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Appendix to Technical Report for "Supporting the Australian Vulnerability Profile": Summary of typical system patterns

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Contents

Figures

1 Introduction

This document is an appendix to the report 'Approach, methods and results for co-producing a systems understanding of disaster. Technical Report Supporting the Development of the Australian Vulnerability Profile' (O'Connell et al., 2018) (the Technical Report). This Appendix provides a full description of the typical system patterns which emerged from the analysis described in Chapter 5 of O'Connell et al (2018). The broader context, as well as the methods behind the approach are described in the Technical Report, and it is recommended that this Appendix is not viewed in isolation, without first reading Chapter 5 of the Technical Report.

In summary, the CSIRO team worked with all of the final sets of diagrams from the Disaster Deconstruction workshops, and the Partnership Team workshops. A detailed process of pairwise and multiway comparisons between diagrams and their components – adding, subtracting, grouping and regrouping, resetting boundaries and scope and level of detail in order to find the minimum, parsimonious set of diagrams that represented the most important patterns as a synthesised set (Proust and Newell, 2012). As shown in in Chapter 5 of the Technical Report, the many diagrams produced during the workshop were gradually reduced to a stable set of typical system patterns with clearly articulated central issues, neutral narratives, causes and effects, and key feedbacks. The content of each typical system pattern was checked against, and supplemented with other sources of information for example expert opinions, and scientific literature.

For each typical systems pattern, a cause-effect diagram and simple neutral narrative was developed, along with a tabulated description of the cause and effect variables. This diagram was used to diagnose a summary of the key vulnerabilities.

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

For each typical system pattern, the following is provided:

- A brief summary
- A more complete description, discussing
    - The central issues

    - How the system operates in times of stability
    - The choices and trade-offs during stable times
    - How the system might work in a disaster
- The cause-effect diagram, with key feedbacks provided as red arrows. The multiple causal links are represented by grey background arrows
- The individual causes and effects shown in more detail, in tabular form
- A summary of the key vulnerabilities diagnosed using this approach

The utility of typical systems patterns can go beyond the diagnosis of vulnerabilities, and can be built on to inform interventions that build resilience and mitigate risk. Further steps are required to check and test out the typical system patterns with a wider range of literature, experts, and a broader range of stakeholders. These system patterns could then be used (in combination with other tools such as Theory of Change) to help identify potential interventions to address the vulnerabilities by addressing systemic risk and root causes. These steps are shown in examples in Chapters 5 and 6 of the Technical Report.

The typical system patterns as shown here are partial systems analyses and require further work. Future efforts to develop more mature system diagrams would probably reveal competing and conflicting system conceptualisations. This is not something to avoid, and indeed these diagrams are a vehicle for making these different perspectives explicit in a constructive way that supports evidence-based reflection. In other words, the diagrams are best recognised as socially constructed living documents, rather than attempts to distil a single, 'correct' system conceptualisation. This knowledge co-production process is relational and dynamic, where knowledge is constructed through relational practices and is constantly being created and recreated through interactions (Brugnach and Ingram, 2012). As described in Chapter 5 of O'Connell et al (2018), they require further review, testing and improvement with experts and literature before they could be reliably used.

Note that the numbering of the typical systems patterns is missing #5 and #13 because these were merged with other system patterns and the numbering has not been adjusted accordingly.

2 Essential goods and services (food, water, electricity, fuel, transport) (#1)

2.1 Summary

The central issues in this typical system pattern are focused around supply and demand for essential goods and services such as food, water, electricity, fuel and transport. The characteristics that are universally important across these goods and services include level of availability, affordability, quality, sufficiency, and equity of access. There are complex interdependencies across the various systems providing food, water, electricity, and fuel. These interdependencies are shaped by many influences, including market demands, supply costs, legislative requirements, environmental factors (e.g. remoteness, exposure to natural hazards, natural resource availability), and people's knowledge, values, experience, connections, habits and expectations.

In times of stability, the systems in Australia that provide these goods and services are generally highly effective and efficient. There are high expectations about access, reliability, quality and affordability of the basics of food, water, electricity, fuel and transport.

When there is a major disruption to one or more of the supply chains for essential goods and services; access/distributions may be affected and because of the interdependency, the low levels of diversity, substitutability and redundancy (e.g. stored food or fuel). These disruptions quickly cascade and amplify across all of the systems. There would be strong differential impacts of disruptions based on the location and type of hazard event, and amplified by people's differing abilities to cope. Social conflict, breakdown of law and order are possible when people cannot access basics such as food and water for an extended period. Although there are emergency rules for access to liquid fuel during emergencies, these are untested, and there are no rules in place for food and water.

2.2 Description

The central issues

The central issues in this typical system pattern are focused around supply and demand for essential goods and services such as food, water, electricity, fuel and transport. There are whole fields of research and operations in each of these areas, and this 'typical system pattern' focuses only on features and dynamics that are common within and across them, and that create vulnerability in times of rapid change, disruption or when natural hazards strike. The characteristics that are universally important across these goods and services include level of availability, affordability, quality, sufficiency, and equity of access.

There are complex interdependencies across the various systems providing food, water, electricity, and fuel. These interdependencies are shaped by many influences, including

market demands, supply costs, legislative requirements, environmental factors (e.g. remoteness, exposure to natural hazards, natural resource availability), and people's knowledge, values, experience, connections, habits and expectations.

In times of stability

In times of stability, the systems in Australia that provide these goods and services are generally highly effective and efficient. Consumer values and preferences, size and distribution of customer base and wealth of consumers are well-understood drivers of demand. There are high levels of expectations about access, reliability, quality and affordability of the basics of food, water, electricity, fuel and transport. In the relatively stable period of the last few decades, these expectations are usually met particularly in main population centres. Although there is evidence of pressure on these systems even during times of stability, due to population increase, and economic factors such as affordability during recent years where increases in incomes for average consumers are lower than the Consumer Price Index.

Specific issues related to sector, cost-of-production, diversity and types of sources, supply routes, infrastructure, technology and geography shape the supply of goods and services, and the interactions set up the major supply-demand feedback loops. Many other factors influence the dynamics of supply and demand, including political and business leadership, the policy and regulatory environment, incentives and tax schemes, the level of reliance on local production versus imports, and the effectiveness of governance which then influences the effectiveness of markets and balance with the needs for public good . Innovation is critical, and relies on business confidence to invest not only in technology but also in fit-for-future infrastructure and markets.

In an increasingly global economy, there is an increasing reliance on imports for some essential goods. For example, there has been an increasing reliance on imported liquid fuels in Australia. With the closure of refining plants in Australia, currently 83% of Australia's liquid fuel is imported (Richardson, 2018) and 91% of Australia's transport fuel (Parliament of Australia, 2015). The International Energy Agency mandates that all countries should hold 90 days in reserve as a minimum. In November 2013 Australia had an estimated 57 days of supply, with only 23 days of supply stockpiled in-country (Vivoda, 2014). Australia has no strategic oil stocks and does not place any stockholding obligation on industry. In 2016, Australia provided a plan to meet compliance requirements to the International Energy Agency's Governing Board, and to date the outcomes are not available.

Interdependencies are critical, and providers of goods and services are driven to find efficiencies in their supply chains in order to be competitive or profitable in the market. Provision of food, water, medical services, and the economy is highly reliant on an uninterrupted energy supply (Latimer, 2018). To continue the specific example above, most of Australia's food distribution relies on road transport using liquid fuel.

The choices and trade-offs during stable times

During stable times, there is a demand for cheap goods, high quality (where there is an inherent trade-off with cost), a large variety of choice, fast delivery of goods, and for some goods such as food - freshness. Past decades have seen a strong trend towards privatisation of service supply so that consumers benefit from competition. The choices driven by consumer demands in a competitive market drive companies to pursue efficiencies and remove redundancies in supply chains in order to reduce supply costs. Population and economic growth, as well as advertising and government incentive programs or subsidies stimulate consumer demand, and these stimuli may also preference some types of goods and services over others.

There are many trade-offs inherent in all actions and choices that are made. The higher level 'system design' both within each industry or sector, as well as across multiple sectors, is an important determinant of vulnerability or resilience. A long period of stability has meant that the drivers of efficiency have reduced the 'buffer' or functional redundancy, substitutability, and diversity in supply chains. There is a trade-off between cheap supply of goods, enabled by 'optimised' supply chains that are highly integrated with low storage (just-in-time), versus more robust supply chains with storage, multiple suppliers and supply routes. Such choices may reduce cost, or may increase choice and demand, but they also reduce the overall resilience and adaptive capacity of a system (Simonsen et al., 2014). The choices and trade-offs in areas of remote or regional Australia differ quite dramatically from those in the cities – for example, the costs of maintaining infrastructure and communities or customer bases in rural Australia may be higher than in the cities, but provides some buffer for self-sufficiency for food production.

In a disaster

When there is a major disruption (which may come from natural hazard or other sorts of events) to one or more of the supply chains for essential goods and services may be affected and because of the interdependency, the low levels of diversity, substitutability and redundancy (e.g. stored food or fuel), these disruptions quickly cascade and amplify across all of the systems. The interoperability of different systems becomes even more important than in times of stability, and commercial in confidence arrangements can create barriers to making systems interoperable.

Catastrophic disaster scenarios which explored interruptions of these supplies for several weeks showed that the major impacts on delivery of critical goods and services would have a rapid feedback to demand factors – for example, demand for food, water and energy quickly changes to subsistence level in line with their expectations and understanding of what is possible. Knowledge and awareness of the interconnections and rapidly creating workable supply chains after disaster is important. The people who have such knowledge can be scarce, and there not much demand for their services in times of stability, so the absence of such expertise becomes a weak link in a disaster.

There would be strong differential impacts of disruptions based on the location and type of hazard event, and amplified by people's differing abilities to cope. The disadvantage for marginalised or vulnerable people is amplified by disaster. Social conflict, breakdown of law and order are possible when people cannot access basics such as food and water for an extended period. Although there are emergency rules for access to liquid fuel during emergencies, albeit untested, there are no such rules in place for food and water. Long-term impacts on health, physical and mental wellbeing are greatly exacerbated due to the flow-on effects of stress and social conflict by extended disruption to critical goods and services. . There may be power imbalances in terms of whose values are prioritised when it comes to returning essential services (e.g. opening freight rail access for industry versus road access for residents). There are a range of consequences (cost, losses of all types) to long recovery times, and in some cases restoring services could be deemed too expensive to be viable, and trigger relocation of remote communities, or herald a step change in their ongoing conditions if they do stay (which may be a good opportunity to create a less vulnerable system in future).

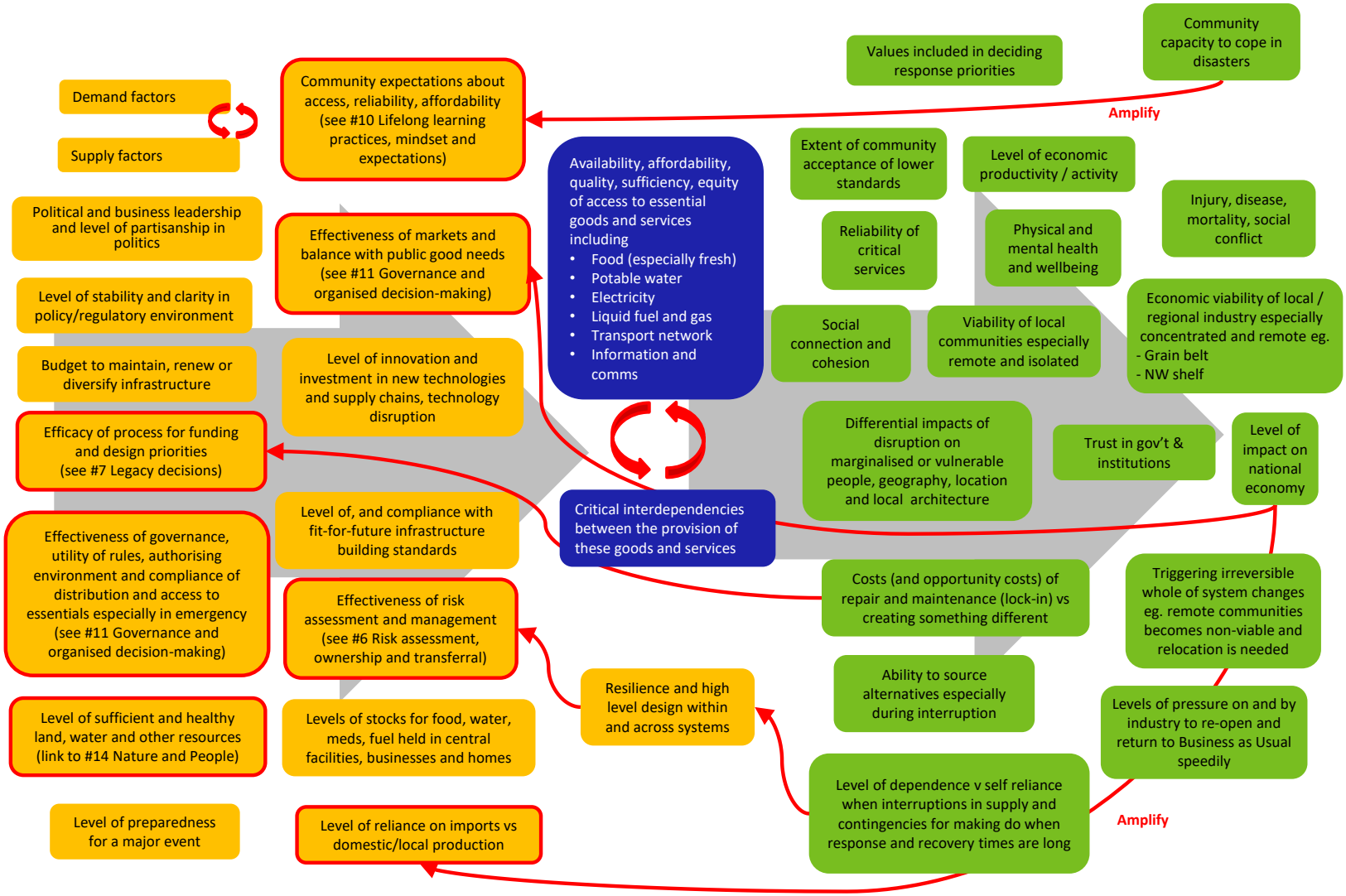


Figure 1 Essential goods and services (food, water, electricity, fuel, transport) - cause and effect diagram, showing feedback loops
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows.

2.3 Causes (influences on) and effects

2.3.1 Causes (influences on)

Demand factors • Preferences of consumers • Wealth of consumers • Size and distribution of customer base
Supply factors: • Location, production rate, cost • Diversity of sources • Capacity and cost of storage • Diversity, cost, reliability of supply routes and infrastructure • Efficiency of 'just in time' supply chains
Political and business leadership and level of partisanship in politics (see #12 Leadership)
Level of stability and clarity in policy / regulatory environment • Drives investment confidence • Builds community confidence in alternatives or changes
Budget to maintain, renew or diversify infrastructure
Efficacy of process for funding and design priorities (see #7 Legacy decisions) • A systems approach and long-term view needed to avoid sectoral silos and perpetuation of lock-in • Degree of politicisation will influence legitimacy and salience of priorities
Effectiveness of governance, utility of rules, authorising environment and compliance of distribution and access to essentials especially in emergency (see #11 Governance and organised decision-making)
Level of sufficient and healthy land, water and other resources (link to #14 Nature and People)
Community expectations about access, reliability, affordability (see #13 Attitude, identity, expectations)
Effectiveness of markets and balance with public good needs (see #11 Governance and organised decision-making)
Level of innovation and investment in new technologies and supply chains, technology disruption
Level of, and compliance with, fit-for-future infrastructure building standards
Levels of stocks for food, water, meds, fuel held in central facilities, businesses and homes
Level of reliance on imports vs domestic / local production (see #15 Production base and jobs)
Level of preparedness for a major event
Resilience of high level design in each system – level of functional redundancy, substitutability, diversity, adaptive capacity vs lock-in, degree of connectedness interoperability between different systems, extent to which design of systems incorporates emergency management knowledge and experience

2.3.2 Effects (consequences of)

Extent of community acceptance of lower standards
Reliability of critical services
Level of dependence vs self-reliance when interruptions in supply and contingencies for making do when response and recovery times are long
Differential impacts of disruption on marginalised or vulnerable people, geography, location and local architecture (e.g. high density, high-rise buildings, cities very different to outer suburbs of cities, or rural areas)
Values included in deciding response priorities
Community capacity to cope in disasters
Ability to source alternatives especially during interruption, e.g. • knowledge of foraging or growing food or finding water locally • backup off grid energy sources • alternative forms of transport if no fuel • exchanges systems if banking not accessible etc.
Economic viability of communities especially remote and isolated
Trust in government and institutions
Level of economic productivity / activity
Social connection and cohesion
Viability of local / regional industry especially concentrated and remote areas, e.g. • Grain belt • North West shelf Affects both production capacity (see #A15 Production base and jobs) and requirements to support communities after disaster
Triggering irreversible whole of system changes e.g. remote communities becomes non-viable and relocation is needed
Levels of pressure on and by industry to re-open and return to Business as Usual speedily
Physical and mental health and wellbeing
Injury, disease, mortality, social conflict, e.g. • Levels of injury and mortality from disaster • Ongoing impacts of disease etc. in weeks months years after disaster • Threshold of days for no access to food or water will lead to social conflict / civil unrest • Tail of heightened social conflict, domestic violence etc. continues for a decade thereafter
Costs (and opportunity costs) of repair and maintenance (lock-in) vs creating something different
Level of impact on national economy, e.g. • If disaster hit critical production areas in North West shelf, there would be flow through impacts to local, regional, state, domestic and global markets
Level of dependence vs self-reliance when interruptions in supply and contingencies for making do when response and recovery times are long

2.4 Key vulnerabilities for *Essential goods and services (food, water, electricity, fuel, transport)*

There are key vulnerabilities to all essential goods and services:

- There are vulnerabilities in the supply chains for essentials such as food, water, electricity, liquid fuel. They are each potentially subject to large and lengthy disruptions due to natural hazards or other factors such as economic shocks and cascading impacts. The supply chains for each of these are vulnerable due to just-in-time supply, low levels of storage, hub and spoke distributions, single sources or lines of supply, low levels of alternatives of substitutes available locally, and scarcity of individuals/institutions with 'whole of system' knowledge and capacity to rig up workable alternatives in times of disaster.
- There are critical interdependencies between the supply of essential goods and services – for example, the provision of food and water is totally reliant on electricity and transport fuel. All of these are in turn completely dependent on access to and utility of transport networks, information and communication, and banking and supply of money.
- There is a particularly stark vulnerability in Australia around transport fuel. Transport fuel is required for many primary industries including growing and transporting food. Australia is almost entirely dependent on imports, and does not meet the International Energy Association guidelines for storage.
- Australian consumers expect around 100% reliability for the uninterrupted supply of food, water, electricity and fuel. This is a major vulnerability. This expectation means that most people and businesses have a very low level of self-reliance in terms of alternatives, substitutes or knowledge about how to meet their needs differently in the event of disruption. In this situation, major supply interruptions would potentially have quite dramatic consequences. The expectation that something will always be accessible can also engender fear, anger, blame or a sense of unfairness when it is not.
- The lack of clear and tested emergency rules for:
    - Roles and responsibilities (as reflected by formal agreements or partnerships) across some of the critical partnerships in public-private sectors, or between local governments and the insurance industry – in pre-disaster as well as during and post-disaster environments.
    - Distribution and access of essentials during a disaster. There are rules for distribution of and access to fuel, but they have not been well tested and are seen by many in Emergency Services to be impractical. There are no rules or protocols for food or water.

