one on one interviews that may last an hour or two, and require specialist skill to use the time effectively, and to elicit relevant and specific information. A semi-structured interview is qualitative with a pre-determined set of open questions (to prompt discussion) with opportunity for the interviewer to explore particular themes or responses further. They're used to understand how interventions work and how they could be improved. It also allows respondents to discuss and raise issues that may not already have been considered. Respondents are limited to a set of pre-determined answers by structured questionnaires, however.	✓	✓		✓	✓	Information gathering prior to assessment
Expert/ facilitator	Mind mapping		✓	An effective method of note-taking and useful for the generation of ideas by associations.		✓			✓	Scoping, values collation, development of actions
Expert/ facilitator	Problem tree/solution tree		✓	Provides an overview of all known causes and effects to an identified problem and is important in planning a project as it establishes the context in which a project is to occur.		✓				Impact and consequence of events
Expert	Audits, counts or stocktake	✓	✓	Undertaking counts, whether they are of fixtures, appliances, materials, or waste usually taken before and after a program, may ask for proof or verification for one-off behaviour changes and can be used to verify reliability of other evaluation methods by comparing what people say (e.g., questionnaires) to they do.	✓			✓	✓	Risk analysis and ownership, setting baselines for measuring change (pre), auditing results (post)
Expert	Baseline CPM schedule (critical path method)		✓	Developed to provide an understanding of how contractors intend to manage subcontractors and execute the project in a timely way. Once published, it can monitor and evaluate what activities are critical to completion by updating the schedule.		✓	✓	✓		Identify ownership of responsibility for risk actions and ownership transfer (pre), implement actions then undertake M&E (post)
Expert	Cost-benefit analysis	✓	✓	A tool for analysing the benefits resulting from particular programs. Can be used in prospect or retrospect. Benefits of a given situation or program action are summed, often with a dollar value and costs associated with taking that action are subtracted.	✓				✓	Cost of strategic risk management program, benefits of impacts and consequences (pre), M&E review of effectiveness of risk actions (post)

Group	Tool			Description						Application
Expert	Cost-effectiveness analysis	✓	✓	A tool for analysing the cost-effectiveness of particular programs. Used in prospect to evaluate strategies for implementing one or more predetermined actions. Used in retrospect to adapt more cost-effective methods of delivery.	✓		✓		✓	Evaluation of different implementation methods for nominate outcomes (pre), M&E review of effectiveness of risk actions (post)
Expert	Deemed savings	✓		Deemed savings refers to using equations or factors to calculate resource consumption savings from a range of actions. The calculations are developed from a set of assumptions that should reflect an average scenario for the action or behaviour.	✓				✓	M&E of implementation of actions. Data from this could be used to inform aspects of the process
Expert	Delphi methods	✓		The Delphi group approach is a technique for gathering data that is similar to focus groups. Delphi groups are comprised of people who have knowledge necessary to analyse a specific problem and they don't have to physically meet.		✓			✓	Can be applied to all assessment activities or information collection prior to this
Expert	Evaluability assessments	✓	✓	An Evaluability Assessment examines the extent to which a project or a programme can be evaluated in a reliable and credible fashion. It reviews a proposed project or programme to ascertain whether its objectives are adequately defined and results verifiable.		✓			✓	M&E actions are planned, assessed for their measurability and developed. Data from this can be used to strengthen aspects of the process
Expert	Expert panel		✓	Expert panels provide highly specialised input and opinion for a project.		✓			✓	Scoping, risk evaluation, planning strategic actions
Expert	Input/output analysis	✓		Estimates of economic activity generated and jobs created that are derived using input/output analysis.	✓	✓	✓	✓	✓	Costings of risk actions, economic
Expert	Literature review		✓	A literature review is a desktop-based research of previous projects and other initiatives that can inform and support the need for a project, as well as provide a foundation for the work to be undertaken.		✓		✓	✓	Pre-workshop/ process activity
Expert	Log frame matrix		✓	Outlines the key features that lead to a project achieving its goal. A four-column by four-row matrix. Rows show: activities, outputs, purpose and goal (bottom to top on the left-hand side). Columns show: objectives, indicator, data source, assumption.		✓		✓		Actions development
Expert	Metering/meter reading	✓		Metering is measuring resource consumption, particularly for electricity, gas and water by reading meters or bills and meter reading refers to getting users to read their own meters.	✓				✓	M&E of implementation of actions
Expert	Monitoring programs in air, water, noise, etc.	✓		Monitoring of air and water quality (as well as sewage) and noise/sound levels, often involving the taking of samples (or readings of volume in the case of sound).	✓				✓	M&E of recovery activities
Expert	Multiple time series assessment	✓	✓	Monitors one or more indicators over time, encompassing periods both prior to and after implementation of a program while also monitoring the same indicator(s) for a non-randomly selected comparison group that did not receive the intervention.	✓			✓	✓	Pre-workshop/ process activity. Evaluation of strategic actions.
Expert	Non-equivalent groups post-test questionnaire or interview	✓	✓	Monitoring outcomes for program participants and a comparison group of non participants matched and selected by characteristics that are considered to be important, rather than randomly recruited. A set of questions for gathering information is applied to both groups after the program.	✓	✓		✓	✓	M&E action effectiveness (post).
Expert	Non-equivalent groups pre/post-test questionnaire or interview	✓	✓	Monitoring outcomes for program participants and a comparison group of non-participants matched and selected by characteristics that are considered to be important, rather than randomly recruited. A set of questions for gathering information is given to both groups prior to and at the end of the program.	✓	✓		✓	✓	Process and action evaluation (pre). M&E action effectiveness (post).
Expert	Observation		✓	Participant observation is a method of collecting information about the operation of, and attitudes existing in, a community through a researcher living in the area for an extended period.		✓		✓	✓	Can be applied to all assessment activities