    - There is potential power imbalances in terms of whose values are prioritised when it comes to returning essential services (e.g. opening freight rail access for industry versus road access for residents).

- There are a range of consequences (cost, losses of all types) to long recovery times, and in some cases restoring services could be deemed too expensive to be viable, and trigger (for example) relocation of remote communities, or herald a step change in their ongoing conditions if they do stay.

3 Health and capacity to care (#2)

3.1 Summary

The central issues for health and capacity to care are the access to and quality of health services compared to the demand for health services, and the capacity for informal help and care outside of the formal provision of medical services. In Australia formal medical services are provided by both the government and the private sector.

In times of stability, the function of the formal health care system is dependent upon elements of many other typical system patterns including funding and decision-making processes, and effective legislative frameworks and authorising environments, goods and services (food, water, waste management, energy) and digital information and communications. Preventative health care is becoming more important in order to take the stress off the medical systems. Formal and informal care provision of the elderly, or chronically ill or special-needs by low paid, unpaid or volunteer carers is a critically important and an under-recognised component of the system.

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

3.2 Description

The central issues

The central issues for health and capacity to care are

- access to and quality of health services compared to the demand for health services; and
- the capacity for informal help and care outside of the formal provision of medical services.

Formal medical services are provided by government and the private sector in Australia, with a strong (relative to many other countries) safety net for health care in the form of Medicare as well as private health insurance.

In times of stability

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

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

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

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

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

The choices and trade-offs during stable times

There are many choices and trade-offs throughout the provision of health services and informal care. Increasing demands on the system places budgetary pressure throughout the public and private systems in regards to the provision and insurance and leads towards strong drive for economic efficiency. When combined with new technologies, there is an

increasing reliance on digital systems for every aspect of formal health care provision. New technologies enable increases efficiency and access, however, they also create susceptibility for major disruption from natural hazards, energy or communications interruptions, or malicious interference. There are particular trade-offs relevant to rural and remote Australia where the relatively high cost of provision of local services for low populations means that there is increasing need to travel to capital cities or regional centres to access services, and increasing reliance on remote medical expertise (National Rural Health Alliance, 2016).

Given the long-term stresses which are widening the gap between supply, equitable access to and demand for medical services; there are some strong complementarities in reducing demand on formal health care services by increased preventative health strategies, and by individuals making healthy lifestyle choices. There are benefits as well as trade-offs between increasing capacity of informal mechanisms of providing health care – for example community based care. Higher levels of community based care can reduce demand on the formal care system and can be beneficial for those needing care. Caring for others is a fundamental aspect of being human, but carers also need to care for themselves in order to be able to care for others. If caring work is not valued highly by the market and falls disproportionally to unpaid or lowly paid people, these carers are at a systemic disadvantage and face disincentives for caring work relative to other activities. In times of disaster, such carers are doubly vulnerable if they feel bound to continue their caring responsibilities and yet their lower financial security gives them access to fewer options for disaster response and recovery.

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

In a disaster

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

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

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

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

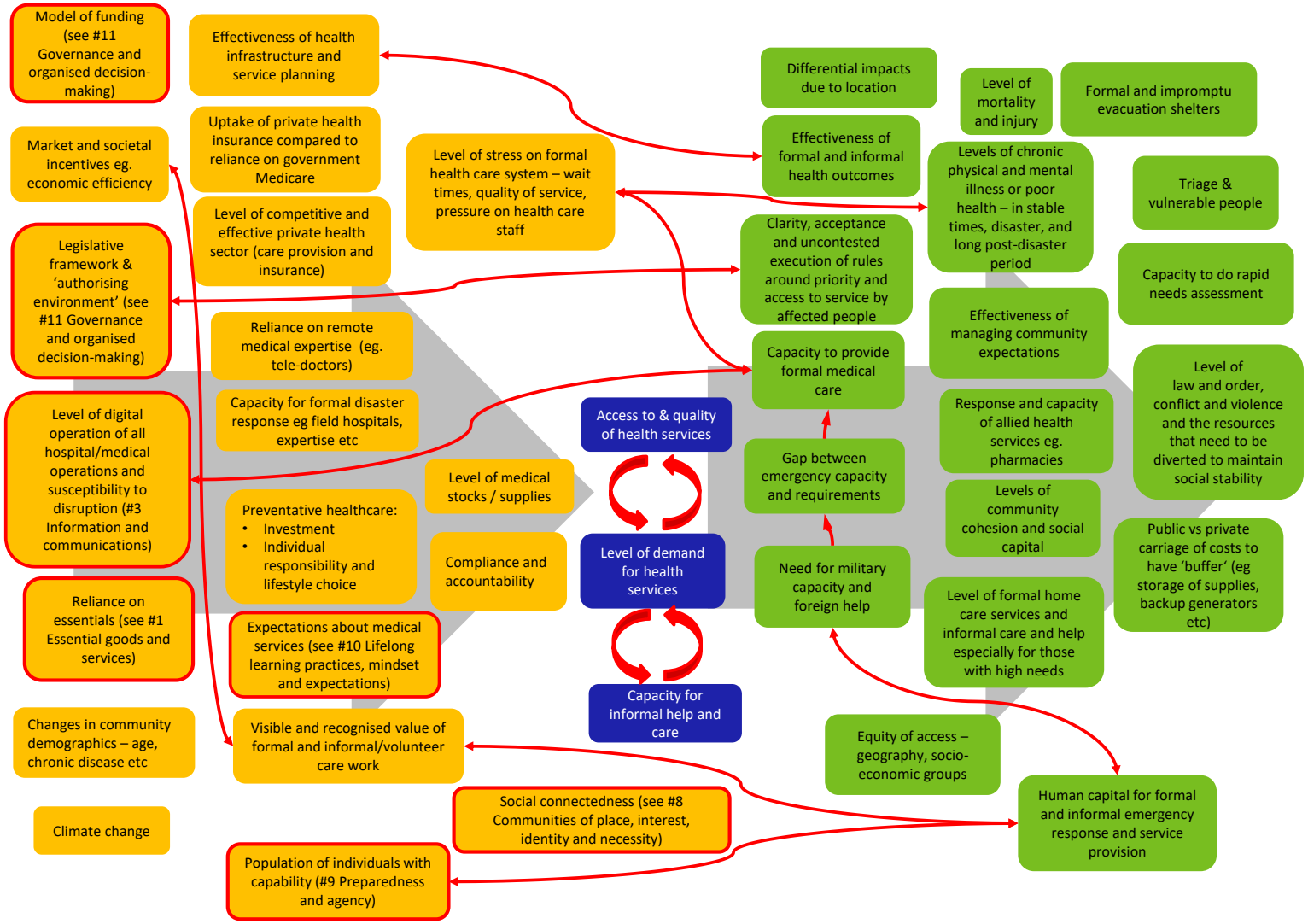


Figure 2 Health and capacity to care - cause and effect diagram, showing feedback loops

The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows.

3.3 Causes and effects

3.3.1 Causes (influences on)

Model of funding (#11 Governance and organised decision-making)
Effectiveness of health infrastructure and service planning
Level of stress on formal health care system – wait times, quality of service, pressure on health care staff
Legislative framework and 'authorising environment' (#11 Governance and organised decision-making)
Reliance on food, water, electricity, supply, transport, waste management and sanitation etc. for formal and home care (see #1 Essential goods and services)
Level of digital operation of all hospital / medical operations
Reliance on remote medical expertise (e.g. tele-doctors)
Level of medical stocks / supplies
Capacity for formal disaster response e.g. field hospitals, expertise etc.
Expectations about medical services
Shifts in locations of populations due to climate change
Changes in vectors and disease distribution and type
Changes in community demographics (ageing population, higher levels of mobility and migration)
Level of government and industry investment in preventative health care
Level of individual responsibility for preventative health / risk management and lifestyle choice
Market and societal incentives e.g. economic efficiency
Visible and recognised value of formal and informal / volunteer care work – currently it is not visible, falls to low paid workers, and falls disproportionately to women.
Levels of social connectedness
Population of individuals with physical capacity, skills, knowledge, and willingness to provide volunteer help / care
Compliance and accountability • Litigation • Extra time and resources to ensure accountability
Social connectedness
Preventative health care • Level of government and industry investment • Level of individual responsibility for preventative health / risk management and lifestyle choice
Uptake of private health insurance compared to reliance on government Medicare
Level of competitive and effective private health sector (care provision and insurance)

3.3.2 Effects (consequences of)

Differential impacts due to location
Level of mortality and injury
Formal and impromptu evacuation shelters
Capacity to do rapid needs assessments
Effectiveness of managing community expectations
Triage of vulnerable people
Capacity to provide formal medical care
Effectiveness of formal and informal health outcomes
Response and capacity of allied health services e.g. pharmacies – as backup generators etc.
Public vs private carriage of costs to have 'buffer' (e.g. storage of supplies, backup generators etc.)
Level of law and order, conflict and violence and the resources that need to be diverted to maintain social stability
Need for military capacity and foreign help
Levels of chronic physical and mental illness or poor health – in stable times, disaster, and long post-disaster period
Level of formal home care services and informal care and help especially for those with high needs
Levels of social capital able to be deployed
Level of human capital for formal and informal emergency response and service provision
Gap between emergency capacity and requirements
Equity of access – geography, socio-economic groups
Clarity, acceptance and uncontested execution of rules around priority and access to service by affected people

3.4 Key vulnerabilities for *Health and capacity to care*

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

- Level of demand for health services is increasing
    - Changes in community demographics (e.g. ageing population, higher level of migrants), which may be further exacerbated in the future by shifts in

locations of populations due to climate change. At the same time, there will likely be changes in vectors and disease distributions and type.

  - Level of chronic illness and poor health is increasing due to lifestyle choices, poor diet, increasing inequality and families in poverty.
  - The high expectations of medical services that the general population holds, combined with a relatively low level of government and industry investment in preventative health care, and a low (and socio-economically stratified) level of individual responsibility for preventative health, risk management and lifestyle choices.

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

4 Information and communications (#3)

4.1 Summary

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

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

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

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

4.2 Description

The central issues

There are three central issues that relate to this typical system pattern; the ability to generate the requisite data and information, the ability to communicate and share it among emergency response personnel and agencies, and the ability to communicate and share it effectively with the public. The typical system pattern relevant to disaster and vulnerability operates across the whole information and communications 'supply and demand' chain and focuses on the features that create vulnerability in times of high demand, high stress, ambiguous and crisis situations. Vulnerabilities relating to information and communication result from a complex mix of technological and human factors (Lea, 2017).

In times of stability

In times of stability, this typical system pattern begins with the value placed on, and the investment made by government and the private sector in the resources, people and infrastructure required to create, disseminate and communicate the requisite data and information. It next requires having clarity around the problems that need solving and having the skills and resources to source, generate, and analyse the data to turn it into information that is timely and fit-for-purpose.

Sharing of data and information among agencies requires the personnel and the systems in place to enable it, but this can be hampered by concerns about privacy, security, competitive advantage and liability. Interoperability between systems and a lack of common standards can also hamper data sharing. Interoperability occurs when data and information are maintained on disparate systems that don't integrate well (Teutsch, 2010).

The final central issue relates to the effective flow of communication and information between emergency services, support agencies and the public being highly dependent on having adequate communication infrastructure and skilled communicators.

Effective communication in a disaster relies on the communication infrastructure withstanding increased loads without system overload and failure, and remaining operational under extreme conditions (e.g. flood, fire, and cyclone).

Communicating clear and consistent information to the public is made complex by the diversity of people and abilities in the community, expectations that information will be available on-demand, that it suits different purposes (frontline responders, service providers, public) and communication preferences (internet, radio, mobile, landline, social media) and that it is relevant at multiple spatial coverages (street, neighbourhood, city, rural, remote). It is further complicated if there is a broad range of emergency communications, warning systems and information technology systems (Martin and Rice, 2012).

Effective communication in a disaster is reliant on communicator having the skills to deliver clear, comprehensive and consistent information about the disaster and the actions that people need to take. During high stress and ambiguous situations, a communication style

that can build trust, is credible, respectful, honest, empathetic, and can deliver vital points quickly and calmly is beneficial. Effective communication also relies on having the communication pathways and networks in place, in addition to ensuring clarity and consistency around the 'message', roles and responsibilities of the communicators.

In times of stability, the choices made by public and private organisations around technologies, systems, staffing, infrastructure and data collection will match the priorities for the day-to-day running of the organisation (e.g. creating business opportunities, connecting virtual communities, targeting markets and improving efficiencies). For reasons such as privacy, specialisation or competitive advantage, organisations can become siloed with little cross-organisation interaction or data sharing (Owen et al., 2013). Fiscal efficiency may mean there is little investment in generating data that would be useful in a disaster. Organisations that do hold data, such as insurance companies, may be reluctant to share it due to concerns about privacy, liability, competitive advantage, insurability or devaluation of property if the risk assessments were made public. During stable times there can be competition for limited resources and funding which limits the uptake of new processes, technologies or systems that may be beneficial in a disaster. Also, trends towards privatising and automating services, driving efficiencies and removing functional redundancy during times of stability may reduce options during a disaster.

Despite readily available information on how to prepare for a disaster during times of stability, few people actually prepare which may leave people more vulnerable during a disaster. They may have reasons like 'I'm too busy', 'It won't happen to me' or 'I'll just leave' (Mayberry, 2015). Australian's have high expectations of connectivity and service delivery in communication services and expect to access the services they want, when they want, with ease and speed on the devices they already own (Bureau of Communications Research, 2016). Social media is an important part of communication, and in times of stability is used in multiple ways for business and personal use (Brynielsson et al., 2018).

The choices and trade-offs during stable times

During stable times there is a trade-off between the skills, resources and infrastructure needed for normal day-to-day operations and those needed for intense, highly stressful and often ambiguous periods during disasters. Short-term gain during times of stability can leave the system vulnerable during times of disaster. Priorities and privacy issues that mean organisations operate as silos during times of stability can reduce cross-agency interaction and sharing of data and resources. However, silos can stymy the things that are needed in a disaster, such as trust, collaboration and the sharing of data and resources. Inadequate preparation for a disaster may be a cheaper and easier in the short term, but may increase vulnerability during a disaster. During times of stability, the drive for fiscal efficiency is adopted to save money by optimally allocating resources and minimising waste, inefficiency and functional redundancy.

In a disaster

During a disaster, however, there is an increased need for resources, skilled personnel and functional redundancy to ensure fail-safe communications with broad coverage including remote areas.

Disasters are intense periods that are highly stressful and often ambiguous. They require clear and consistent messaging, adequate and fail-safe communications infrastructure, interoperability of systems and platforms, and a clear and coordinated flow of information and resources. The level of each of these will influence the messages that are received and the capacity of individuals, groups and services to make decisions and take action with confidence.

During disasters, there is urgent pressure to make complex, difficult decisions with speed and accuracy. This in turn relies on streamlined communication and sharing between public and private organisations. There is a heightened need for fail-safe, broad reaching communication and information technologies and media so that vital information can be passed in all directions between emergency services, support agencies and the public.

In a disaster, interruption to one component of the information and communication pathway increases the risk of misinformation, leaving people confused, unable to cope and potentially in danger. The task is made more challenging by the diversity and breadth of information that is required. The variety of modes and devices that information needs to be made available on, and the range of locations that it often needs to reach. Vulnerability can be reduced with the sharing of data, people and resources across organisations, by having interoperable systems and ensuring there is clarity around roles and responsibilities, networks and information channels.

During disasters, people can feel confused, fearful, anxious and unsupported and if there are conflicting or vague messages about actions people need to take, the public can downplay the danger, potentially leaving them more vulnerable (Auf der Heide, 2004). Further to this, vulnerable groups of people have quite specific communications needs (Howard et al., 2017). It is therefore important that messages are clear, comprehensive and consistent. A communication style that builds trust, is respectful, honest, empathetic, credible, and can communicate key points of information quickly, calmly and effectively in high pressure situations is required. A community's ability to recover from a disaster is assisted by the social sharing of emotions and joint remembering to help claim agency and control (Sarrica et al., 2018). Having sufficient and diverse avenues for the community to share their experiences can reduce vulnerability following a disaster event.

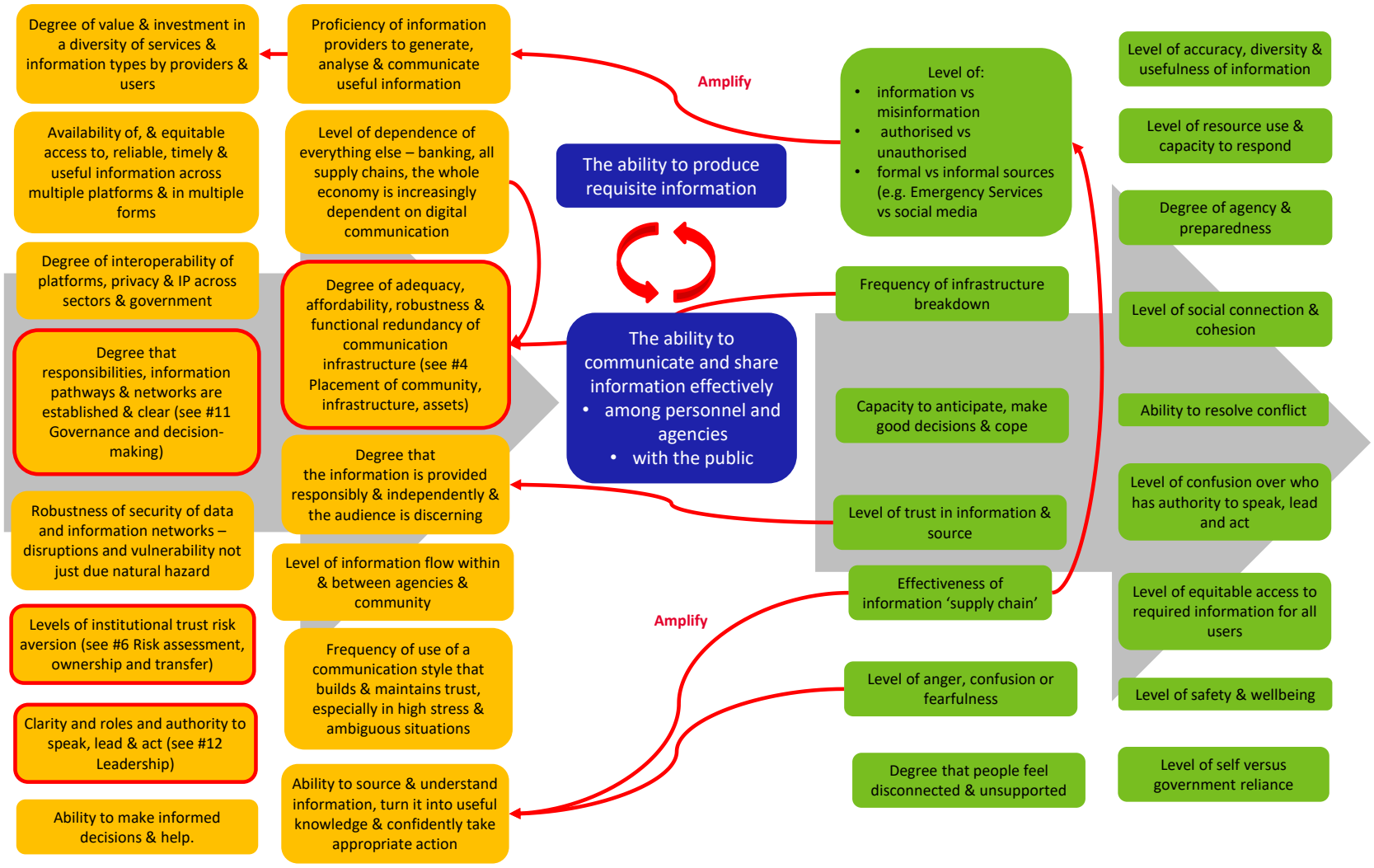


Figure 3Information and communications - cause and effect diagram, showing feedback loops.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows.

4.3 Causes and effects

4.3.1 Causes (influences on)

Degree of value and investment in a diversity of services and information types by providers and users
Proficiency of information providers to generate, analyse and communicate useful information
Availability of, and equitable access to, reliable, timely and useful information across multiple platforms and in multiple forms
Level of dependence of everything else – banking, all supply chains, the whole economy is increasingly dependent on digital communication
Degree of adequacy, affordability, robustness and functional redundancy of communication infrastructure
Degree of interoperability of platforms, privacy and IP across sectors and government
Degree that responsibilities, information pathways and networks are established and clear (#11 Governance and decision-making)
Degree that the information is provided responsibly and independently and the audience is discerning
Robustness of security of data and information networks – disruptions and vulnerability not just due natural hazard
Level of information flow within and between agencies and community
Frequency of use of a communication style that builds and maintains trust, especially in high stress and ambiguous situations, and demonstrates: • Empathy and caring • Competence and expertise • Honesty and openness • Commitment • Accountability
Levels of institutional trust and risk aversion
Clarity of roles and authority to speak, lead and act
Ability to source and understand information, turn it into useful knowledge and confidently take appropriate action
Ability to make informed decisions and help

4.3.2 Effects (consequences of)

Level of: • Information vs misinformation • Authorised vs unauthorised • Formal vs informal sources (e.g. Emergency Services vs social media)
Level of accuracy, diversity and usefulness of information
Level of resource use and capacity to respond
Degree of agency and preparedness
Frequency of infrastructure breakdown
Level of trust in information and source
Level of social connection and cohesion
Ability to resolve conflict
Level of confusion over who has authority to speak, lead and act
Effectiveness of information 'supply chain' (investing, generating, collating and synthesising, disseminating, being used to inform decisions in a way which maintains trust and good relationships to obtain good outcomes)
Level of equitable access to required information for all users
Level of anger, confusion or fearfulness
Level of safety and wellbeing
Capacity to anticipate, make good decisions and cope
Level of self vs government reliance
Degree that people feel disconnected and unsupported

4.4 Key vulnerabilities for *Information and communications*

Main vulnerability themes from the workshop:

The ability to generate the requisite data and information:

- Inadequate value and investment in data, skilled personnel and infrastructure that is needed in a disaster.
- Limited ability of organisations to produce and communicate information that is timely, useful and fit-for-purpose; this relies on having access to data, having skilled personnel and having the technology and infrastructure that is needed in place.
- Lack of clarity around the problems faced and the processes needed to address them which is hampered by a lack of standards, definitions, and systems of work, or agreement on the responsibilities for the delivery of the data and information (Emergency Management Victoria, 2017).

The ability to communicate and share data and information among emergency response personnel and agencies:

- Barriers to sharing data and information due to concerns about privacy, liability, competitive advantage, insurability or devaluation of property if the risk assessments were made public.
- Organisations becoming silos with little cross-agency interaction, guarding authority and resources and keeping their expertise, data, and knowledge to themselves (Owen et al., 2013).
- The systems and structures are not in place to enable data and information sharing and there is poor interoperability between systems and platforms. This occurs when information is widely distributed in numerous organisations and in disparate systems (Teutsch, 2010).
- Concerns about the security of the data systems (theft, hacking and foreign interference).

The ability to communicate and share data and information with the public:

- Inability of communications infrastructure to withstand increased loads without system overload and failure and remaining operational under extreme conditions (e.g. flood, fire, cyclone),and insufficient infrastructure protection and functional redundancy (e.g. fewer mobile towers with more transmitters on them means higher spatial concentration of infrastructure, making it more vulnerable).
- A slow repair time of damaged communications infrastructure. This can impede a community's ability to withstand a disaster and impede recovery. It can also impact supply chains, systems, assets, information technologies and communication networks which can in turn impact the social or economic wellbeing of the community (Emergency Management Victoria, 2017).
- Limited capacity of organisations to get the message out to people when and where it is needed; which is made difficult by expectations that information will be available on-demand, and to suit different purposes (frontline responders, service providers, public), communication preferences (internet, radio, mobile, landline, social media), and is relevant at multiple spatial coverages (street, neighbourhood, city, rural, remote).
- Multiple emergency communications and warning systems and information technology systems (Martin and Rice, 2012).
- Inability to communicate in high stress and ambiguous situations in a way that builds trust, is credible, respectful, honest, empathetic, and can deliver key information quickly and calmly.
- Communication networks not in place and little clarity around the 'message', roles and responsibilities.

- Inability to communicate clear, comprehensive and consistent information about the disaster, with the aim of directing people to the actions they need to take.
- Information that is not clear and accessible to a broad diversity of people with differing abilities.
- A lack of consistency over terminology, symbology and data for public information and warnings, which can lead to confusion during crucial emergency situations (Owen et al., 2013).
- Insufficient avenues for the community to share their experiences following a disaster, which can impede recovery and claim agency and control (Sarrica et al., 2018).

5 Placement of communities, infrastructure, assets (#4)

5.1 Summary

The central issues regarding communities and the infrastructure and assets upon which they rely, are a consequence of both their locations (exposure) and the standards to which the infrastructure is built (vulnerability). The choices and actions leading to the location of communities and quality standards of buildings and infrastructure are shaped not only by formal land use planning processes, but other formal and informal planning, decision-making and communication processes reflecting individual and societal values and priorities. There are different options for dealing with the changing risk profile in terms of forward planning of new infrastructure, buildings and assets, compared to what is already existing and therefore has inherited risk from legacy decisions.

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

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

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

5.2 Description

The central issues

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

There are quite different options for dealing with the changing risk profile in terms of forward planning of new infrastructure, building and assets compared to what is already existing and therefore has an inherited risk from legacy decisions.

In times of stability

There is an interaction between the demand for housing and infrastructure, and supply.

On the supply side, Australia during recent stable times has had a steadily increasing population, as well as a changing demographic – for example changing rural/city populations – the basic drivers of demand. The increasing demand for housing has led to high prices in many cities, and there have been recent issues with affordability, which have differential socio-economic impacts. Demand factors drive decisions about where and how communities live, the construction of buildings, assets and infrastructure. The choices people make about where they live and build are based on numerous considerations including affordability of land and housing, convenience, amenity and lifestyle, cost of construction, availability or proximity of jobs. These are affected by trends in the housing sector, the state of the economy, and a range of different policies of governments, banks and other financial institutions which are not described here.

On the supply side, factors around development and planning processes are critical. Economic frameworks in which the future is discounted, and the political will to engage in long-term land-use planning considerations is important to the way the supply of housing, assets and infrastructure are supplied. Other influences include the expertise and preferences of designers, planners, engineers, builders and developers. Amenity and economic considerations are driving factors in choices of location and construction. Proximity to and state of natural resources (e.g. water) to support a population is usually a consideration, but there has been insufficient consideration paid to risks from nature (for example development on floodplains) even in times before the current changing climate risk profile was evident. The inclusion of emergency services planning expertise in the early phases of planning is rare, and when included often there is insufficient information available.

Land-use planning incorporates a range of institutional processes that shape what can be built, where, and how. It includes interactions between a range of stakeholders including state and local governments, developers, investors, utility providers. It is in this set of

processes from design of concept, through approvals, funding, construction and sale is where fundamentally much of the risk is shaped, and transferred. The degree of equity, legitimacy, accountability, adherence to legislation, and transparency in development and land-use decision-making processes in balancing monetary gain, political gain and community values is a critical factor.

Building and construction standards have an important interplay with land-use planning with respect to disaster risk. For example, houses in cyclone and bushfire areas have specific construction standards to help them resist these hazards. Construction in areas vulnerable to flooding, from creeks, rivers and estuaries are often subject to flood floor levels to reduce potential inundation. These are based on some anticipation of future likelihood and magnitude of events, often based on past frequency.

People's knowledge or lived experience of disaster also shape their personal choices about where they may choose to live and build. Decisions made at time of purchase or construction are embodied in the infrastructure for its life. Infrastructure quality is dependent on the extent to which appropriate standards are set, interpreted and regulated. Population growth and economic development drive housing and infrastructure demand and affordability. When these are coupled with future discounting they work against the development of higher building standards.

Location is regulated by land-use planning processes and again, population growth and housing demand and affordability, all create pressure to make land available in areas of lower cost, which can include areas more exposed to natural hazards. Building in more hazardous locations is also driven by the desirability of living close to the bush, rivers and coasts.

The choices and trade-offs during stable times

As well as reducing the risk of disaster, higher building standards and restrictions of land zoning add costs to construction and limit the availability of cheap and higher amenity land. As a result there is a balance in the specification of these instruments.

There are also trade-offs inherent in the timeframe people choose when considering location and construction. High economic returns to infrastructure may lead to choices toward lower quality. Where land use processes reflect exposure to natural hazards, flooding or fire, this may have disproportionate impact on people and businesses with lower means who cannot afford higher prices.

There can be strong resistance by many consumers and local councils to move to more conservative zoning and regulations – in part this is driven by desire for equity in access and costs between past and current developments. Moving home / renovating infrastructure and assets in response to update knowledge about risks and new technology is difficult and costly. Revising building standards and zoning is time consuming. Equity, cost-sharing and grandfathering issues are important.

The trade-offs implicit in land-use decisions are not necessarily made explicit and visible for all to see. For example, many stand to benefit in the short term for not investing in or

drawing attention to information about risks that should inform planning decisions, which creates asymmetries in who is aware of and empowered to act on risks and consequences, and leads to other planning criteria and priorities dominating. Furthermore, even where there are appropriate building regulations and standards, there are also incentives to interpret these standards to benefit short-term self-interests, especially if regulatory enforcement is weak and risks can be transferred to others. If information about the real risks is shared for existing assets, this can create further vulnerabilities if the effect is to increase insurance premiums and decrease property values, so increasing the risk of stranded assets or attracting low-income buyers who are then more vulnerable to natural hazards and impacts which would also amplify their financial vulnerability (a vicious cycle).

Other factors creating vulnerabilities include fear of litigation (e.g. councils have been challenged in court when trying to enforce tighter planning restrictions), people's expectations about desirable places to live, high demand for land development due to changing demographics, the limitations of 12-month budget cycles, and resistance to exercising preparedness for extreme events.

In a disaster

When natural hazards occur, people and buildings in their way have a chance of getting damaged or destroyed. There can multiple failures, or failures of multiple assets, leading to cascading impacts, as impact in one aspect of life, sector or service flows on to others.

In some locations the unwanted impacts and vulnerabilities of land-use decisions are already apparent, revealed by routinely occurring natural hazards. These can be viewed as early warning signs of impacts in the event of more catastrophic natural hazard events. For example, in the 'deconstructing disaster' workshop scenarios, where large urban populations were at risk, even the most fundamental communication tasks of warning the population of impending events and advising them what to do were problematic. The sheer logistics of communicating to such a large area within a narrow window of time and the lack of options available to people for changing their level of exposure, made clear the disastrous locked-in consequences of prior land-use planning decisions.

The inherent transfer of risk, and the locked-in consequences in times of disaster, contribute to cascading impacts that worsen already catastrophic outcomes. In particular, the limitations of emergency personnel are reached far sooner than would need to be the case due to higher numbers of citizens exposed to greater risks, poor accessibility to and mobility within affected areas, loss of critical infrastructure, higher losses among emergency personnel who have been put at greater risk unnecessarily, and the sheer complexity of the response and recovery requirements.

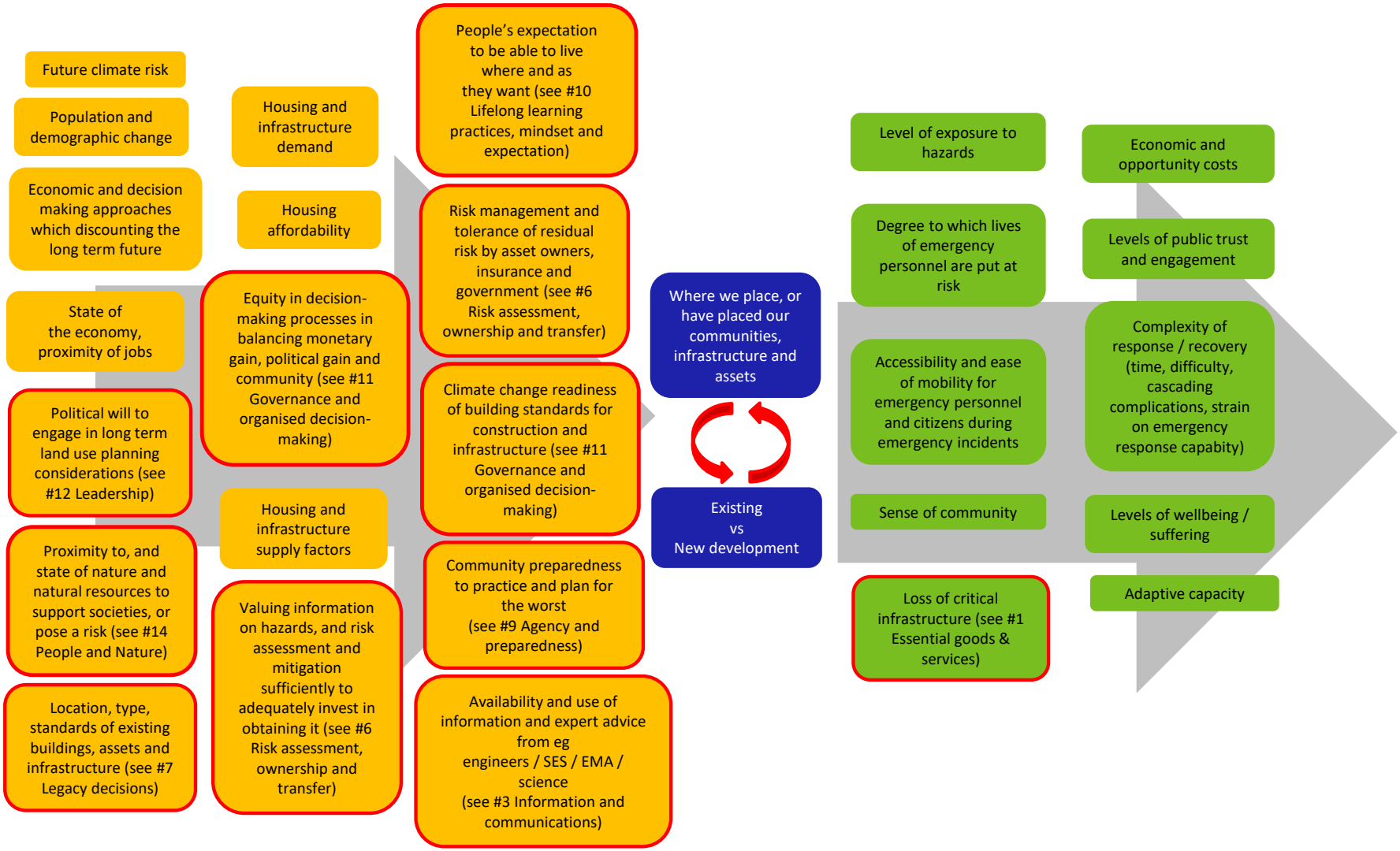


Figure 4 Where we place communities, infrastructure, assets – cause and effect diagram.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows.