Expert	Method			Description						Notes
Expert	Randomised one group pre/post-test questionnaire/ interview	✓	✓	Before a program participants are given a short survey to assess their state before and after the implementation of a program, participants receive a set of questions for gathering information.	✓			✓	✓	M&E of implementation of actions, evaluation of the process (post)
Expert	Randomised post-test only (one group) questionnaire/ interview	✓	✓	Following the implementation of a program, participants are given a set of questions for gathering information from them.	✓			✓	✓	M&E of implementation of actions, evaluation of the process (post)
Expert	Randomised post-test only (two group) questionnaire/ interview	✓	✓	A set of questions for gathering information is administered to two groups, one group that didn't participate in a program and another that did.	✓			✓	✓	M&E of implementation of actions, evaluation of the process (post)
Expert	Randomised pre-post program comparison Questionnaire/ interview	✓		An evaluation in which only one measure or indicator is collected before and after the program using a set of questions for gathering information from individuals.	✓			✓	✓	Targeted evaluation for a specific purpose
Expert	Randomised retrospective pre/post-test questionnaire/ interview	✓	✓	Participants in a program receive a set of questions for gathering information afterward, which asks them to assess their state before and after a program.	✓			✓	✓	M&E of implementation of actions. Also can be used for evaluation of the process
Expert	Randomised social experiments	✓	✓	Test the effectiveness of new social interventions/ programs by measuring impacts of alternative program strategies or the 'incremental' impacts of adding new program elements to each other.	✓			✓	✓	M&E of implementation of actions, evaluation of the process (post)
Expert	Randomised two-group pre/post-test questionnaire/ interview	✓	✓	Two groups – one that receives a program and one that doesn't. Both receive a set of questions for gathering information.	✓			✓	✓	Evaluation of actions implemented
Expert	Responsive evaluation	✓	✓	The essential feature of the approach is a responsiveness to key issues or problems especially those recognised by people at the site of program delivery.	✓	✓	✓	✓	✓	Can be applied to all assessment activities (pre) appropriate to risk owners. M&E of implementation of actions (post)
Expert	Simulation (electronically generated)	✓	✓	Simulations attempt to display the outcomes of particular choices through changing the inputs to a computer model that simulates the likely outcomes of a system with choices.	✓			✓	✓	Can be applied to all assessment activities
Expert	Sketch interviews/ visual recording		✓	A visualisation technique applicable to planning, design and problem solving. This tool provides for the visual articulation of ideas facilitated through drawings and sketches.		✓	✓	✓	✓	Can be applied to all assessment activities, particularly useful where the may be language or literacy issues
Expert	Stakeholder analysis		✓	Stakeholder analysis is a term that refers to the action of analysing the interactions and attitudes of stakeholders towards a project. It is a means to identify the relevant stakeholders and assess their views and support for the proposed project.		✓		✓	✓	Engagement and strategic management of participants and collaborators during and following the assessment
Expert	Time series	✓	✓	Monitors one or more indicators (e.g., reported crime) over time, encompassing periods both prior to and after implementation of a program.	✓			✓	✓	Evaluation of long-term strategic actions and goals
Expert	Time tracking		✓	The process of tracking the amount of staff time spent on a project, and what activities the work is related to, so as to provide lessons for future projects.	✓		✓			M&E of project related to auditing and assessing cost effectiveness

Appendix L: Economic evalution methods

Economic evaluation methods are most useful applied between tasks 12 and 13 in the process, but the collection of information will take place through a number of the earlier tasks.

Firm conclusions about costs and benefits in dollar terms are often required for an assessment to be considered valid, and may be a pre-requisite for obtaining funding. The workshops themselves are not designed for undertaking applied economic assessments, which require expert input. By mapping key risks and their ownership, workshops can be used to identify and prioritise further assessment needs. Unless costings are previously available, or are specifically prepared to be part of a workshop process, specific expertise and resourcing will be required to prepare economic evaluations of costs, benefits and trade-offs based on workshop priorities.

Because the risk ownership framework is an all-value, multiple-hazard approach to a system, and because treatments consider both pre and post-hazard actions, the results are more applicable to developing a strategic plan with a portfolio of potential actions rather than assessing a single action. The difference can be seen in two hypothetical strategies: one may propose a levee for a town and evaluate its benefits in terms of avoided property loss, lost income and stress; the other may look at flooding and flood protection, wetland assets, residual risk, the role of water in extreme heat and drought management, water-based recreation and community interactions. The first is a protective strategy, the second is more of a regional development strategy.

The advantage of the second strategy is that ownership is assessed more widely, shared ownership is more likely to be developed, solutions are internal to the community and 'owned' by the community rather than externally applied and that aspects like community resilience that are difficult to implement from outside, are more likely to be developed as part of the process. By also identifying the co-benefits of actions, the opportunity for sustainable development, in addition to protection from disaster, can be pursued. The results can then be developed into a business case for strategic investment. In such cases a variety of economic valuation methods can be applied, ranging from qualitative to quantitative.

Idealised cost-benefit analysis

With perfect information, the economic evaluation and selection of a portfolio of actions designed to manage strategic risk will assess the costs of an event or series of events on a given system, ideally including long-term consequences of damage and loss, and the benefits of acting to reduce those costs. This requires the following lines of information:

■ quantifiable estimates of the frequency and magnitude of events preferably with a climate change component if relevant to the hazard,

■ identification and quantifiable estimates of the resulting impacts and consequences, preferable including projects of change in exposure and their resulting costs in dollar terms, and

■ the costs of implementing treatment actions compared with the ongoing returns of those actions.

This sets a high bar for the availability and quality of data. In circumstances where both the hazards and exposure are changing, it is impossible to assess the outcomes of any single hazard with any accuracy. In these cases, scenarios are required to sample the plausible range of uncertainty. The baseline case will provide a minimum estimate with a degree of risk hedging required through to taking account of the maximum plausible loss.

When taking a values-based all-hazards approach, economic evaluation is made even more difficult because it is doubly impossible to quantify costs and benefits across all values. Reasons include:

■ All values cannot (and should not) be converted into dollar values. For example, community resilience will improve disaster recovery, but to what degree is unpredictable. If justice and equity are built into government disaster policy, then the cost effectiveness of delivering the policy measured against policy outcomes is a good approach.

■ Vulnerabilities may be well understood qualitatively but very difficult to quantify. This means that different types of value can be compared with each other and ranked but not all can be converted into dollar values.

■ Different kinds of value may be co-dependent. For example, a policy and market mechanism may both be needed to produce a benefit. The market mechanism can be costed whereas the policy mechanism is not so easy to cost but the market mechanism will not be efficient or effective without the policy mechanism.

In some circumstances, cost-benefit analysis (CBA) or a related method may be required for funding but may not be the best approach to use. The development of a business case is one way to achieve credible results, with partial CBA undertaken where feasible.

Economic approaches

Orthodox economics deals with individual preferences within the market economy, sometimes adopting non-market methods to convert non-monetary preferences into monetary measures. Orthodox economics is suitable for assessing actions in the built environment and in sectors that have a direct effect on the economy.