5.3 Causes and effects

5.3.1 Causes (influences of)

Future climate risk
Population change • Running out of space in desirable areas • Changing industries • Demographic change • Mobility • Population growth
Housing and infrastructure demand
Housing affordability
Housing and infrastructure supply factors
State of the economy • Availability of jobs
Equity, legitimacy, accountability, adherence to legislation and transparency in development and land-use decision-making processes in balancing monetary gain, political gain and community values
People's expectation to be able to live where and as they want • People expect to live where they want • Age of entitlement, 'I want therefore I should' • People taking unacceptable risks • Curiosity placing people in harm's way during disaster
Political will to engage in long-term Land Use Planning considerations • Three year election cycle • Challenge of difficult topics • Planning changes difficult to prioritise
Climate change readiness of Land-Use Development and Planning practices • Based on personal memory, not real risk • Acceptance of risk without true appreciation of impact • Asymmetries in information on exposure to risk • Assumes static environment • Awareness and understanding the value of the building code
Adequacy of regulation / incentives for safe Land Use Planning and development • Standards for development • State vs local vs national • Inadequate provisions for risk • Availability of mortgages and insurance • Those creating risk are not liable • Misinterpretation of existing regulations • Conflicting laws (e.g. environmental protection vs hazard reduction)
Fear of legal action • Difficult for Councils to tighten restrictions at risk of legal action
Preparedness to practice and plan for the worst • Organisations, agencies (including Emergency Management)('she'll be right', lack of imagination, too contentious) • Fear of exposing vulnerabilities • Unwilling to learn
Availability and use of information and expert advice from, e.g. engineers / State Emergency Services / Environment Management Agency / science

Locked-in legacy decisions about assets and infrastructure • Locations based on historical needs, no longer current • Built around industry or infrastructure (sources of employment or services)
Economic and decision-making approaches which discounting the long-term future
Proximity to, and state of nature and natural resources to support societies, or pose a risk (see #14 Nature and people)
Valuing information on hazards, and risk assessment and mitigation sufficiently to adequately invest in obtaining it
Risk management and tolerance of residual risk by asset owners, insurance and government

5.3.2 Effects (consequences of)

Level of exposure to hazards due to buildings in high-risk areas.
Sense of community
Accessibility and ease of mobility for emergency personnel and citizens during emergency incidents
Loss of critical infrastructure (see #1 – availability, affordability of essential goods and services)
Complexity of response and recovery • Length of time and difficulty of recovery • Extent of cascading follow-up issues (e.g. disease) • Level of interstate / international support required • Level of strain on emergency response capacity
Extent to which emergency personnel lives were put at risk responding to incidents that were preventable
Levels of wellbeing / suffering • Poverty trap
Economic and opportunity costs • Length of time and feasibility of paying costs post-disaster • Cost shifting (see #6 – risk transfer) • Land values
Levels of public trust and engagement
Adaptive capacity

5.4 Key vulnerabilities *for Placement of communities, infrastructure, assets*

Identified vulnerabilities include:

- Long-term building and infrastructure decisions and investments without adequate design for climate risks that will manifest within the lifetime of the investment. This is inherently the case for older existing infrastructure with embedded legacy decisions, and is still an issue with new developments and infrastructure where climate risks and planning and development processes are continuing to create future risk.

- The risk ownership and transfer issues, described in detail in #6, are particularly prevalent in the issues of where communities, assets and infrastructure are placed, and who bears the risk and the costs.
- Routinely occurring natural hazards are already revealing preventable vulnerabilities that result from choices in asset placement, pointing to the likelihood of more catastrophic impacts when rarer (but inevitable) more extreme events occur in the future.
- Decisions are being made across different sectors without considering repercussions for emergency management, even when the decisions impact upon emergency management personnel, their effectiveness and their level of risk exposure during emergency incidents. Silo-based planning and decision making also overlooks cross-sectoral interdependencies and impacts.
- Lack of transparency about risks and associated risk transferral is contributing to vicious cycles reinforcing disadvantage and / or lack of adaptive capacity. This is compounded by lack of trusted information and data and high levels of uncertainty (or in some cases confusion due to the volume and complexity of information to digest).
- There are inconsistencies and inequities in the interpretation, compliance, and enforcement of regulations. Barriers to enforcing regulations in some jurisdictions include budgets, risk of expensive litigation and power imbalances. Retrospective implementation of codes is difficult, and stranded assets and other sunk costs create further barriers to change.
- Growing populations and absence of explicit population policies or strategies contribute to social inertia resisting change.
- Absence of regulatory power to act on some hazards (e.g. the absence of a Climate Change Act).
- Weaker community networks are making it harder to foster community cohesion in urban areas relative to rural areas.

6 Risk assessment, ownership and transfer (#6)

6.1 Summary

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

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

In a disaster, the during and in the immediate aftermath of a natural hazard event, the capacity to cope for everyone – individuals, communities, industries and governments – is in part dependent on the level of anticipation and proactive decisions taken by those bearing the risk, the scalability of emergency response capability to deal with the event, general risk awareness, implementation of the risk management and controls, agency and preparedness. Therefore the effectiveness of the risk assessment and mitigation processes and the way that they have been implemented through a range of institutional processes is critical.

6.2 Description

The central issues

The central issues are around the interplay between risk assessment and management (based around methods, data, information and knowledge), and risk ownership and transfer (based around values, decision-making and the sets of formal 'rules' in business and government).

Many standardised approaches for risk assessment have been developed, tested and applied for identifying hazards or threats, estimating the probability of their occurrence, understanding the nature and magnitude of the consequence, designing controls or mitigations to lower the risk, and then assessing the 'residual' risk. There is a vast body of literature on this topic which cannot be covered here. There are numerous standards around how to conduct risk assessments – for example the ISO 31000 series (ISO, 2009). More complicated and complex forms of risk do, however, need different approaches (e.g. (Jones et al., 2014)).

The cycle of risk creation ownership and transfer refers to the processes of designing and proposing, funding and approving, and constructing and managing assets. Whether or not risk is formally assessed or addressed, the on-ground outcome is that the elements of risk relating to physical exposure and many aspects of vulnerability are materially created through this cycle of asset planning, approvals, ownership and transfer (Young and Jones, 2016, Young, 2016). It is where the risk is operationalised, and where mitigations in a high quality risk assessment process can be proposed and implemented.

In times of stability

The issue of risk has been given more attention due to the increasing cost of disasters. Much of the effort to date has been around improved characterisation of the natural hazards, including predicting the likelihood of occurrence, the behaviour of the phenomena and the impacts. All levels of government, as well as many industries in Australia, have progressed to various levels of implementing these approaches in the context of emergency management and disaster resilience. The implementation of local scale, single hazard risk assessment and design of mitigation strategies is widely operational, though focuses more on assessment than on mitigation. This is necessary, but is not sufficient. The aspects of exposure, vulnerability, how to deal with risk in the context of low probability events that have catastrophic consequence, and more complex forms of cumulative risk with non-linear interactions at wider scales and across multiple sectors and stakeholders, are critical gaps in knowledge and form the basis for the Profile project (Crosweller, 2015).

For effective risk assessment and mitigation to be implemented, a broad set of stakeholders will need to take action, and the actions of each group will affect other groups. Additionally, the tools and data for risk assessment and mitigation are only useful if they are deployed within effective institutional processes that underpin robust decision-making (O'Connell et al., 2015).

Risk ownership and the shared responsibility of who, what and how is of critical importance and has been reviewed in the Australian context by Lukasiewicz et al. (2017). These authors found that there is a tension between the Australian Government National Disaster Resilience Strategy emphasis on government at the centre of disaster risk management and the simultaneous emphasis on 'community empowerment' and 'shared responsibility', around which there is less clarity and explanation (Lukasiewicz et al., 2017). Issues of scale are of fundamental importance to the interaction between risk assessment and management, and risk ownership and transfer. At the household scale, there are clear decision makers, and a limited set of decisions about property purchase, rebuild, retrofit or insurance. The need for highly contextualised local data is critical, and is usually not available. At the scale of local government, community or private corporations, there is a constrained set of hazards, with fewer stakeholder groups with clear decision-making structures in place. At national, state and territory levels, the needs are quite different and more complex – there are multiple hazards, multiple stakeholders with competing interests and priorities, and often no clear decision-making governance structures in place. At these higher levels, the degree of complexity is challenging, especially after incorporating; the values, attitudes and behaviours of stakeholder groups; the awareness and infiltration of knowledge; and the rules, which are the formal set of policies, incentives, regulations etc. Market drivers, issues of shared values and norms including cultural perceptions of risk tolerance and ownership, responsibilities and obligations are also important.

The choices and trade-offs during these stable times

The institutional processes for decision making lead to a cycle of risk creation when new developments or pieces of infrastructure are built, and transferred when they are sold. There are many different owners, managers or insurers involved who each bear the risk of loss and damage from disasters in different ways and at different times. Governments and businesses are often involved in the early stages, bearing risks during the development stage. But ownership is frequently transferred to individuals, businesses and/or insurers who must bear the risks from disasters for a much longer period of time, and who are frequently less able to pay for recovery, especially when there is increasing exposure to disasters. The rapidly evolving role of insurers and reinsurers and their response to quantifying and pricing risk, and the feedbacks of relevant information to customers in order to modify decisions and behaviours, is critical. Different insurers use different models of distributing the cost of premiums across risk profiles – for example some apportion costs relative to actual risk exposure, while others spread the cost across a range of risk profiles.

Initial decisions about undertaking a development considers risks during the building process itself and deliberately balances private benefits to the developing entities, with public benefits to broader society in the short term. Those initial decisions may not fully consider the risks for longer-term owners and residents, who are increasingly likely to suffer from disasters as lives are disrupted or even lost and costs of recovery soar. Even when taking risk into account is mandated, there is often a 'minimum compliance' approach taken. This ultimately disadvantages all affected residents, who may lose the ability to be positive participants in society and who may, for socio-economic reasons, be

disproportionately experienced by individuals who can't carry the cost, and thus it transfers back to government again in the form of higher recovery costs. The resulting special spending in some parts of the country rather than others, especially if funds have to be raised through national levies, constrain proactive cooperation among jurisdictions to share risk, and further entrench patterns of risk transfer.

At a higher societal scale, market drivers such as the drive for government efficiency and reduced spending as well as insurance models which may move towards apportioning premium price relative to risk exposure (rather than spreading it across a range of risk profiles) may exacerbate the impacts on vulnerable or marginalised groups of people and reduce the equity of outcomes for those who are disproportionately impacted and have the least opportunity for choice.

In a disaster

During, and in the immediate aftermath of a disaster event, the capacity to cope for everyone – individuals, communities, industries and governments – is in part dependent on the level of anticipation and proactive decisions taken by those bearing the risk, the scalability of emergency response capability to deal with the event, general risk awareness, implementation of the risk management and controls, and the level of agency and preparedness. Therefore the effectiveness of the risk assessment and mitigation processes and the way that they have been implemented through a range of institutional processes is critical.

The levels of loss, disruption, and equity of outcomes across socio-economic groups will either feed into cooperation, pragmatism, acceptance and learning or will fuel anger, blame and litigation. In part, this is dependent upon adequate accountability with respect to responsibilities and obligations, availability and quality of recovery plans and costs, perceived fairness of 'who pays' and the roles of insurance, industry, community and government in supporting the recovery.

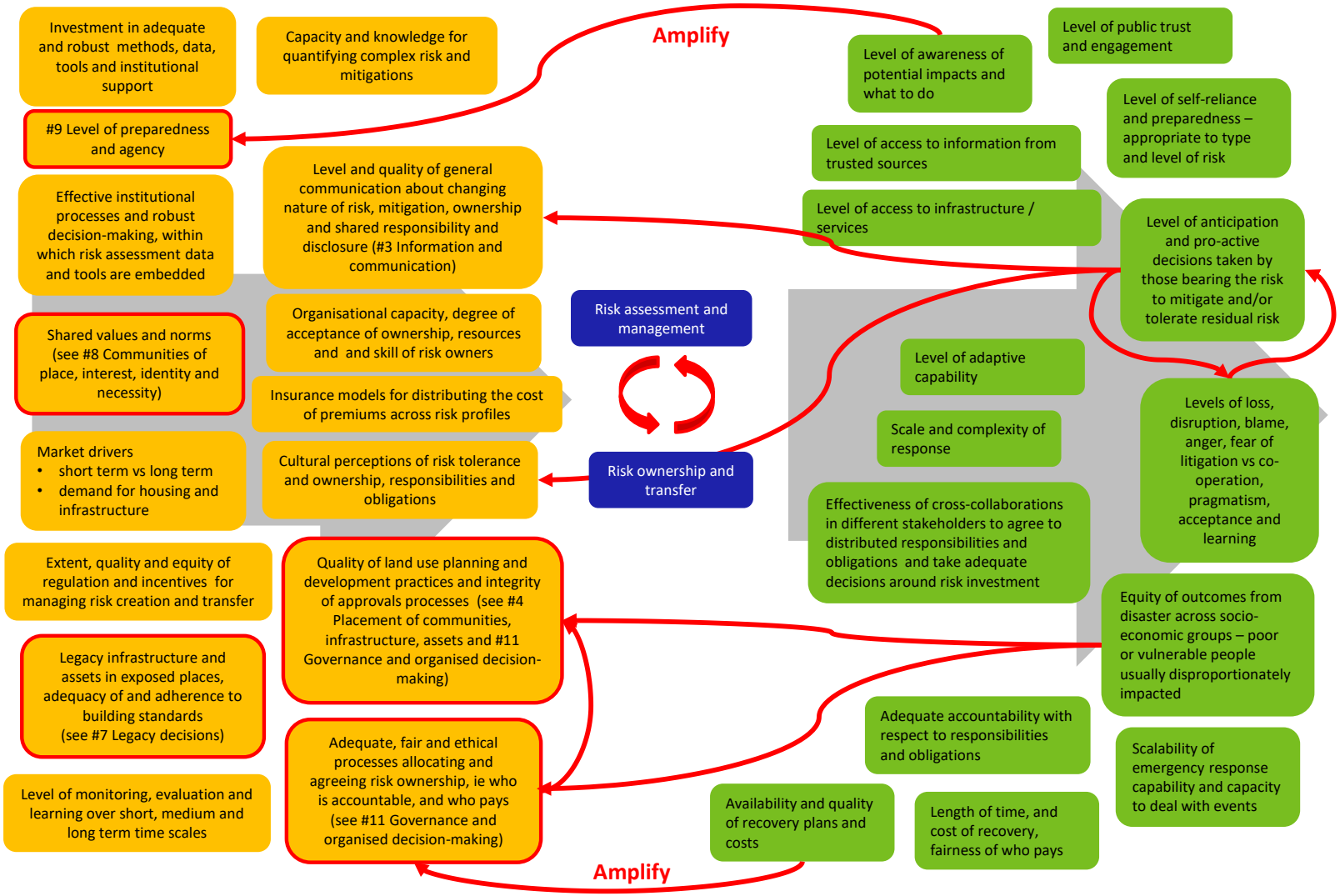


Figure 5 Risk assessment, ownership and transfer - cause and effect diagram, showing feedback loops.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows

6.3 Causes and effects

6.3.1 Causes (influences of)

Investment in adequate and robust methods, data, tools and institutional support
Capacity and knowledge for quantifying complex risk and mitigations - multiple stakeholders, multiple accounting for cumulative risks of different types, under increasingly variable and uncertain conditions
Effective institutional processes to underpin robust decision-making, within which risk assessment data and tools are embedded
Shared values and norms (see #8 Communities of place, interest, identity and necessity)
Quality of land-use planning and development practices and integrity of approvals processes (linked to #4 Information and communications and #11 Governance and organised decision-making)
Insurance models for distributing the cost of premiums across risk profiles (apportioning costs relative to risk exposure, while vs spread the cost across a range of risk profiles) and across successive owners
Legacy infrastructure and assets in exposed places, adequacy of and adherence to building standards (see #7 Legacy decisions)

Level of preparedness and agency
• Calculated risk vs no choice
• Individuals, communities, organisations
• Situational awareness
• Level of experience of a natural hazard event
  ○ Preparedness not tested
  ○ Individual, community, organisations, governments
• Level of education and connection
  ○ People, communities, systems
  ○ Networked, interconnected

Level and quality of general communication about changing nature of risk, mitigation, ownership and shared responsibility, as well as disclosure of specific risk information by insurers or government (#3 Information and communication)
Adequate, fair and ethical processes allocating and agreeing risk ownership, i.e. who is accountable, and who pays (see #11 Governance and organised decision-making)
Extent, quality and equity of regulation and incentives for managing risk creation and transfer • Retrospective • Individuals / community

- Standards
- Litigation / fear

Availability and quality of resources needed to identify and manage risk
- Assets, natural capital, social capital
- Who is accountable, who manages the risk, and who pays for the risk

Cultural perceptions of risk tolerance and ownership, responsibilities and obligations

Market drivers
- Short vs long term
- Demand for housing and infrastructure
- Profit maximising vs community building

Organisational capacity, degree of acceptance of ownership, resources and skills of risk owners
- Processes, systems, capacity, skills
- Identified interdependencies
- Assessing tangible and intangible values
- Risk literacy

Level of monitoring, evaluation and learning across short, medium and long term time scales
- Funding, skills
- Mainstreaming, cross-scales (levels of government, business, community etc.)