The all-values approach extends economic assessments beyond orthodox methods in two ways:

1. Different types of values being exercised in a range of locations – called a polycentric approach because it involves multiple areas of focus. For example, governments, communities and markets can all be involved in a related set of decisions.
2. Different ways of valuing – called a heterodox approach because it applies different kinds of economics. These extend beyond objective methods based on price, to account for ethical values such as justice and equity.

The need for both approaches reflects the diversity with risk owners, types of ownership they have and their roles in exercising that ownership.

Values can be individual, collective or institutional, and each has a different function:

- Individual values cover market and non-market price and preferences.
- Collective values arise out of social interaction and cover areas such as community and culture.
- Institutional values are those that institutions aim for as part of their goals.

Value owners are likewise individuals, groups/communities and institutions. Individuals, and groups and communities can exhibit both individual and shared preferences so it is important that these are treated carefully and not doubled-counted.

Individual values can be assessed through market behaviour and non-market preferences, so span from the tangible (e.g., monetary) to the intangible (e.g., ethical). Collective values include community spirit and social connectedness – things that people do together. Institutional values are at the core of formal and informal rules that guide institutional aims. With respect to the emergency services sector, the sector itself has very strong values regarding disaster risk management and the protection of life and property. However, government more broadly has a range of institutional values that encompass equity, fairness, protection of the vulnerable and are delivered via policy and government services.

Social contracts can be considered as informal arrangements within and between institutions. Business and industry has a social licence to operate, the community has certain expectations of the government's role in an emergency and the government has certain expectations of the community's role in protecting itself. Not all of these expectations may be met and understanding risk ownership within the context of social contracts is very important.

Types of valuation tasks

The following tasks are those where economic assessments are most needed:

12. Evaluate costs and benefits and effectiveness of actions (p 48):
    - What are the direct benefits, indirect benefits and co-benefits of risk management actions and who do they flow to?
    - Who is responsible, who is accountable and who pays?
13. Evaluate trade-offs (p 49):
   - What criteria are being used to estimate trade-offs?

Ideally, criteria for assessing trade-offs are determined beforehand. They can be discussed and ranked within a workshop process, but their reliability may need to be established before a larger community of stakeholders before they can be accepted. Criteria can be based on factors such as cost effectiveness, return on investment, maintenance of specific values, ability to represent policy, ease of implementation, degree of ownership, ease of financing and a host of other criteria. Methods for evaluation can range from informal voting, ranking methods, multi-criteria analysis, return on investment and/or cost effectiveness.

One of the most difficult tasks is weighing up investment between actions taken prior to an event occurring (e.g., resilience, preparedness, mitigation), versus improving recovery after an event. There is no doubt all are needed, because some element of residual risk is unavoidable in almost all cases. This is described in the next section.

Action identification and evaluation context

As outlined in the section on risk actions, there are four main types of action: prevention, preparedness, recovery and resilience. The first three are shown in Figure L1, which is the planning schematic for strategic decision-making that distinguishes between the different types of actions in how they treat hazard risk, and allocate the broad type of benefit (e.g., reduced damage, faster recovery). Resilience will mainly influence response (not covered in the framework) and recovery.
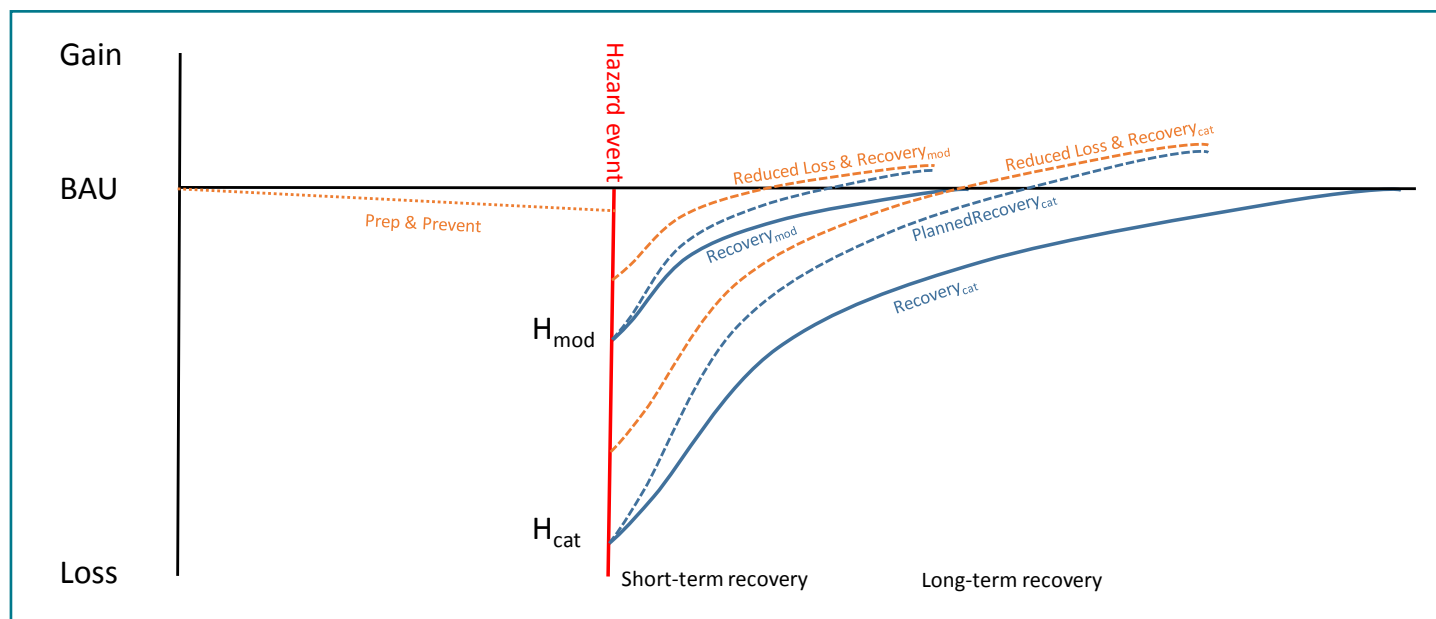
Figure L1 Planning schematic for value-based strategic decision-making looking at changing total value over time. BAU is business as usual without hazards, hmod is a moderate hazard, hcat is a catastrophic hazard. The prep and prevent line denotes cost of investment. The strong blue lines are business-as-usual damages and recovery profiles, the dotted blue lines are with planned recovery, and the dotted orange lines with reduced damage and planned recovery

The 'business-as-usual' (BAU) line shows business as usual without hazards, which includes the economy and broader social-ecological system. A hazard event (the red line), will cause damage and loss depending on its severity interrupting the normal configuration of values. With no particular preparation, prevention or readiness a given amount of damage will occur, depending on the severity of the hazard and level of exposure. In the figure, this damage relationship on the red line looks linear but is logarithmic – catastrophic damages will be several orders above moderate damages, being the difference from a couple of million dollars to over a billion.

The blue lines show a hypothetical recovery line with no strategic planning in place, based on a purely reactive response. The blue dashed lines show recovery if resilience and planned recovery is put in place. The orange dashed lines show that recovery needs are reduced by hazard mitigation efforts. In the figure, the recovery is shown as returning to BAU, but there is no guarantee that this will be the case, especially after a catastrophic event. Sometimes recovery may be incomplete, leaving a region worse off. The specific shape of a recovery is highly uncertain – many regions affected by a catastrophic event do not recover to their former capacity, but others seek to transform in order to be better off.

Most of the evaluation techniques in the following pages are relevant to different contexts, which depend on available data, skills and uncertainty, and to the needs of any business case that needs to be prepared.

Economic evaluation techniques

A wide range of valuation methods exist that may be employed to evaluate benefits and costs. The methods described below are all stand-alone approaches that may be used separately but combined can be used across a range of different kinds of value.

Cost benefit analysis (benefit cost analysis)

Cost-benefit analysis (CBA) is the mainstay of valuation techniques and takes a wide range of forms, ranging from quite prescriptive applications of cost, benefits and discount rates to calculate net present value return on investment through to quite flexible arrangements designed to manage uncertainty and different kinds of value (Hallegatte, 2011). One of the key areas needing development in the natural hazard area is long-run CBA taking in intergenerational equity and accounting for long-lived built and natural infrastructure. The use of social discount rates is justified with the values being assessed under the natural hazard process, and probably at lower rates than most current applications in Australia (Jones, et al., 2015).

Probabilistic cost-benefit analysis

Probabilistic CBA is used when subjective probabilities can be assigned to input assumptions, or when allowing for future uncertainties in hazards and exposure. Real options techniques, also called sequential analysis, minimise the 'cost of error' caused by uncertainty (Hallegatte, 2011; Dobes, 2012). State-contingent CBA also builds flexibility into adaptation (Adamson, et al., 2009), where different activities designed to maintain maximum returns or bolster resilience can be triggered based on a given set of signals. Again, this methodology is suitable for assessing rapid changes in conditions, but diagnosing the correct set of signals is paramount. The largest limitations of CBA are that it is restricted to situations that involve one, or a few decisions, and that it requires sufficient information about the potential benefit to be computable.

Cost-effectiveness analysis

Cost-effectiveness assesses the cost of acting without specific assessments of the resulting benefits. This may be due to an *a priori* decision having already been made, benefits being self-evident, incommensurate benefits and costs, or the benefits of different options are considered to be broadly the same.

Ideally, costing will look at the whole project cost from research and development through to implementation. A weakness of this approach is that often the different options may themselves be incommensurate and the relative benefits uncertain, so 'effectiveness' is very difficult to measure. An example is where a town vulnerable to sea level rise, storm surge and groundwater contamination may weigh up building a sea wall and safeguarding groundwater supplies as opposed to relocation.

Computable general equilibrium modelling

Computable general equilibrium (CGE) models consist of equations describing model variables and a database consistent with the model equations. The equations often assume cost-minimising behaviour by producers, average-cost pricing, and household demands based on optimising behaviour.

While CGE models rely on inaccurate assumptions, they can provide beneficial insight in certain circumstances. They provide useful information around the flow-on effect of extreme events in the economy; an example being the 2010–11 Queensland floods (Hartley, et al., 2011), and also on shorter term trade effects of different impacts. Their basic assumption of marginal change from equilibrium means they are unable to provide meaningful estimates of large future impacts other than in a qualitative way (Ackerman, et al., 2009; Balbi, et al., 2013).

Preference methods

Three formal methods for eliciting value preferences are willingness to pay, willingness to avoid damages, which are both stated preference methods (what people say), and survey of how people behave in given circumstances, or revealed preference. These methods are subject to framing effects, where the first two are asymmetric but measure the same thing (Bateman, et al., 2009), and the second only deals with past but not future values. Aligned with this is a range of survey methods that can elicit peoples' psychological and cultural preferences in order to better understand social and cultural influences on valuation linked to adaptation preferences (Reser, et al., 2011).

Revealed preference methods assume that the preferences of consumers can be revealed by their purchasing habits, but otherwise cannot be obtained through market prices (i.e. national parks, beaches, ecosystems). These methods include hedonic pricing and travel cost methods.

Hedonic pricing models assume that the price of a product (e.g., real estate), reflects characteristics of that product valued by an implicit or shadow price. Hedonic pricing uses secondary data on prices and attributes of different product or service alternatives.

Travel cost method assumes the time and travel cost expenses that people incur to visit a site represent the 'price' of access to the site. Consequently, peoples' willingness to pay to visit the site can be estimated based on the number of trips that they make at different travel costs. This represents peoples' willingness to pay for a service or good.

Shadow pricing

Shadow pricing methods estimate the value of an asset or commodity by the benefits associated with closely linked economic variables. For example, property prices are higher near open space providing shadow prices for the benefits of open space amenity in urban settings (Hatton MacDonald, et al., 2010). It is a method for assessing mean conditions and not suitable for assessing rapid change. However, it has great potential for assessing the co-benefits of adaptations where social and environmental outcomes are important.

Multi-criteria analysis

Multi-criteria analysis (MCA) is extremely flexible in approach. As a fully quantitative technique it will score options according to various criteria, resulting in a combined score that identifies the most optimal outcome. At its most qualitative, it can involve a room full of people with a given set of criteria making a subjective selection from a set of proposals. MCA can also be incorporated into linear programming techniques to combine both qualitative and quantitative techniques.

Qualitative approaches to MCA are vulnerable to the social constructions of the stakeholders making the collective decision. By conducting an institutional analysis (where the respective values of the different participants are made explicit in addition to the institutional value at play), much more well-informed decisions can be made. While a room full of people making a decision can look very imprecise, if they are informed by analyses of value consistent the methods above and a rigorous analysis of the hidden values and assumptions being used at the organisational and institutional level is facilitated, the MCA can be very useful.