6.3.2 Effects (consequences of)

Level of access to information from trusted sources
- Hazard risks
- Implications / impacts
- Support / education

Level of public trust and engagement
- Confidence

Level of awareness of potential impacts and what to do
- Preparedness
- Mitigation

Level of adaptive capability and capacity
- Self, community
- institutions, governments

Level of self-reliance and preparedness
- Appropriate to type and level of risk

Scalability of emergency response capability and capacity to deal with events
- Mitigate risk
- Provide essential services
- Business / service continuity

Level of access to infrastructure / services • Supply chain, services, infrastructure • isolation
Level of loss, disruption and damage • Loss / impact • Equity of relief and support • Economic disruption • Livelihoods
Scale of complexity of response • Cascading impacts • Limitations of capability
Availability and quality of recovery plans and costs • Cost shifting, funding mechanisms • Environment and social recovery • Mitigation vs recovery • Short vs long term
Effectiveness of cross-collaborations in different stakeholders to agree to distributed responsibilities and obligations and take adequate decisions around risk investment
Equity of outcomes from disaster across socio-economic groups – poor or vulnerable people usually disproportionately impacted
Level of anticipation and pro-active decisions taken by those bearing the risk to mitigate and/or tolerate residual risk
Adequate accountability with respect to responsibilities and obligations
Length of time, and cost of recovery, fairness of who pays

6.4 Key vulnerabilities for *Risk assessment, ownership and transfer*

Main vulnerability themes:

- Analytical tools and data for risk assessment and mitigation are only useful if they are deployed within effective institutional processes, and the latter are both 'variable' and 'distributed' across relevant organisations and areas of government.
- In risk assessments, most of the existing tools, data and processes are for defining the risk, but there are few operational tools in the solutions area.
- There are challenges in applying risk mitigation tools across scale (local through to national) in terms of the number of stakeholders, the types of decisions, governance and decision-making processes, complexity of risk treatments and adaptations, and the data and information requirements. A different set of challenges arises from cross-scale

interactions and cumulative risks which are hard to quantify, and hard to apportion responsibility for.

- There is a lack of integrity and risk sharing culture across some organisations and individuals that need to share the risk, for example, a lack of Disclosure of Interest (government and developers).
- There are continuing failures in the risk planning system. Combined with growing inequalities in society, this is leading to a shift in costs to those who can least afford it, with the government being the insurer of last resort.
- As disasters related to natural hazards increase, the concept of risk- and responsibility-sharing has been increasingly emphasised, and the capacities of governments and emergency services, have been stretched. This is premised on the concept that all actors have some obligation and must work collectively to manage the risk and pay for the mitigation and/or recovery. However, the balance between the obligations of self-reliance and resilience of individuals and communities, and government and business is not clear or established and is strongly contested, especially in the wake of a disaster.
- Cultural world views regarding prioritisation of public versus private interests, individualism and choice versus control etc. influence all aspects of risk assessment and management including trust in different sources of data and information, perception of risk and allocation of responsibilities. There is a lack of understanding and mechanisms to address these aspects of risk.
- Risk ownership and responsibility (who is responsible, accountable and who pays) is contentious and needs time, skills and negotiation to achieve outcomes. There is currently a lack of clarity in relation to how shared ownership should be defined, and the governance structures required to support it. Risk allocation for event response may be relatively clear, but allocating risk ownership to strategic areas of planning that precede and follow events is not. Mitigating these risks requires high collaboration, high transaction and operational costs, and therefore requisite skills and resources to be distributed across multiple parties and longer timeframes. None of these mechanisms are in place.
- Insurability and consequences for property prices, infrastructure and other assets. As areas become exposed to higher levels of risk, they are likely to become uninsurable, unsaleable and perhaps unliveable with stranded assets burdening current owners with cost obligations even if a natural hazard has not actually occurred.
- Insurance and reinsurance companies will be called on more frequently to cover extreme costs of more frequent disasters and pricing structures are likely to alter significantly in the future. It is unclear what would happen if reinsurers are no longer able to carry the risks and costs of recurring disaster.
- Risk contagion – impacts are seen to spread across geographical and institutional borders ‘like a contagious disease’ creating a cumulative effect far larger than the initial event.

7 Legacy decisions (#7)

7.1 Summary

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

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

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

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

7.2 Description

The central issues

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

In times of stability

All sorts 'rules' exist to codify, simplify, or provide common 'guidelines' for society at large. These 'rules' can take many forms – from laws and policies and regulations from government, incentives, consultation processes, business plans, codes of conduct, building and planning codes and processes. In this way, the scope of choices made by individuals is dramatically shaped by the actions of businesses and governments, communities or societies, and by history. Once some key pieces of infrastructure exist in a location, it sets the scene for further developments that provide other related services in its vicinity. There are many, many layers and mechanisms for different rules, and therefore many unintended consequences in terms of the choices and actions that are made. These are complex to understand, and will be challenging to resolve.

Decisions are driven by societal values related to gaining prosperity in the short term, such as providing sufficient and affordable housing, generating jobs and other economic benefits, and satisfying lifestyle desires and expectations.

The choices and trade-offs during stable times

Several barriers prevent unwanted, unintended consequences of past decisions from being acknowledged and acted upon in times of stability. First, the unintended consequences are not necessarily being felt and the benefits of past decisions are still being realised. Furthermore, depending on risk governance processes, the beneficiaries of past decisions may or may not have to experience the unwanted unintended consequences. The appetite and courage to talk about anticipated unwanted consequences can be low, particularly if accompanied by political risk. For example, if anticipating and mitigating unwanted consequences involves bearing sunk costs and overturning precedents it involves unpalatable decisions and difficult trade-offs between short-term cost savings and long-term risk. It can be easier and cheaper to act in ways that serve immediate interests, transferring risk to others in the future (sometimes future generations, so raising questions of intergenerational equity). The capacity to characterise and act upon long-term risk assessment depends on the level of complexity of analysis that is tolerated within policy and governance discourse; because action can involve understanding and responding to a complex system of past decisions, path dependencies and consequences. The quality of risk governance, particularly processes for bearing sunk costs and overturning precedents, as

well as the quality of cross-jurisdictional cooperation and interoperability, all affect the degree to which decision making is proactive and the level and nature of risk transfer.

In a disaster

Historical decisions means that, in changing times, people can be highly exposed to increasing natural hazards and carry 'locked-in' risks. These can be due to historical decisions about placement of infrastructure and assets, but also less tangible legacies, such as the governance structures, values and expectations inherited from previous generations (e.g. institutions for managing common pool resources such as the Great Barrier Reef, the Murray-Darling Basin and valuable mineral deposits). In some areas historical choices now result in more loss and disruption of services, higher recovery costs, and increased human suffering, all of which risk eroding not only long-term quality of life, but also the social and personal qualities that build the resilience required to live successfully with natural hazards. The risk transfer processes and consequences are spelled out in more detail in typical system pattern #6 (risk assessment, ownership and transfer).

The extent to which stories of anticipation, preparedness and prevention are visible and such actions rewarded also play a role. Mitigation and planning actions bring their own rewards in times of disaster, however if the stories are not told and celebrated, and stories of loss, blame and daring acts of heroism dominate, it means that forethought, anticipation and preparedness are less visible and perceived to be more dull and less worthy of attention.

Together these weaken our ability sustain a prosperous future, but now that there is more understanding about natural hazards and their effects. The future consequences of land-use planning decisions could be shifted so our choices put greater value on our future prosperity.

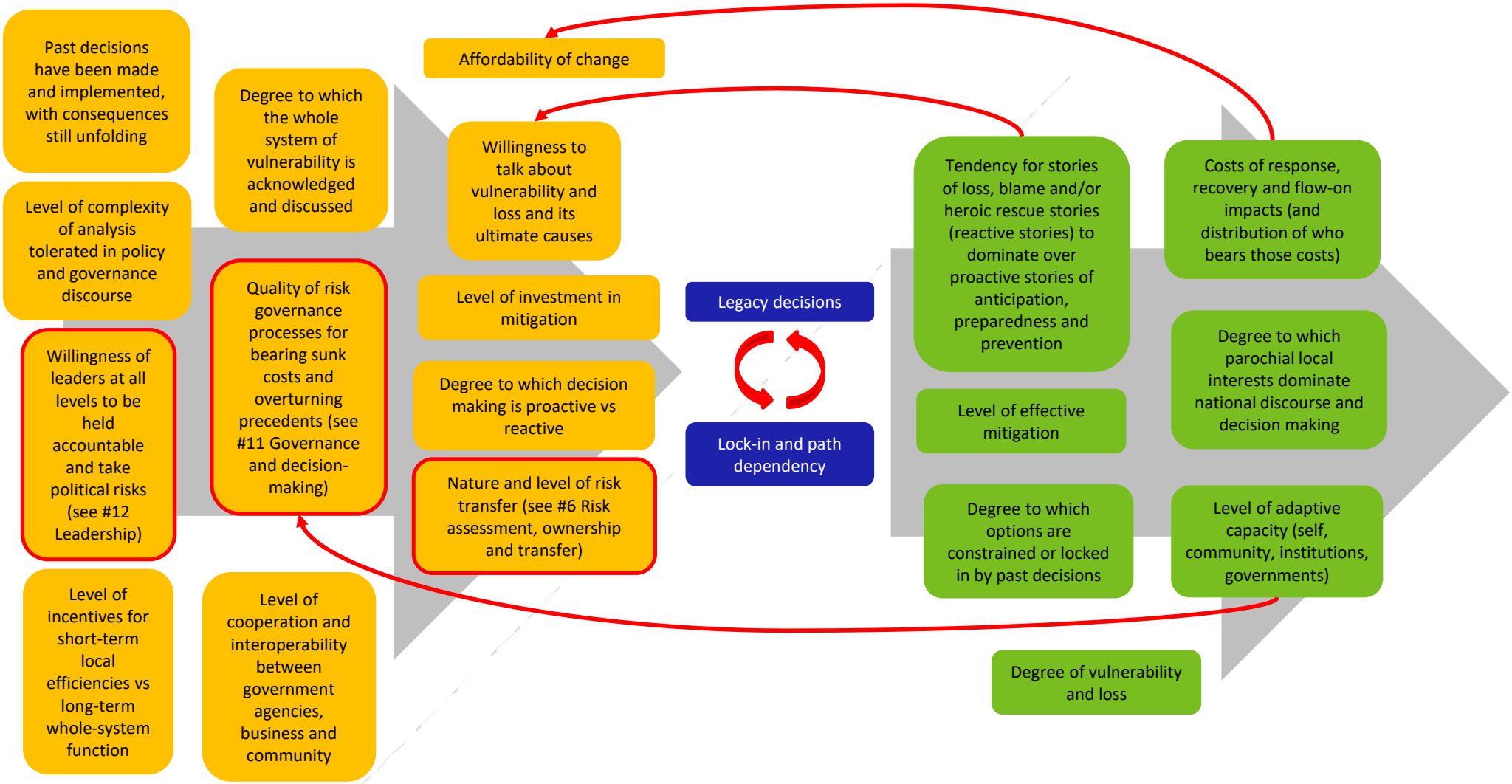


Figure 6 Legacy decisions - cause and effect diagram, showing feedback loops.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows.

7.3 Causes and effects

7.3.1 Causes

Past decisions have been made and implemented, with consequences still unfolding
Level of complexity of analysis tolerated in policy and governance discourse
Willingness of leaders at all levels to be held accountable and take political risks (see #12 Leadership)
Level of incentives for short-term local efficiencies vs long-term whole-system function
Degree to which the whole system of vulnerability is acknowledged and discussed
Willingness to talk about vulnerability and loss and its ultimate causes
Quality of risk governance processes for bearing sunk costs and overturning precedents (see #11 Governance and organised decision-making)
Level of cooperation and interoperability between government agencies, business and community
Affordability of change
Level of investment in mitigation
Degree to which decision making is proactive vs reactive
Nature and level of risk transfer (see #6 Risk assessment, ownership and transfer)

7.3.2 Effects

Tendency for stories of loss, blame and/or heroic rescue stories (reactive stories) to dominate over proactive stories of anticipation, preparedness and prevention
Level of effective mitigation
Degree to which options are constrained or locked in by past decisions
Costs of response, recovery and flow-on impacts (and distribution of who bears those costs)
Degree of vulnerability and loss
Level of adaptive capacity (self, community, institutions, governments)
Degree to which parochial local interests dominate national discourse and decision making

7.4 Key vulnerabilities for *Legacy decisions*

Key vulnerabilities include:

- The difficulty in fully exploring and understanding the yet-to-unfold consequence of historical decisions and actions, particularly when any future costs (or benefits of acting now) are heavily discounted.
- The quality of risk governance processes, particularly equitable and affordable processes for bearing sunk costs and overturning precedents (and the degree to which there is cross-jurisdictional and cross-sectoral cooperation and characterising and handling risks).
- If the consequences of legacy decisions are not recognised and acted upon cascading consequences can reduce means and options for acting upon them later in times of need.
- Failure to deal with legacy decisions risks eroding relationships between affected parties (e.g. relationships between State and Commonwealth governments).

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

8.1 Summary

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

In times of stability, communities are created by people based on their geography, their interest or willingness, their levels of skills and knowledge, and their capacities to engage with others. This capacity is influenced by both individual and collective levels of economic means, health and the existing social capital and communication within that community. Governments and markets can influence the development of communities through investment in infrastructure (both hard and soft), incentives, and the quality of representation and leadership provided to these communities. Yet, there is a trade-off between what may be good or ideal for the individual and what may be good or ideal for the collective or wider society. In these 'stable times', people can be individualistic, choosing to engage with their communities as, when and how they wish. This individuality allows people to choose to belong to, or not, various networks.

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

When disaster strikes, the amount of harm felt across individuals and the community is in part determined by the level of community preparedness. The level of preparedness is affected by a number of things including but not limited to; the agency individuals and communities have to access information and maintain awareness, their level of self-sufficiency, the level of connection between people, experience of prior events, dependence on others, and things that can their help or hinder this access. This level of preparedness can be high or low. The vulnerability of individuals and communities is increased resulting in a new or greater reliance on the support from formal and informal networks, services and

capacities at a time when these services and networks are also challenged (greater need, interruption in service, networks broken).

The central issues

The central issues can broadly be described as the level of community cohesion, inclusion and sense of belonging people have for their communities of place, interest, identity and necessity. These elements are related to relationships, values, personal choices, and responsibilities people take upon themselves.

People simultaneously belong to multiple communities which can be geographic, and/or 'of interest or practice'. Communities of necessity can spring up whenever there is a specific need; such as a temporary power outage or a disaster where people might be stranded in a commute home from work, or in an evacuation shelter with a bunch of strangers – and may be there for an extended period and need to work together.

The degree of community cohesion, inclusion and belonging is core to what makes a liveable society in both the good times and the bad.

In times of stability

Communities are created by people based on their geography, their interest or willingness, their levels of skills and knowledge, and their capacities to engage with others. This capacity is influenced by both individual and collective levels of economic means, health and the existing social capital and communication within that community. Governments and markets can influence the development of communities through investment in infrastructure (both hard and soft), incentives, and the quality of representation and leadership provided to these communities.

The choices and trade-offs during stable times

In times of stability there is a trade-off between what may be good or ideal for the individual and what may be good or ideal for the collective or wider society. In these 'normal times', people can be individualistic, choosing to engage with their communities as, when and how they wish. This individuality allows people to choose to belong to, or not, various networks.

While this level of choice is desired or celebrated, it can also make us vulnerable if we don't put the required effort into creating or maintaining nurturing relationships (family, community etc.). This vulnerability is exacerbated if we also don't spend the time growing our knowledge, capacities, and awareness of others or contributing to our communities (place-based and others)(Bandura, 2000).

The current situation is not usually the stated preference of individuals, however, other life drivers / choices make it the default option. Reasons for this include the 'busy-ness' of everyday life, the drive to get ahead / to be individually successful, the growing mobility of people, and seeking the comfort of the familiar (Brown, 2017).

These everyday choices result in varying individual-level adaptive capacities and are related to their 'attachment to place, social networks, and duration of residence' (Waters and Adger, 2017). This also impacts community resilience or adaptive capacity, as low level of social cohesion not only prevents a community from responding effectively to an event, it can also weaken community resilience in the aftermath of a disaster (Hikichi et al., 2016).

In addition to individual choices, the quality of government representation of the community, as well as government's willingness and ability to fund facilities and services to support and encourage cohesion, inclusion, belonging and mitigate inequalities are constrained by limited budgets, conflicting policy and short-term policy agendas, as well as a lack of trust (Wilkinson and Pickett, 2010).

Inequalities in society are systemically entrenched in Australian society due to predominance of policies that promote commercially-oriented development and conservative mindsets that promote small government or roles for government. The combination of smaller government, large public-sector debt, and less regulation of markets is creating larger numbers of marginalised or disadvantaged individuals and groups with declining access to resources, incomes and jobs, capacity and weakening societal safety nets, all of which lowers an individual's latitude to engage in communities (Wilkinson and Pickett, 2010).