Structured ranking methods (e.g., INFFER)

INFFER is structured around CBA, but often does not calculate monetary benefits, though benefits do have to be measurable. Conditions for assessing whether the project is feasible for assessment follow 'SMART' criteria (specific, measurable, achievable, relevant and time-bound) (Pannell, et al., 2010). Asset valuation is scored on a scale of 1:100, which is elicited from stakeholders to ensure all values are represented. The framework contains assessments of uncertainty and risk, a public-private benefits framework, accounts for funding lags, adoption rates, technical feasibility and time-lag for benefits, and factors in discount rates and operating costs.

Its main advantage is that it introduces a rigorous project management and economic structure into a working environment where such tools are generally not used in that way (Pannell, et al., 2010; Pannell, et al., 2013). Most of its application has been in the natural resource and land management sectors, working on environmental issues such as salinity management and land degradation.

Robust methods

Robust decision-making approaches seek optimality for a given situation or best-guess outcome, but instead seek decisions that will perform well over a wide range of plausible climate futures, socio-economic trends, and other factors (Dessai and Hulme, 2007; Groves, et al., 2008; Wilby and Dessai, 2010; WUCA, 2010; Brown, et al., 2011; Lempert and Kalra, 2011). Robustness criteria can often illuminate trade-offs that help decision-makers achieve consensus on actions, even when they do not agree on expectations about the future (Lempert and Collins, 2007). Resilience tends to describe a property of systems, which might be affected by decision-makers' choices (Folke et al., 2010), while robustness is a property of the choices made by those decision-makers.

Methods also exist to summarise trade-offs for decision-makers for multiple objectives and values, and at higher levels of uncertainty, by exploring decisions that are robust over many futures and objectives (Kasprzyk, et al., 2013). Robust decision-making can also be used to satisfy a range of institutional values inherent in the operation of a system, satisfying criteria such as distributional equity, procedural fairness and affordability in the case of water or energy.

The process of robust decision-making is a collective process that brings stakeholders together in dialogue regarding values, vulnerabilities, performance metrics and acceptable risks (Hallegatte, et al., 2012). The use of multiple scenarios allows the possibility of scenarios representing extreme events (Hallegatte, et al., 2012) that can easily test different realisations of plausible rapid change. Such testing would also be able to investigate system resilience, investigating the potential to enhance that resilience and respond better to future events.

Robust decision-making is resources-intensive and the stakeholder process can be unpredictable. If quantitative modelling is being used with a wide range of scenarios, this can also be resource-intensive (Kowalski, et al., 2009; Hallegatte, et al., 2012; Ranger and Garbett-Shiels, 2012).

Bounded cost and trade-off methods

Situations may be resource-constrained where there are only a certain amount of resources available to adaptation, or where low-risk and broadly effective solutions are preferred over others that may be unfamiliar or high-risk, but potentially more effective.

Low-regrets

Low-regrets approaches (sometimes called no-regret) have net benefits under all natural disaster scenarios (Hallegatte, 2009; Hallegatte, et al., 2012). For example, increased disaster risk reduction would have a benefit today and under all potential natural disaster scenarios.

Satisfying over a wide range of futures

Low-regrets adaptations described above are a subset of robust approaches that are widely-recognised (Productivity Commission, 2012) to be a suitable starting point for adaptation investments. Extending the idea of low-regrets adaptations that are of benefit now and under future scenarios, we can utilise formal robust decision-making approaches that are designed to be acceptable under a wide range of futures (Lempert and Collins, 2007). These approaches include minimising the maximum regret (minimax regret) and maximise the minimum (maximin) across a range of potential scenarios.

Soft adaptations

Soft adaptations can offer more flexibility than hard adaptations, and may be able to manage a wide range of conditions. Resilience falls within this category where They are more difficult to predict and cost, so require measures of social rather than economic performance to evaluate and sustain. For example, warning and evacuations combined with insurance may be cheaper in areas subject to storm-tides than dikes and sea walls, and can be readily adapted to new conditions (Hallegatte, et al., 2012).

Environmental accounting

The principles of environmental accounting are very useful for tracing ownership between values at risk and impacts and consequences for environmental values.

The System of Environmental-Economic Accounting (SEEA) became an international statistical standard in early 2012. The SEEA framework links information on the economy and the environment to provide a range of suitable metrics, and an integrated database for policy analysis and decision-making (ABS, 2012).

The SEEA framework counters the historical 'information silo' approach to statistics and provides indicators that directly respond to the requirements of integrated policy-making. For example, indicators derived from the accounts provide the measures for the following issues:

■ What are the impacts on the state of the environment and on other sectors of the economy?
■ How does the impact of natural disasters on natural resources affect measures of the real income of a nation? Are the depletion costs recovered by the government? What is the composition of the wealth of a nation?

Four main types of accounts in the SEEA framework are added to the existing monetary stock and flow accounts of the System of National Accounting:

■ Physical flow accounts record flows of natural inputs from the environment to the economy, flows of products within the economy, and flows of residuals generated by the economy (including water and energy used in production and waste flows to the environment)
■ Functional accounts for environmental transactions record the transactions between different economic units (i.e., industries, households, governments) that concern the environment
■ Asset accounts in physical and monetary terms measure the natural resources available and changes in the amount available, and
■ Ecosystem accounts are structured to summarise information about complex plant, animal and micro-organism communities, their non-living environment interacting as a functional unit and their changing capacity to operate as a functional unit and their delivery of benefits to humanity. These accounts are not yet part of the international statistical standard.

These different accounts can be used to measure changes in environmental stocks and flows to assess both impacts and progress in natural hazard management (ABS, 2012). In particular, they address monetary flows to hazard management, mainly using transactions relating to environmental protection. As such, they can be used to trace costs, benefits and risk owners.

Adapted from:

Jones, R. N., Young, C. K., Handmer, J., Keating, A., Mekala, G. D., and Sheehan, P. (2013). *Valuing adaptation under rapid change,* 90–95. National Climate Change Adaptation Research Facility, Gold Coast.

Jones, R .N., Young, C. K., Symons, J. (2015). *Assessing the Economic Value of Green Infrastructure*. Green Paper. p67. Victoria Institute of Strategic Economic Studies, Victoria University, Melbourne.

References

Australian Bureau of Statistics (ABS). (2012). Completing the Picture – Environmental Accounting in Practice, 4628.0.55.001. p164. ABS, Canberra.

Ackerman, F., DeCanio, S., Howarth, R., Sheeran, K. (2009). Limitations of integrated assessment models of climate change. *Climatic Change, 95*, 297–315.

Adamson, D., Mallawaarachchi, T., Quiggin, J. (2009). Declining inflows and more frequent droughts in the Murray–Darling Basin: climate change, impacts and adaptation. *Australian Journal of Agricultural and Resource Economics, 53*, 345–366.