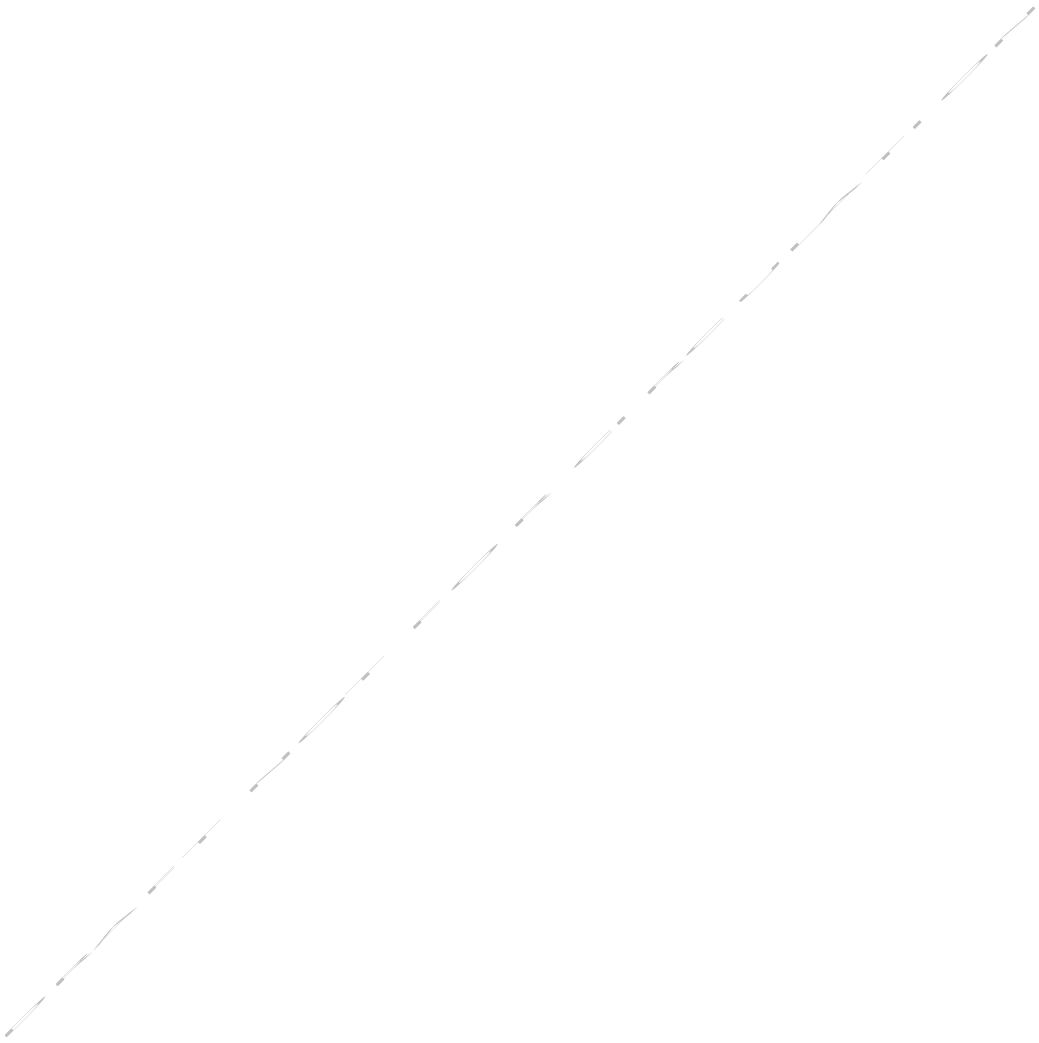
In a disaster

When disaster strikes, the amount of harm felt across individuals and the community is in part determined by the level of community preparedness. The level of preparedness is affected by a number of things including, but not limited to: the agency individuals and communities have to access information and maintain awareness, their level of self-sufficiency, the level of connection between people, experience of prior events, dependence on others, and the things can their help or hinder this access. This level of preparedness can be high or low. Vulnerable groups can become differentially impacted during disasters and emergencies, and require specific planning and preparedness measures (e.g. (Department of Health and Human Services, 2017, Howard et al., 2017))

In a disaster, the vulnerability of individuals and communities is increased resulting in a new or greater reliance on the support from formal and informal networks, services and capacities at a time when these services and networks are also challenged (greater need, interruption in service, networks broken).

Levels of resilience in post-disaster periods can be improved by interventions such as: information to help individuals manage emotion, make effective decisions and plan; enable access to resources; face to face communications to restore or create new social connections; and the rebuilding of community capacity through coordination of volunteers and donations and policies that manage disaster risk (van Kessel et al., 2015). The levels of post-disaster depression and post-traumatic stress disorder are linked closely to the effectiveness of social networks (Bryant et al., 2017)

The main vulnerability themes surfaced through the workshops were: 1) the unequal distribution (spatially, socio-economically) of the impacts / costs and abilities / capacity to cope or adapt to disasters; 2) the short-term and primarily profit-oriented nature of land-use planning and development decisions that have and continue to put people and houses in harm's way; 3) the rise in the prioritisation of the individual over the collective; and 4) the declining capacity and funds of emergency management agencies to understand, engage, communicate with communities in developing preparedness plans and responding to disasters.



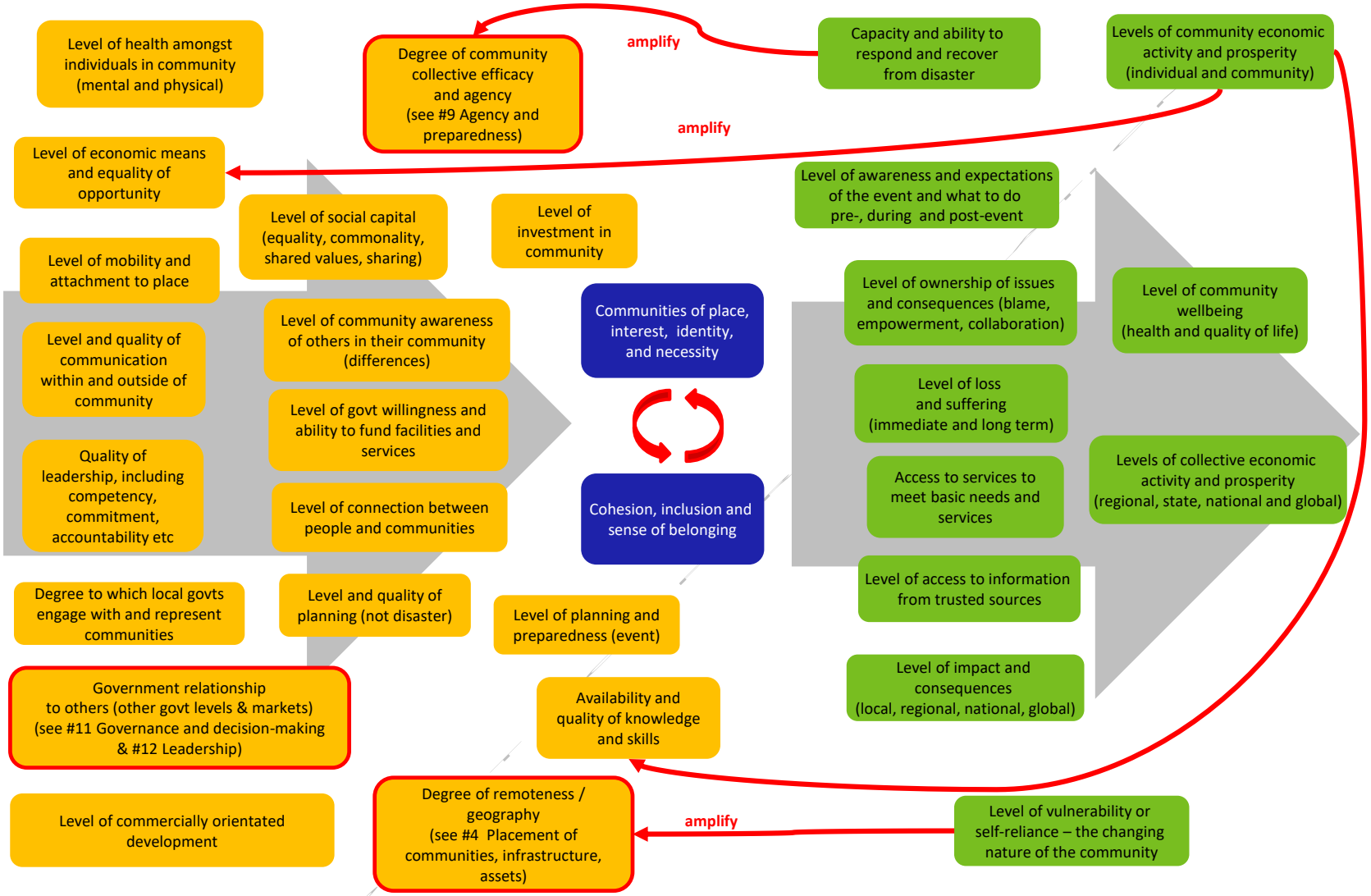


Figure 7 Communities of place, interest, identity and necessity - cause and effect diagram, showing feedback loops.
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8.2 Causes and effects

8.2.1 Causes (influences of)

Quality of leadership, including level of: • Competency and commitment • Accountability • Values (honest, inclusive etc.) • Community orientation • Understanding of local needs and values
Degree to which local governments engage with and represent communities • downward accountability
Government relationship with others, including • Level of trust between state and local governments, and communities • Level of understanding of roles and responsibilities • State and federal roles
Levels of government willingness and ability to fund services and facilities • These are heavily influenced by mindset or ideology. Prevailing ideological based on unfounded principles, assumptions and ideas such as 'small government to minimise chance of government failures', 'markets are the best institutional arrangement for achieving efficient allocations of resources including critical infrastructure and public services', 'governments should minimise interference / regulation', 'low corporate taxes (as this stimulates jobs, incomes and economic growth)'.
Level and quality of planning (not disaster) • Standards and guidelines • Rules • Anticipatory
Level of planning and preparedness (event) (individual, community, institution, government) • Availability of emergency plans • Degree of community participation in recovery planning
Level of social capital • Shared values • Degree of commonality (purpose, location) • Social justice • Equity of access • Level of diversity of local needs and values • Level of connection and belonging • Inclusive - degree to which people feel 'forgotten' or excluded • Shared responsibility for others and space • Sharing of resources, information, knowledge and history • Degree to which local values supported • Degree of building vs wearing away social fabric of community
Level of health among individuals in the community • Mental and physical • Age profile
Level of economic means and equality of opportunity
Level of mobility and attachment to place

Level of connection between people communities
- Within and outside communities
- People too busy to initiate / maintain contact

Level and quality of communication
- Within community
- With those outside of community
- Level of access to information from trusted sources

Level of community awareness of others
- Vulnerable people in their neighbourhood
- Differences

Degree of community of collective efficacy and agency (see #9 Agency and preparedness)
- Level of community self-reliance
- Degree of assistance needed
- Extent / number of communities needing assistance
- Optimism bias - ('it won't happen to me')

Availability and quality of knowledge and skills
- What social resources does the community have to draw on, e.g. trades, professionals, special-needs etc.?

Level of investment in community
- Level of effort put into making and maintaining connections (festivals, …)
- Range of incentives (buying locally, etc.)
- Level of opportunity for community to contribute and be listened to

Level of commercially-oriented development
- Economic activity and productivity
- Main motivating objectives of agencies is maximise profit and efficiency
- Narrow cost-benefit analysis is applied to inform investment decisions
- Markets proposed and supported as the best means of allocating resources
- Low levels or weak regulation of markets

Degree of remoteness / geography (see #4 Placement of communities, infrastructure, assets)
- Location of communities

8.2.2 Effects (consequences of)

Capacity and ability to recover from disaster
- Length and level of effectiveness of recovery

Levels of community economic activity and prosperity
- Individual
- Community

Levels of collective economic activity and prosperity
- Regional
- States and Territory
- National
- Global

Level of awareness of the event and what to do pre-, during and post-event
- Level and quality of preparedness
- Physical (capability)
- Material (what resources are required)
- Psychological (mental preparedness)

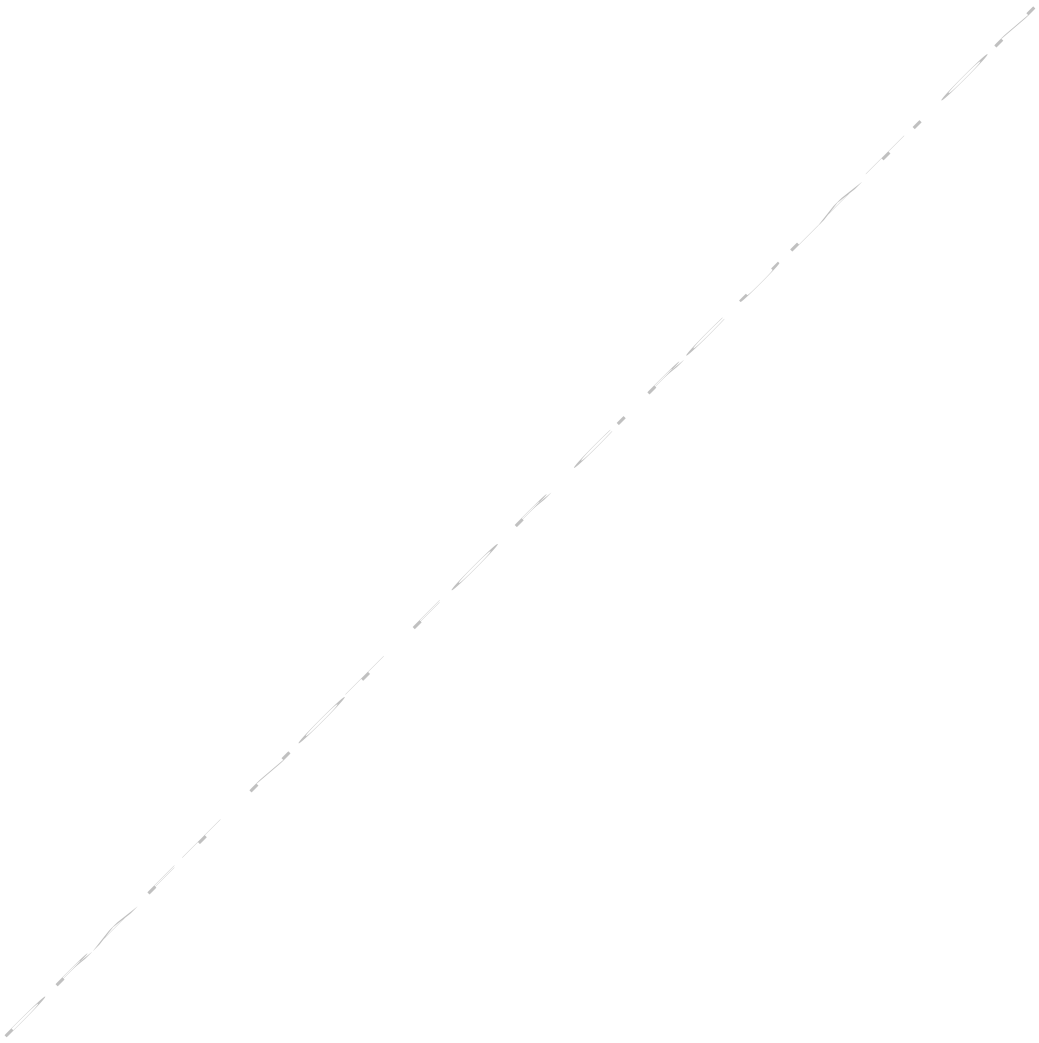
Level of ownership of issues and consequences • Blaming others • Done ‘to’ people vs ‘with’ people • Community initiative C empowerment
Level of community wellbeing • Mental and physical health • Quality of life
Level of loss and suffering (immediate and long term) • Level of stress • Individuals, family, carers – inability to access info, support, services
Level of access to information from trusted sources
Access to services to meet basic needs and services Level of loss of access to essential needs: food, water, shelter, health, safety, critical infrastructure
Level of impact and consequences (environment, social and economic) • Local • Regional • National • Global
Level of vulnerability or self-reliance • Changing nature of the community (positive / negative)

8.3 Key vulnerabilities for *Communities of place, interest, identity and necessity*

Main vulnerability themes in the discussions were:

- The unequal distribution (spatially, socio-economically) of the impacts / costs and abilities / capacity to prepare for, cope with, or adapt to disasters.
- The short-term and primarily profit-oriented nature of land-use planning and development decisions that have and continue to put people and houses in harm’s way.
- The declining capacity and funds of emergency management agencies to understand, engage, and communicate with communities in developing preparedness plans and responding to disasters.
- The current reliance on communication infrastructure for multiple sources of knowledge (e.g. telephone, maps / directions, information). This compounds the challenges during an event due to system / infrastructure failure and of not being able to communicate.
- The current quality of life is fragile, lacks redundancy, and relies on the current systems working optimally. How do we maintain or improve quality of life pre- and post- events?

- Events impact on the health of the community, both physically and mentally over the immediate, short and sometimes long term. To an increasing degree how the health of community impact on the ability to prepare and respond (e.g. ageing or increasingly obese communities).
- The role formal leadership (good and bad) plays in creating or catalyzing a community, before, during and after an event.



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

9.1 Summary

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

In times of stability, strong local communities with trusted leaders are more likely to positively depend on each other and self-organise in order to respond to disaster in ways that continue to unite the community, get the community functioning sooner, enabling faster and more effective return to normal. This reduces loss and suffering in the immediate (post-disaster), medium (during recovery) and long (after next disaster) term. Parallel to this is the connection to government and organisations, who are often seen by the community as providers of information, facilities and services. This can be in place of, or complementary to, community organised aspects of preparedness.

Community-organisation / government partnerships for event preparedness are more effective where there is a self-organised motivated community to provide guidance and leadership and drive responses. This cooperation can reduce loss and suffering during an event, as well as build trust and generate shared learning when preparing for and recovering from future disasters. This then builds the (adaptive) capacity of organisations and governments to work with the community, as well as building self-reliance within the community. The level of adaptive capacity of all players in the system contributes to the quality of the emergency response and lives saved or injuries prevented, and the speed and quality of the return to normal.

In a disaster where a community has low agency and preparedness there is often a low level of awareness of what is happening and how to respond which is exacerbated by a lack of shared trusted information. This leads to a shortfall in human capital for emergency response and a wider event impact and a low quality of emergency response. Access to essential needs is compounded by the individual and community's lack of time, self-

sufficiency and just-in-time reliance on facilities and services. Leading to greater injury, suffering and loss of life, and a longer time to return to 'normal'.

9.2 Description

The central issues

There are many things that grow or weaken agency, know-how, experience and preparedness of individuals, communities, organisations and governments. To have agency is to intentionally enact change by one's actions, and requires forethought, self-reactiveness and self-reflectiveness (Bandura, 2018). For individuals and communities this relates to the degree of self and collective efficacy which influences levels of motivation, self-regulation, learning and achievement. There is also the ability to influence others to direct change, and this type of efficacy is related to levels of connection between people and communities, their economic means and their health and education.

Personal or community resilience can be viewed as a product of developing self-efficacy which in turn contributes to agency and self-sufficiency (Bandura, 2000). If all of these are high, especially when combined with prior knowledge or experience of a hazard event, the individual or community will have a high level of collective preparedness, with the know-how and agency to deal with the situation.

In times of stability

Strong local communities with trusted leaders are more likely to positively depend on each other and self-organise in order to respond to disaster in ways that continue to unite the community, get the community functioning sooner, enabling faster and more effective return to normal. This reduces loss and suffering in the immediate (post-disaster), medium (during recovery) and long (after next disaster) term.

Parallel to this is the connection to government and organisations, who are often seen by the community as providers of information, facilities and services. This can be in place of, or complementary to, community organised aspects of preparedness. Government and organisations are constrained by rules and resourcing, as well as values associated with their mandates. This influences the quality and effectiveness of leaders, as well as the skill and attitude of staff within the organisations or departments. In particular the skill and attitude of agencies to 'work with', rather than 'do to' communities in terms of growing community capacity, networks, belonging and preparedness.

The extent to which government departments 'work with', as opposed to 'doing things to', communities can have a large impact on loss and suffering in the immediate, medium and long term. To work with communities, organisations need internal capacities and to have earnt the trust of the community, as well as an external authorising environment (suitable rules). Community-organisation / government partnerships for event preparedness are more effective where there is a self-organised motivated community to provide guidance and leadership and drive responses. This cooperation can reduce loss and suffering during

an event, as well as build trust and generate shared learning when preparing for and recovering from future disasters. This then builds the (adaptive) capacity of organisations and governments to work with the community, as well as building self-reliance within the community. The level of adaptive capacity of all players in the system contributes to the quality of the emergency response, lives saved or injuries prevented, and the speed and quality of the return to normal.

The choices and trade-offs during stable times

The nature of the trade-off is the balance between planning and preparing for the future and dealing with the busy now. This is true for individuals and communities who in a disaster stand to lose homes, livelihoods and loved ones, leading them to wish that they had been better prepared both in terms of planning and know-how.

The reason for this trade-off in normal times is the busy-ness of life, the societal blindness to caring roles / work (Knowles et al., 2016), the increasing disconnection to the local community with growing mobility of people and increasing connection to online relationships and communities of choice (sports, craft, special interests etc.)(Cebr, 2017). This is exacerbated by rising inequality, and overreliance on facilities and services which have become increasingly dependable and are no longer expected to fail (Wilkinson and Pickett, 2010).

This trade-off is also true for organisations and governments who stand to lose the trust and support of individuals and communities, and over the longer term funding or power. They may wish they had been better prepared, adaptable and engaged with the community and other organisations or departments prior to the event. The reason for this in normal times is due to short policies cycle and lack of bipartisan approaches, together with a siloed approach to government activity and funding, with current rules and access to information constraining leaders within these organisations and departments. Norms within these organisations and departments is also focused on disaster response rather than preparation, and learning from the past without anticipating the future might be different.

There are some counteracting choices available, with individuals and communities choosing to step back from a fast paced life to grow their efficacy and collective agency through local action, such as installing water tanks and solar cells, farmers markets, local currencies, and strengthening community participation through field days. Some government organisations and departments are starting to work across silos, and to engage more effectively with the communities they represent.

In a disaster

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

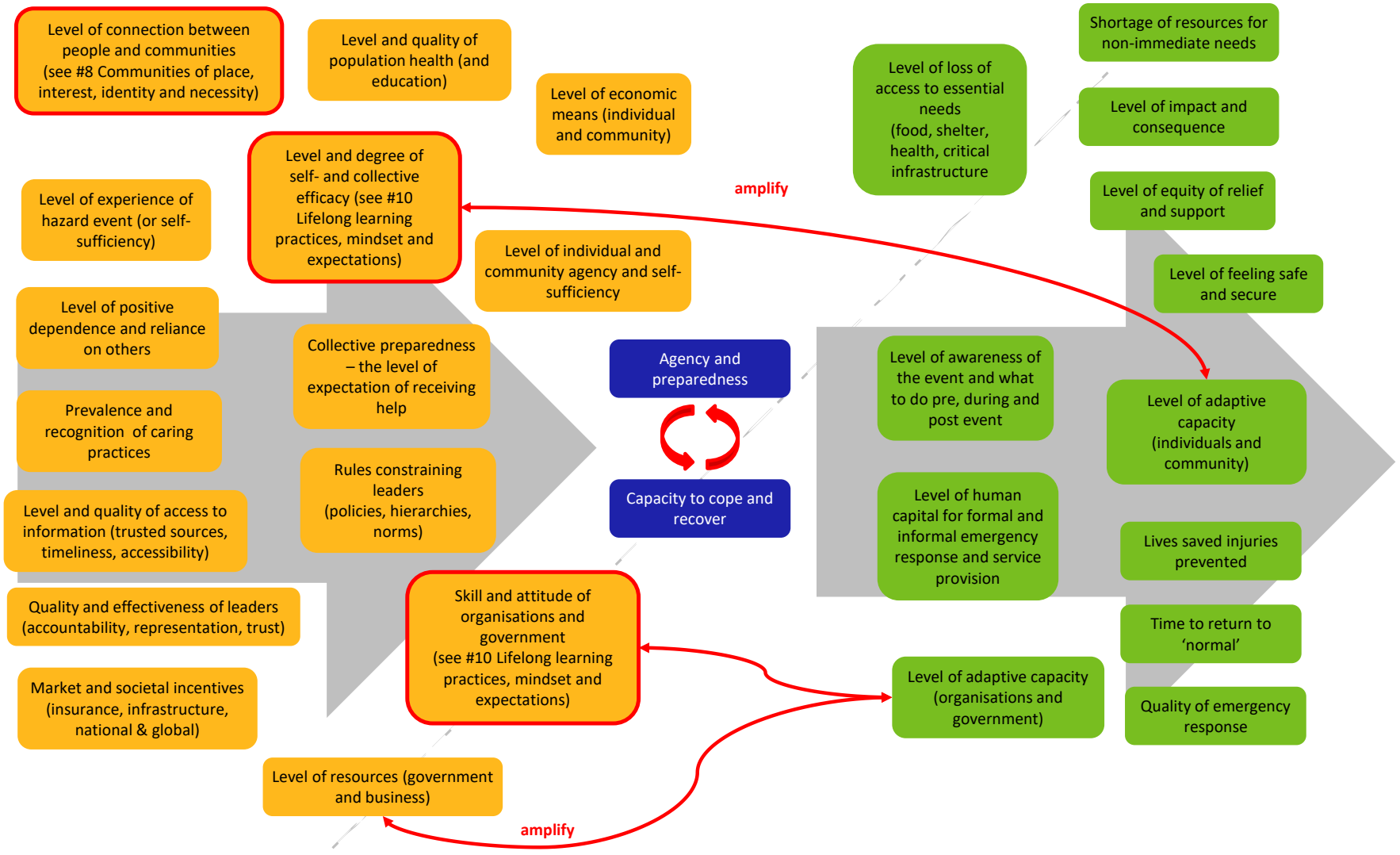


Figure 8 Agency and preparedness - cause and effect diagram, showing feedback loops.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows

9.3 Causes and effects

9.3.1 Causes (influences of)

Level of economic means (individual and community)
Level and quality of population health • Habits (good / bad - overwork, lack of sleep and exercise) • People with mobility issues • Age distribution
Level of connection between people and communities (linked to #8 Communities of place, interest, identity, and necessity) • Connection between people and communities • Commitment to place-based community, shared purpose, understanding and trust (this links to equality and inclusion etc.) • Level of shared / common values • Commonality of interests and experiences that catalyse unity • Desire to be part of the local community
Level of experience of a natural hazard event • Include other types of experience e.g.. living remotely, extreme camping, having grown up in a developing country etc.
Degree of self and collective efficacy (linked to #10 Lifelong learning practises, mindset and expectations) • Previous experience (self-reflective and assessment) • Learning from others (vicarious) • Social persuasion • Physiological indexes (mental load to do something) • Leads to agency – motivation, self-regulation, learning and achievement
Level of agency and self-sufficiency (individuals, communities, decisions) • Level of motivation, self-regulation, learning and achievement • Experience or ignorance on how to help • Ability to self-organise • Links to economic means
Level of positive dependence and reliance on others, sharing and relying on: • Decisions made • Manage risks • Infrastructure • Access to essentials
Level of collective preparedness • Level of expectation of receiving help from outside
Prevalence and recognition of caring practices • Education and infrastructure • Invisibility of care work • Multiple forms of capital available for helping others

Level and quality of access to information
• Trusted sources
• Ease / frequency of access
• Level of willingness to share info and effort:
  ○ Individuals
  ○ Institutions
  ○ Governments
• Link to communication, community, leadership and trust

Quality and effectiveness of leadership • Effectiveness, accountability, representation, trust (ethics)
Rules constraining leaders (formal and informal) • Policy, hierarchies and norms
Level of resources (government, business)
Skill and attitude of organisations and government (emergency, health, social services etc.) • Able to engage with communities, local leaders and understand their needs, strengths and vulnerabilities • Priorities match community needs • Level of investment • Level of learning
Market and societal incentives • Insurance – i.e. where and how we (re)build • Infrastructure • Land / other resource development • National and global markets (export, import)

9.3.2 Effects (consequences of)

Level of impact and consequence
Level of loss of access to essential needs: (food, water, shelter, health, safety, critical infrastructure)
Shortage of resources for non-immediate needs
Level of equity of relief and support
Level of feeling safe and secure
Level of adaptive capacity: (individuals, community)
Level of awareness of the event and what to do pre-, during and post-event • Learning • Access to information (trusted source) • Links to adaptive capacity
Level of human capital for formal and informal emergency response and service provision • Human capital available in formal and informal emergency response roles • Gap between emergency capacity and requirements
Level of adaptive capacity: (organisations, governments)
Lives saved and injuries prevented
Time to return to normal (normalcy established)
Quality of emergency response

9.4 Key vulnerabilities for A*gency and preparedness: individuals, communities, governments and business*

Main vulnerability themes include:

- Societal changes in expectation and reliance on services, such as the just-in-time access to basic essentials (food, water, money), or fast, convenient information and communication tools through mobile telephones and the internet. This is not just an individual or community vulnerability, but also a government and organisational one, as we direct towards efficiency we collectively fail to prepare or build redundancies.
- Level of experience of a natural hazard event, especially as the scale and severity events change due to climate change. In communities most people can't imagine what we might face or how to get prepared, and have a significant dependence and reliance on others, especially the government to respond. At the same time there has been a breakdown in community and spirit, leading to a loss of positive reliance, dependence and skills at the community level to pull together when needed.
- The growing inequity in Australia is in some cases widening the equity of relief and support during an event, with some communities having the economic means enabling self-sufficiency (water tanks, solar power etc.) and to leverage government for swifter recovery. While other people have limited choice and personal agency to avoid living in hazard areas. This can also be compounded during an event due to a loss of income or assets creating a cycle of disadvantage. There are also differences between rural and urban communities, although unless extremely remote, this is mostly still driven by differences in socio-economic inequities.
- Governments and agencies can compound their own vulnerabilities associated with agency and preparation by a lack of willingness to share information and effort with other entities or the communities they work with. This relates to the level of social connection and adaptive capacity, and contributes to poor policy, decisions and accountability.
- In addition to a lack of willingness to share information, governments and organisations can suffer from a lack of access to useful information from trusted sources. This can lead to a lack of transparency or transference of risk, which is exacerbated by short time horizons and a lack of system perspective in decision making and planning.

10 Lifelong Learning Practices, mindset and expectations (#10)

10.1 Summary

The central issues focus on opportunities for experience-based learning that can be created throughout life so that people are better at looking after themselves and others, both during emergencies and in times of stability. This system pattern represents learning practices across society, and how they shape societal outcomes in times of disaster. It considers the whole person, including spiritual and emotional dimensions of mindset, identity (individual and group), level of opportunity (privilege), how these flow into shaping expectations, and what people feel entitled to. Many of these personal attributes are learned and also affect how we learn and the expectations we place on others. Lifelong learning, particularly social learning is a vital attribute for adapting to and responding to change. If effective, social learning generates shared ways to gain knowledge that lead to changes in practice. Lifelong learning is more than formal education. It includes experiential learning ('learning by doing'), cultural activities such as art, stories and songs, as well as the acquisition of specialist knowledge in trades and professions, local knowledge of people and places, and social and personal awareness. The capacity to cope with change requires abilities in systems thinking, strategic thinking, anticipatory learning and interpersonal skills for collaborating with others. These skills and lifelong learning practices are as important in business and government as they are at the community level.

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

In a disaster, everyone feels grief and despair when there is a loss and this can be greatly influenced by prior expectation. For example, if there is an expectation or entitlement to 'safety', it can be a shocking surprise when something unsafe happens. This can manifest as anger and blame about the unfairness of the situation. In contrast, shaping expectations around what events might possibly happen, and mentally preparing for those possibilities as well as physically preparing for improving the likelihood of better outcomes, helps to mitigate post-event trauma and anger. Learning practices for improving personal and social awareness and communication skills give people the experience to work effectively together

when responding to emergency situations. Governments and businesses that foster lifelong learning practices are better equipped to connect with and learn from a more diverse range of people and knowledge sources, and grow their adaptive capacity and ability to deal with extreme events. Learning after disasters helps build adaptive capacity and reduce the risks of the same thing happening again.

10.2 Description

The central issues

The midst of a hazardous incident is not the time to be learning about basic survival needs or discovering the challenges of how to work in groups to solve difficult life-threatening problems. Opportunities for experience-based learning can be created throughout life so that we are all better at looking after ourselves and others both during emergencies and in times of stability.

This system pattern represents learning practices across society, and how they shape societal outcomes in times of disaster. It considers the whole person, including spiritual and emotional dimensions of mindset, identity (individual and group), level of opportunity (privilege) and how these flow into shaping expectations and what people feel entitled to. Many of these personal attributes are learned, and also affect how we learn and the expectations we place on others (Chamlee-Wright and Storr, 2010). Lifelong learning, particularly social learning[1] is a vital attribute for adapting to and responding to change. If effective, social learning generates shared ways to gain knowledge that lead to changes in practice. Lifelong learning is more than formal education. It includes experiential learning ('learning by doing'), cultural activities such as art, stories and songs, as well as the acquisition of specialist knowledge in trades and professions, local knowledge of people and places, and social and personal awareness. The capacity to cope with change requires abilities in systems thinking, strategic thinking, anticipatory learning and interpersonal skills for collaborating with others. These skills and lifelong learning practices are as important in business and government as they are at the community level.

In times of stability

Anticipatory learning is forward looking in order to craft decisions and actions that will shape the future. It involves learning from the past, monitoring of current trends, deliberately imagining and preparing for surprises or shocks, building anticipatory capacity and using planning and decision-making tools that support adaptation and change. In times of stability, most attention on learning is within the formal education system with a focus desktop-based learning for children and specialist training for particular careers for older students. Learning environments are created deliberately as safe places for people to make

[1] "Social learning", defined as "knowledge-sharing, joint learning and knowledge co-creation between diverse stakeholders around a shared purpose, taking learning and behavioural change beyond the individual to networks and systems."

mistakes and learn. These learning environments are equipping students for 'normal' life, and also play a role in shaping experiences of what 'normal' is and setting expectations of what to expect in life.

The choices and trade-offs in stable times

Access to and the quality of lifelong learning depends on financial means and resource availability. Poverty can impose a cognitive burden that dulls the capacity to think deliberatively, connect with others, or engage with business or government. Even in the absence of poverty, learning practices can be under-resourced if the long-term benefits (including benefits of prevented costs) are not adequately recognised and accounted for. In a sustainable, resilient learning system, the long-term benefits of investing in learning are recognised and valued and the beneficial outcomes are used to create new means for ongoing resourcing of learning practices.

Workshop participants and the Partnership Team pointed to a trade-off between the benefits of avoiding risks in order to create safe learning environments and the benefits of engaging with risks in order to be better familiar with and prepared for them. Risk avoidance can foster an expectation that it is others' responsibility to make life safe for us, whereas having some exposure to and skills in navigating risks wisely builds skills in living with real world risks.

There is a balance between encouraging reliance and setting expectations that things are not always 100% safe. People need to have some self-reliance, and yet not so that governments or agencies step back from their duty of care obligations and responsibilities. The responsibility of coping with stresses, disaster and trauma cannot be placed solely on individuals, but nor is it helpful to have people reliant on the system; they do need to learn and build their capacity.

In a disaster

Everyone feels grief and despair when there is a loss and this can be greatly influenced by prior expectation. For example, if there is an expectation or entitlement to 'safety', it can be a shocking surprise when something unsafe happens. This can be manifest as anger and blame about the unfairness of situation. In contrast, shaping expectations around what events might possibly happen, and mentally preparing for those possibilities as well as physically preparing for improving the likelihood of better outcomes, may help to mitigate post-event trauma and anger (Forbes et al., 2015).

When crisis does happen, people can step up and feel empowered even if nobody can get in to help them and they are isolated from the system. They can feel in control, have agency and be connected to a common cause. Our systems for learning in times of stability risk preventing this sense of agency that is possible during a crisis.

During emergency incidents, informal groups formed by necessity in specific locations are vital for caring for people's basic needs, and to connect and engage with relevant businesses, organisations and government agencies to deal with situations and recover

swiftly. Their effectiveness is shaped by the quality and effectiveness of anticipatory and other individual and societal learning practices in the years preceding any incident. Learning practices for improving personal and social awareness and communication skills give people the experience to work effectively together when responding to emergency situations. Governments and businesses that foster lifelong learning practices are better equipped to connect with and learn from a more diverse range of people and knowledge sources, and grow their adaptive capacity and ability to deal with extreme events.

Learning after disasters helps build adaptive capacity and reduce the risks of the same thing happening again. Learning what happened, who was responsible, who benefited and who was harmed helps inform the distribution of compensation for damages, as well as addressing processes that may have caused vulnerabilities in the first place. There are vulnerabilities in this learning process because reflecting on past actions, particularly if mistakes were made, exposes people to blame and personal financial and reputational losses. Where there is conflict or intrigue it can drive intrusive media and public scrutiny.