Balbi, S., Giupponi, C., Olschewski, R., Mojtahed, V. (2013). *The economics of hydro-meteorological disasters: approaching the estimation of the total costs: Approaching the estimation of the total costs,* BC3 Working Paper Series 2013–12. p17. Basque Centre for Climate Change, Bilbao.

Bateman, I. J., Day, B. H., Jones, A. P., Jude, S. (2009). Reducing gain–loss asymmetry: a virtual reality choice experiment valuing land use change. *Journal of Environmental Economics and Management, 58*, 106–118.

Brown, C., Werick, W., Leger, W., Fay, D. (2011). A decision analytic approach to managing climate risks – Application to the Upper Great Lakes. *Journal of the American Water Resources Association, 47*, 524–534.

Dessai, S., Sluijs, J.P.v.d. (2007). *Uncertainty and climate change adaptation: a scoping study,* NWS-E, p95. Copernicus Institute for Sustainable Development and Innovation, Department of Science Technology and Society, Utrecht.

Dobes, L. (2012). *Adaptation to Climate Change: Formulating Policy under Uncertainty,* CCEP Working Paper 1201. p61. Centre for Climate Economics and Policy, Crawford School of Public Policy, Canberra.

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., Rockstrom, J. (2010). Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society, 14*, 20.

Groves, D. G., Davis, M., Wilkinson, R., Lempert, R. (2008). Planning for Climate Change in the Inland Empire: Southern California. *Water Resources IMPACT 10*, 14–17.

Hallegatte, S. (2009). Strategies to adapt to an uncertain climate change. *Global Environmental Change, 19*, 240–247.

Hallegatte, S. (2011). Uncertainties in the Cost-Benefit Analysis of Adaptation Measures, and Consequences for Decision Making. In: Linkov, I., Bridges, T.S. (Eds.), *Climate*, 169–192 Springer, Netherlands.

Hallegatte, S., Shah, A., Lempert, R., Brown, C., Gill, S. (2012). Investment decision making under deep uncertainty – application to climate change, *Policy Research Working Paper Series No. 6193*, 39. The World Bank.

Hartley, J., Thomas, M., Mushtaq, D. (2011). A Regional General Equilibrium Analysis of the 2011 Queensland Flood Disaster. In: Doughney, J., Hoa, T.V. (Eds.), Proceedings of the 41st Australian Conference of Economists, The Future of Economics: Research, Policy and Relevance, pMS91. Victoria University, Melbourne.

Hatton MacDonald, D., Crossman, N. D., Mahmoudi, P., Taylor, L. O., Summers, D. M., Boxall, P. C. (2010). The value of public and private green spaces under water restrictions. *Landscape and Urban Planning, 95*, 192–200.

Kasprzyk, J. R., Nataraj, S., Reed, P. M., Lempert, R. J. (2013). Many objective robust decision making for complex environmental systems undergoing change. *Environmental Modelling & Software, 42*, 55–71.

Kowalski, K., Stagl, S., Madlener, R., Omann, I. (2009). Sustainable energy futures: Methodological challenges in combining scenarios and participatory multi-criteria analysis. *European Journal of Operational Research, 197*, 1063–1074.

Lempert, R. J., Collins, M. T. (2007). Managing the risk of uncertain threshold responses: Comparison of robust, optimum, and precautionary approaches. *Risk Analysis, 27*, 1009–1026.

Lempert, R. J., Kalra, N. (2011). Managing Climate Risks in Developing Countries with Robust Decision Making. In: World Resources Institute (WRI), United Nations Development Programme, United Nations Environment Programme, World Bank (Eds.), *World Resources Report*, 9 World Resources Institute, Washington, DC.

Nauheimer, H. (1997). *The Change Management Toolbook*.

Pannell, D. J., Roberts, A. M., Park, G., Alexander, J. (2013). Designing a practical and rigorous framework for comprehensive evaluation and prioritisation of environmental projects. *Wildlife Research, 40*, 126–133.

Pannell, D. J., Roberts, A. M., Park, G., Curatolo, A., Marsh, S. (2010). INFFER (Investment Framework For Environmental Resources): practical and theoretical underpinnings, 54th Annual Conference of the Australian Agricultural and Resource Economics Society. p10–12. Australian Agricultural and Resource Economics Society, Adelaide.

Productivity Commission. (2012). *Barriers to Effective Climate Change Adaptation*, Productivity Commission Issues Paper. p293. Productivity Commission, Canberra.

Ranger, N., Garbett-Shiels, S-L. (2012). Accounting for a changing and uncertain climate in planning and policymaking today: lessons for developing countries. *Climate and Development, 4*, 288–300.

Reser, J. P., Morrissey, S. A., Ellul, M. (2011). The threat of climate change: psychological response, adaptation, and impacts. In: Weissbecker, I. (Ed.), *Climate Change and Human Well-Being: Global Challenges and Opportunities*, 19–42. Springer Science, New York, NY.

Wilby, R. L., Dessai, S. (2010). Robust adaptation to climate change. *Weather, 65*, 180–185.

Water Utility Climate Alliance (WUCA). (2010). *Decision Support Planning Methods: Incorporating Climate Change Uncertainties into Water Planning*. Water Utility Climate Alliance, San Francisco.

Glossary

Built assets and infrastructure. 'Hard' assets such as housing, business establishments, roads, communications, energy and water infrastructure.

Catastrophic natural disaster. This is an extreme hazard event that affects one or more communities, resulting in widespread, devastating, economic, health, social and environmental consequences, and that exceeds the capability of existing State or Commonwealth Government emergency and disaster management arrangements. An event could be of sudden impact or sustained impact over an extended timeframe.[1]

Disaster. A serious disruption to community life that threatens or causes death or injury in community and/or damage to property which is beyond the day-to-day capacity of the prescribed statutory authorities, and which requires special mobilisation and organisation of resources other than those normally available to those authorities.[1]

Domains. Geographical areas of jurisdiction such as local, state or national government areas or institutional areas, such as the public and private economy.

Emergency management. A range of measures to manage risks to communities and the environment; the organisation and management of resources for dealing with all aspects of emergencies. Emergency management involves the plans, structures and arrangements required to integrate the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to deal with the whole spectrum of emergency needs, including prevention, response and recovery.[1]

Emergency service. An agency responsible for the protection and preservation of life and property from harm resulting from incidents and emergencies. Synonymous with 'emergency services authority' and 'emergency service organisation'.[1]

Hazard. A source of potential harm or a situation with a potential to cause loss; a potential or existing condition that may cause harm to people or damage to property or the environment. Adapted from Emergency Management Australia, 1998[1].

Institution. Rules and norms held in common by social actors (individuals, groups and organisations) that guide, constrain, and shape human interaction. Institutions can be formal, such as laws and policies, or informal, such as norms and conventions. Institutions can influence human interaction through direct control, through incentives and through processes of socialisation.[2]

Mitigation. Measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and environment.[1]

Natural assets and infrastructure. The natural environment, sometimes modified by people, consisting of ecosystems, biodiversity and the biophysical environment of land, soil and water.

Preparedness. Measures to ensure that, should an emergency occur, communities, resources and services are capable of coping with the effects; the state of being prepared.

Prevention. Measures to eliminate or reduce the incidence or severity of emergencies.[1]

Recovery. The coordinated process of supporting emergency-affected communities in reconstruction of the physical infrastructure and restoration of emotional, social, economic and physical wellbeing.[1]

Resilience. The capacity of a system (or organisation) to cope with a hazardous event or shock by responding or reorganising in ways that maintain its essential function and identity. Central to this is the ability to learn, adapt and transform. Adapted from Arctic Council[3].

Response. Actions taken in anticipation of, during, and immediately after an emergency to ensure that its effects are minimised, and that people affected are given immediate relief and support.[1]

Risk. The likelihood of harmful consequences arising from the interaction of hazards, communities and the environment; the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood; a measure of harm, taking into account the consequences of an event and its likelihood.[4]

Risk owner. Asset owner who faces a potential loss. A person or entity that has been given authority to manage a particular risk and is accountable for doing so.[4]

Shared ownership. Where multiple owners hold responsibility of some kind for an asset or a risk.

Social assets and infrastructure. The soft assets of society and communities that bind them together such as health, education, social connectedness, knowledge, clubs and religious groups.

Values. Things considered important because they are useful or appreciated for their existence. Values can be tangible: good and services with a direct monetary value; or intangible: values that do not have an explicit monetary value but are still considered important. Intangible values include environmental and social values such as community connectivity, beauty of a landscape and environmental services such as clear air and water. These values also help to support the economy and enhance resilience.

Residual risk. The remaining level of risk after risk treatment measures have been taken.[1]

Response. Actions taken in anticipation of, during, and immediately after an emergency to ensure that its effects are minimised, and that people affected are given immediate relief and support. Measures taken in anticipation of, during and immediately after an emergency to ensure its effects are minimised.[1]

Mitigation. Measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and environment.[1]

Preparedness. Arrangements to ensure that, should an emergency occur, all those resources and services which are needed to cope with the effects can be efficiently mobilised and deployed. Measures to ensure that, should an emergency occur, communities, resources and services are capable of coping with the effects.[1]

Prevention. Regulatory and physical measures to ensure that emergencies are prevented, or their effects mitigated. Measures to eliminate or reduce the incidence or severity of emergencies.[1]

Strategic decision-making. An ongoing process that involves creating strategies to achieve goals and altering strategies based on observed outcomes.[4]

Strategic planning. A systematic process of envisioning a desired future, and translating this vision into broadly defined goals or objectives and a sequence of steps to achieve them. In contrast to long-term planning (which begins with the current status and lays down a path to meet estimated future needs), strategic planning begins with the desired end and works backward to the current status.[5]

Systemic risk (general). Probability of loss or failure common to all members of a class or group or to an entire system.[5]

Values-based decision-making. A straightforward process for making and communicating decisions based on the most important values. A leader's integrity and credibility in the eyes of others come from a values-driven process, and from transparency and honesty in communication.[6]

References

1. Tasmania State Emergency Services. (1998). *Australian Emergency Management Glossary*. Emergency Management Australia. Commonwealth Government of Australia

2. North, D. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge University Press, UK

3. Plain English ISO 13000 2009. Risk Management Dictionary webpage: http://www.praxiom.com/iso-31000-terms.htm Accessed 2 February 2017.

4. Arctic Council. (2013). Glossary of terms. In: *Arctic Resilience Interim Report*. Stockholm Environment Institute and Stockholm Resilience Centre, Stockholm.

5. Business Dictionary webpage: http://www.businessdictionary.com Accessed 2 February 2017.

6. Centers for Disease Control and Prevention. *Values based decision making, Making good decisions that last*. Sustainable Management Development Program, Department of Human Health and Services, USA.

References

Australian Emergency Management Institute (AEMI). (2011). *Community recovery. Australian Emergency Management Handbook Series, Vol 2.* Australian Emergency Management Institute, Attorney General's Department, Canberra.

AEMI. (2013). *Australian Emergency Management Handbook 6: National Strategy for Disaster Resilience – Community Engagement Framework.* Australian Government Attorney-General's Department, Canberra, ACT.

Allan, N. and Beer, L. (2006). *Strategic Risk: It's All in your Head, Working Paper 2006.01*, School of Management, University of Bath, Bath.

Argoon, A. (2014, 30 January). Marysville rises from the ashes five years after Black Saturday. *Herald Sun.*

Arvai J. L. (2003). Exploring technical and cultural appeal of strategic risk communication: The Fernal Radium Case. *Risk Analysis, 23*(2).

Australian Institute of Disaster Resilience (AIDR). (2015). *Australian Emergency Management Handbook 10 National Emergency Risk Assessment Guideline: Practice Guide.* (Formerly Handbook 11, now Practice Guide 10.1.) Australian Government Attorney-General's Department, Canberra.

AIDR. (2015). *National Emergency Risk Assessment Guidelines. Australian Emergency Management Handbook Series, Vol Handbook 10.* Australian Government Attorney-General's Department, Canberra ACT. doi:978-1-921152-15-3

Australian Public Service Commission. (2016, February). Creating a positive risk culture. http://www.apsc.gov.au/publications-and-media/current-publications/learning-from-failure/creating-a-positive-risk-culture Australian Commonwealth Government. Accessed 22 August 2016.

Burton, I., Kates, R. W, White, G. F. (1993). *The environment as hazard.* Guilford Press, New York, NY, USA.

Bordo, M. D., Antu P. M. (2000). *Are The Financial Crises Becoming More Contagious? What Is The Historical Evidence on Contagion.* NBER working paper No:7900, National Bureau of Economic Research, Cambridge.

Burton, I., Kates, R. W. and White, G. F. (1993). *The Environment As Hazard*, p290. Guilford Press, New York.

BusinessDirectory webpage, definition of strategic planning page: http://www.businessdictionary.com/definition/strategic-planning.html Accessed 1 February 2017.

Carbone, D. and Hanson, J. (2012, 8 March). Floods: 10 of the deadliest in Australian history. *Australian Geographic.*

Cavallo, E. and Noy, I. (2010). *The economics of natural disasters: a survey.* IDB Working Paper Series Washington DC: Inter-American Development Bank. Department of Research and Chief Economist.

CeRDI webpage, Victorian Fire Risk Register-Bushfire Goes Live Accessed 16 September 2016.

CFA media release, Success for Vic Fire Register 10 June 2014, Accessed 10 September 2016.

Colac Otway Shire Maps webpage: http://cos.cerdi.com.au/cos_map.php?view=2018_608854b Accessed 10 September 2016.

Deloitte Access Economics. (2013). *Building our Nation's Resilience to Natural Disasters.* Report for the Australian Business Round Table for Disaster Resilience and Safer Communities, Canberra.

Eckel, C. C. and Grossman, P. J. (2008). *Men, women and risk aversion: experimental evidence.* Handbook of experimental economics results, 1:1061–1073

Emergency Management Victoria. (2014). *Critical Infrastructure Resilience Strategy,* Victorian State Government, Australia

Jones, R. N., Young, C. K. and Symons, J. (2015). *Mapping Values at Risk from Natural Hazards at Geographic and Institutional Scales: Framework Development.* Bushfire and Natural Hazards Cooperative Research Centre.

Jones, R. N., Patwardhan, A., Cohen, S., Dessai, S., Lammel, A., Lempert, R., Mirza, M., von Storch, H. (2014). Foundations for decision making. In: Field, C. B., Barros, V., Dokken, D. J., et al. (eds). *Climate change 2014: Impacts, adaptation, and vulnerability. Volume 1: Global and sectoral aspects.* Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge, United Kingdom and New York.

Jones, R. N., Young, C. K. and Handmer, J. (2012). *Beyond the mean: valuing adaptation under rapid change.* Climate Change Working Paper No. 17. Centre for Strategic Economic Studies, Victoria University, Melbourne.

Hartley, J., Thomas, M. & Mushtaq, D. A. (2011). Regional General Equilibrium Analysis of the 2011 Queensland Flood Disaster. In: Doughney, J. & Hoa, T. V., (eds). P*roceedings of the 41st Australian Conference of Economists, The Future of Economics: Research, Policy and Relevance.* Victoria University, Melbourne.

Hewitt, K., Burton, I. (1971). *The hazardousness of a place: A regional ecology of damaging events.* University of Toronto, Toronto.

ISO. (2009). *ISO 31000:2009 risk management – principles and guidelines.* International Organisation for Standardisation, Geneva.

Kambil, A., Layton, M. and Funston, R. (2005, June). Disarming the value killers, *StrategicRISK*, 10–33.

Kayser, T. A. (2001). *Building team power: how to unleash the collaborative genius of teams for increased engagement, productivity, and results*, (2nd Edition). McGraw-Hill, New York.

Nauheimer, H. (1997). *The Change Management Toolbook.*

North, D. (1990). *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, UK.

Patton, M. Q. (2002). *Qualitative research and evaluation methods*, Sage, Thousand Oaks, CA.

Palomba, C. A. and Banta, T. W. (1991). *Assessment essentials: planning and implementing, and improving assessment in higher education*, Jossey-Bass, San Fancisco.

Public Interest Research Centre. (2011). *The Common Cause Handbook*, ISBN 978-0-9503648-7-2. Public Interest Research Centre, UK.

PwC. (2013). *Black swans turn grey: The transformation of risk*. PricewaterhouseCoopers Limited, Hong Kong.

Ollerenshaw, A., Dalhaus, P., McDonald, K., et al. (2014). *Understanding the 2011 Grampians Natural Disaster, addressing the risk and resilience*. Centre for eCommerce and Communications, Federation University, Ballarat.

O'Sullivan, M. (2011, 4 January). Losses and delays in flooded state, *Sydney Morning Herald*.

Productivity Commission. (2014). *Natural disaster funding arrangements, draft inquiry report*. Canberra.

Queensland Floods Commission of Inquiry. (2012, March). *Final Report*. Brisbane.

Australian Associated Press. (2010, 28 February). Hundreds of roads closed in flooded Qld. *Sydney Morning Herald*.

Queensland University of Technology. (2010). *Impacts and adaptation responses of infrastructure and communities to heatwaves*, report for the National Climate Change Adaptation Research Facility, Gold Coast, Australia.

Schwartz, Shalom H. (2012). An Overview of the Schwartz Theory of Basic Values. *Online Readings in Psychology and Culture, 2*(1). Doi:10.9707/2307-0919.1116

Schwartz, Shalom H. (1992). Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries. *Advances in Experimental Psychology*, 1–65.

Teague, B., Mcleod , R and Pascoe, S. (2010). *Final Report: Summary*, 2009 Victorian Bushfires Royal Commission (VBRC), State of Victoria, Melbourne.

Medhora, S. (2015, 6 January). Emergency Spending must be protected in disaster overhaul – state. *The Guardian*. Accessed 6 September 2016

Wilson, L. (2011, 23 March). Gillard's flood and cyclone levy wins vote. *The Australian*.

World Economic Forum. (2017). *The Global Risk Report 2017*, Edition 12, World Economic Forum Geneva.

Young, C. (2014). *The problem solution framework: process guidance for adaptation practitioners*. VISES Climate Change Working Paper No. 19, Victoria Institute of Strategic Economic Studies, Victoria University, Melbourne.

Young, C., Jones, R. N., Symons, J. (2015b). *Understanding our values at risk and risk ownership*, Workshop Context Paper. Victoria Institute of Strategic Economic Studies, Victoria University, Melbourne.

Young, C. K., Symons, J., Jones, R. N. (2015a). *Whose risk is it anyway?* Desktop review of institutional ownership of risk associated with natural hazards and disasters. Bushfire and Natural Hazards Cooperative Research Centre, Melbourne.

Young, C. K., Jones, R. N., Symons, J. (2016a). *Understanding Values at Risk and Risk Ownership*. Workshop Synthesis Report. Bushfire and Natural Hazards Cooperative Research, Melbourne.

Young, C. K., Symons, J. and Jones, R.N. (2016b). *Institutional Maps of Risk Ownership for Strategic Decision Making*. Bushfire and Natural Hazards CRC, Melbourne.