Learning can happen at different levels, ranging from understanding what happened in order to refine existing practices, through to reflecting on underpinning values, principles and expectations in order to bring about system-level social change. Experiencing and recovering from trauma can be made more bearable with reflective and reflexive learning practices that foster empathy, compassion, forgiveness, generosity and love in the most difficult of times. Where there is potential for high levels of post-traumatic stress, ideally these would instead be opportunities for seeking post-traumatic growth. There are many stories from communities where individuals talk about all the ways they have benefited and grown from loss, and they have found ways to thrive by learning from disaster.

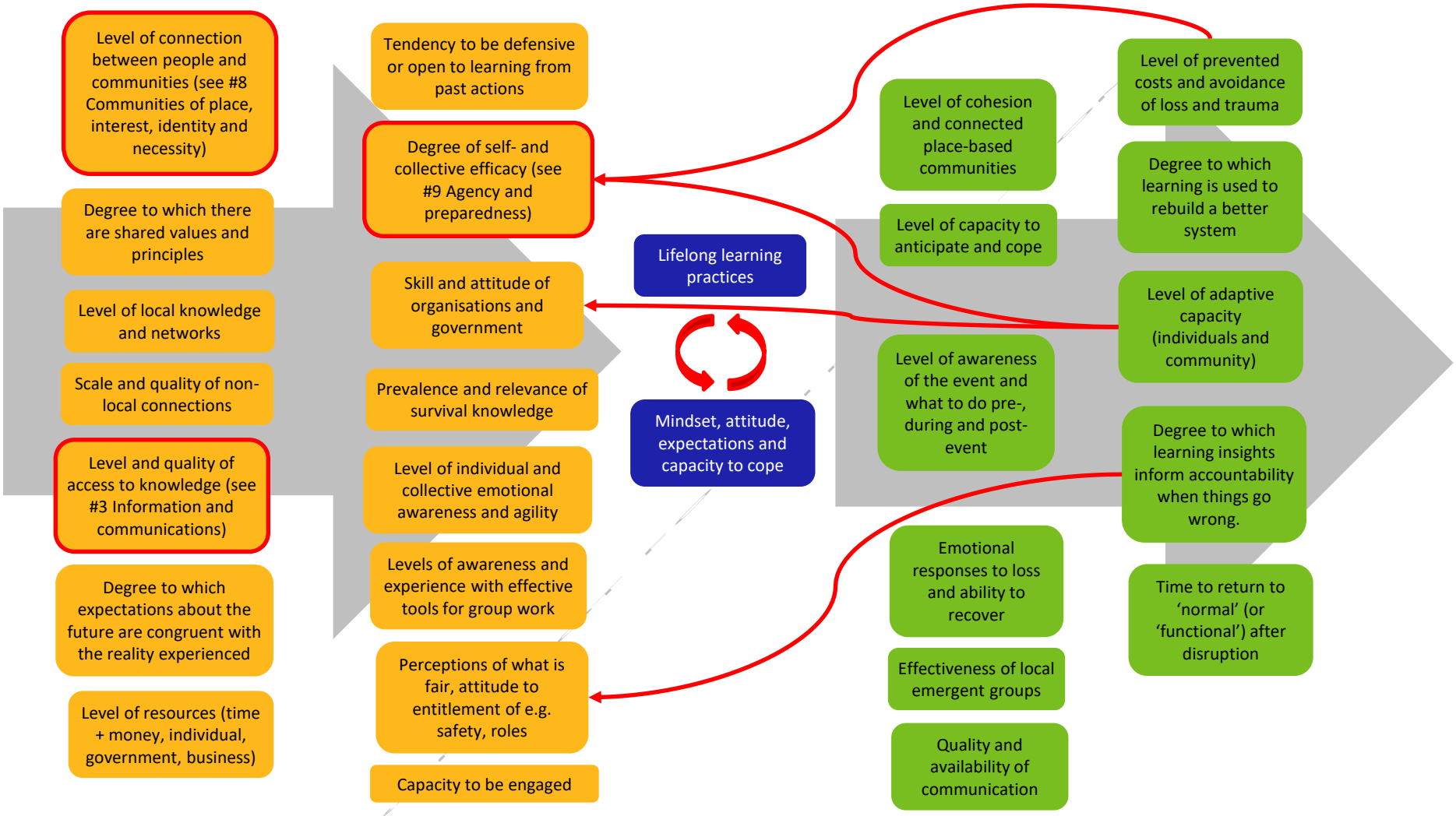


Figure 9 Lifelong learning practices, mindset and expectations - cause and effect diagram, showing feedback loops.
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10.3 Causes and effects

10.3.1 Causes (influences of)

Level of connection between people and communities (link to # 8 Communities of place, interest, identity and necessity): • Level of connection between people and communities • Level of commitment to place-based community, shared purpose, understanding and trust (this links to equality and inclusion etc.) • Level of shared / common values • Commonality of interests and experiences that catalyse unity • Desire to be part of the local community
The degree to which there are shared values, principles and expectations Examples include: • Primacy of life, do no harm, care and respect for others • Valuing community • Acceptance of limits in self and others • Live with nature, don't fight it • Equity of access to learning opportunities • Open sharing of information • Valuing work / life balance • Accommodating different ways of seeing the world, cultures, backgrounds • Valuing all ages e.g. recognising kids' strengths (imagination, asking why)
Level of capacity to be engaged: • Degree to which primary needs are met • Literacy levels • Existence of shared language • Level of economic means • Affordability and accessibility of learning opportunities (geographically, financially, socially) • Amount of time, interest and willingness to participate • Level of access to gathering places
Prevalence and relevance of survival knowledge, e.g. • How to secure shelter, safe food and water • Safe hygiene practices • Firstaid skills • Coping without central services • Skills in preparedness and anticipation • Level of experience of natural hazard events or similar experiences (e.g. living remotely, wilderness camping)
Degree of self- and collective efficacy (see #9 Agency and preparedness): • Previous experience (self-reflective and assessment) • Learning from others (vicarious) • Social persuasion • Physiological indexes (mental load to do something) • Leads to agency – motivation, self-regulation, learning and achievement
Degree to which there are expectations about the future including: • Impacts of natural hazards • Attitude and acceptance of risk safety/unsafety Roles and responsibilities of emergency response and others are congruent with the reality experienced
Levels of awareness and experience with effective tools for group work: • Decision-making and adapting under uncertainty • Communication skills

- Conflict resolution
- Skills in triage and resource allocation in traumatic situations

Levels of self and collective emotional awareness:
- Well-developed strategies for coping with fear, pain, anxiety, uncertainty, loss, anger in self and others

Level and quality of access to knowledge (link to #3 Information and communications):
- Trusted sources
- Ease / frequency of access
- Level of willingness to share info and effort:
    - Individuals
    - Institutions
    - Governments
- Link to communication, community, leadership and trust

Level of local knowledge and networks:
- Places (e.g. familiar gathering places)
- People know each other and skills
- Knowledge of local history
- Mechanisms for bringing people together
- People in bridging roles are valued
- Story-telling valued

Scale and quality of non-local connections:
- Crossing sectors and silos
- Crossing scales / distance
- Mechanisms for bringing people together
- People in bridging roles are valued

Level of resources (individual, government, business):
- Time and money directed to other priorities (not learning)
- Entrenched disadvantage (community, region doesn't have the facilities / services for learning)

Skill and attitude of organisations and government (emergency, health, social services etc.):
- Able to engage with communities, local leaders and understand their needs, strengths and vulnerabilities
- Priorities match community needs
- Level of investment
- Level of learning

Degree to which there are shared values and principles

Tendency to be defensive or open to learning from past actions

10.3.2 Effects (consequences of)

Quality and availability of communication:
- Quality and effectiveness of peer-to-peer communications even if wider communications are down and there is no official information
- Degree to which information is tailored to specific needs
- Degree to which people are willing to be challenged (e.g. by children or people with different views)
- Levels of empathy and compassion in handling intense emotions

Level of capacity to anticipate and cope:
- Degree to which individuals know what to do
- Degree to which groups know how to work together to solve problems
- Level of adaptive capacity
- Level of awareness of (or ability to create) diverse response options

Level of cohesion and connected place-based communities: • Degree to which people know each other and care about each other • Level of knowledge and skills • Levels of trust, leadership and camaraderie • Level of collective awareness of safety systems and priorities
Effectiveness of groups that form in times of emergency or necessity: • Effectiveness at coordinating informal (emergency) response • Effectiveness at allocating resources • Ability to delegate tasks so all feel helpful • Effectiveness at acquiring helpful information • Effectiveness in looking out for / caring for others in distress • Effectiveness in resolving conflict • Effectiveness of triage decision-making
Emotional responses to loss and ability to recover – grief cycle through to acceptance and recovery; anger, blame at unfairness and long-term trauma etc.
Level of awareness of during an emergency incident and what to do pre-, during and post-event: • Learning • Access to information (trusted source) • Links to adaptive capacity
Level of adaptive capacity (organisations, governments): including systems thinking, strategic thinking, anticipatory or pre-emptive thinking, normative, and interpersonal skills
Level of prevented costs and avoidance of loss and trauma
Degree to which learning is used to rebuild a better system (first, second and third loop learning)
Degree to which learning insights inform accountability when things go wrong
Time to return to normal (or 'functional') after disruption

10.4 Key vulnerabilities for *Lifelong learning practices, mindset and expectations*

Main vulnerabilities include:

- Currently, formal education is recognised, valued and resourced more than developing good practices in lifelong learning from experience and developing effective skills to cope with difficult changes, foster emotional awareness, communicate effectively, and work effectively in diverse groups.
- Lack of understanding, skills and expertise, and practice in critical forms of learning including:
    - Deeper levels of learning required for system-level change, and anticipatory, reflective and reflexive learning.
    - A culture and practice of setting up change activities which embed the rapid, structured learning loops required in order to manage a future of unprecedented and novel change. In a situation where learning from the recent past of relative stability is insufficient because the problems now emerging are not going to be fixed by 'off the shelf' solutions. The creation of structured rapid learning opportunities will help to enable how to learn adaptively whether interventions are steering towards, or away from desired futures.
- Community:

    - Limited experience in imagining emergency incidents and practising the skills required to cope with them (e.g. practising going 72 hours without central services).
    - Expectations by the public that formal government services will provide for them in times of emergency, resulting in dependency and loss of self- and collective efficacy.
- Governments and agencies:
    - Short time horizons and a lack of system perspective in decision-making and planning.
    - Inflexible structures that prevent learning and adaptation.
    - Information and resource sharing issues prevent learning, especially across jurisdictions, levels of government or sectors.
    - Accountability practices focused more on avoiding blame or litigation rather than learning.
    - Access to information (see #3 Information and communications):
        - Dependence on particular technologies that are vulnerable
        - Levels of trust in information sources

11 Governance and organised decision-making (#11)

11.1 Summary

The central issues of governance and organised decision making describes the processes and 'rules' which are formalised by various groups in society including three levels of government, business, non-government organisations and other instruments of civil society and community.

In times of stability, governance and decision-making can be a highly formal and structured process, with static rules that stay in place and can be difficult to change (e.g. the Constitution). Stability in some instruments is an important underpinning of well-functioning societies and economies. Governance and organised decision making can also be highly agile, flexible and adaptive with 'rules' that emerge from a given context (protocols developed by a community or business in response to a rapidly changing situation). This is known as adaptive management or governance (Ostrom, 1990, Olsson et al., 2006, Folke, 2007, Chaffin et al., 2014, Sharma-Wallace et al., 2018). Therefore the characteristics span consistency, cooperation, continuity, agility and adaptive capacity – there is no right or wrong way, rather it is about having governance and decision-making processes which are fit-for-purpose. In periods of rapid change or crisis, it becomes more important to have adaptive approaches (especially if the established 'rules' contributed to creating the crises).

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

11.2 Description

The central issues

This typical system pattern focuses on decision-making processes and 'rules' which are formalised by various groups in society including three levels of government, business, NGOs and other instruments of civil society and community. Governance and decision-making can be a highly formal and structured process, with static rules that stay in place and

can be difficult to change (e.g. the Constitution). Stability in some areas of governance provides an important underpinning of well-functioning societies and economies, providing certainty that supports long term planning horizons. Governance and organised decision making can also be highly agile, flexible and adaptive with 'rules' that emerge from a given context (protocols developed by a community or business in response to a rapidly changing situation). This is known as adaptive management or adaptive governance. Therefore the characteristics of governance span consistency, certainty, cooperation, continuity, agility and adaptive capacity – there is no right or wrong way, rather it is about having governance and decision-making processes which are fit-for-purpose. In periods of rapid change or in a crisis, it becomes more important to balance certainty with adaptive approaches (especially if the established 'rules' contributed to creating the crises). In times of war, disaster or emergency, a different set of powers and authorities are set into operation.

In times of stability

In times of stability, Australia operates as a democracy with elected leaders making key decisions that are underpinned by a functional rule of law, and a governance system for governments, industry and the community. In times of war, disaster or emergency, the separation of powers means that a different set of decision makers and authorities are put into operation. There is a strong interaction between governance and leadership (see typical system pattern #12Leadership), but they also operate independently to some extent.

There are many interpretations of democracy in the literature, and in practice. The aspects that workshop participants contributing to this system pattern considered were fundamental concepts of democracy in Australia included: rule of law rather than rule of individuals; voting and adequate representation; capacity for participation in governance; separation of state, church and judiciary; and freedom of speech / free press. The way that these concepts are absorbed into different political ideologies and operationalised is an ongoing topic of civic debate in many democracies, including Australia. In recent times of technological change, globalisation, and migration around the world, many of these ideas continue to be challenged and refined.

Macro-economic paradigms influence, and are in turn influenced by, the distribution of wealth, power, inequality, poverty and education. The recent economic paradigms of operation in Australia have had a number of underlying trends prevailing in the last fifty years of relative socio-economic stability at the same time as there has been a strong trend towards globalisation. Important trends have included profit maximising, smaller role for government, deregulation, economic efficiency, and uncertainty associated with rapid change challenging efforts to work with long term planning horizons.

Governance is the system of formal rules (or institutions) that are used as instruments in the public and private domains to operationalise economic paradigms. Instruments may take a number of forms, for example, policies, laws, regulations, standards, or industry codes of practice. They are considered functional when they are matched to context, purpose, and societal beliefs and values of the organisations they serve, and deliver the intended outcomes. Workshop participants identified that there are clear expectations in Australia for

fit-for-purpose instruments of governance in public and private sectors, including accountability and transparency, and institutional checks and balances. The efficacy of budget cycle management and balancing short and long-term planning processes were considered important. Of particular importance with respect to governance and disaster are the issues around risk assessment and transfer between business, different levels of government, and individuals. This has been dealt with as a stand-alone typical system pattern (#6 Risk assessment, ownership and transfer).

Workshop participants were concerned about the relationship between the freedom and independence of the formal press, the increasing prevalence of social media and how to ensure that information is credible. In addition, how informed and discerning the public is who demand and use the information, and the way that leadership interacts with the media. The issues of governance, legitimacy and ethics in these relationships was seen as important.

The choices and trade-offs during stable times

There are choices and trade-offs around economic models and the flow-on effects to governance, which in stable times may benefit the country as a whole – for example overall wealth or Gross Domestic Product, while also increasing inequality. There will always be debate and rebalancing around the costs / imposts of government and governance structures and processes in comparison to the benefits delivered – in terms of what, and to whom. This has particular relevance to the cost and impost of a higher level of disaster preparedness, compared to the benefit gained in reduced costs and suffering.

The groups exploring governance and organised decision-making were explicit in recognising trade-offs as well as conflicts in values. For example, they recognised that in Australia there is generally a high level of tolerance, goodwill and an attitude of 'she'll be right'. The flip side is that this can manifest as complacency and an expectation or entitlement that 'it will never happen to me'. There are generally high levels of individualism, but also a desire to help others and do the right thing. There are elements of social responsibility, but there are also imperatives and expectations to maximise individual utility. There is not just one set of values, but many which will be in different balance during normal times, and the balance can shift in times of disaster (see typical system patterns #8Connected community and#13 Attitude, identity and expectations).

The governance of human capital is vitally important, and links to the Health and Capacity to Care typical system pattern (#2). During stable times workplaces seek to maximise short-term productivity from workers to use resources efficiently (and to remain viable in a competitive market in the private sector). If the operational tempo makes it difficult for staff to maintain the basics of good sleep, nutrition, exercise and mental health, this has long-term unwanted consequences. In the case of first responders who devote themselves to extreme bursts of work in times of crisis, it is particularly important that during times of stability their workplace governance systems support them in strengthening their personal reserves in preparation for emergency times.

In a disaster

A declaration of disaster in Australia leads to a change in governance structure and leadership (separation of powers) and there may be varying degrees of clarity or confusion about ownership of decisions and responsibilities, actions and cost bearing.

There appears to be a gap in current Australian governance around immediate emergency planning and rules in relation to access to goods and services (e.g. access to food, water, fuel and medical supplies) and the authorising environment may be unclear. In catastrophic disaster, issues of law and order, social conflict, presence of armed soldiers and citizens and respect for the rule of law may be tested.

The relationships between media, social media, and leadership is critically important during and after a disaster. Disaster recovery also requires a different set of governance structures and decision-making processes to come in to play.

Post-disaster discussions at workshops exposed a range of deeper values and causal factors that were not explicitly evident during discussion of times of relative stability. Exploring potential impacts of a disaster on loss of life, loss of access to essential needs, capacity to be self-reliant (for individuals, urban and remote communities, organisations, vulnerable groups, business and government) offers a different perspective. For example, the realisation that the disaster may require help from other countries in the Asian-Pacific region prompted another level of analysis about law and order, social conflict, presence of armed soldiers (Australian and foreign) that might be needed to manage the distribution of food, water and medical attention during a crisis. The Lifelong Learning Practices typical system pattern (#10) points to the value of effective emergent governance in informal groups that form out of necessity during disaster.

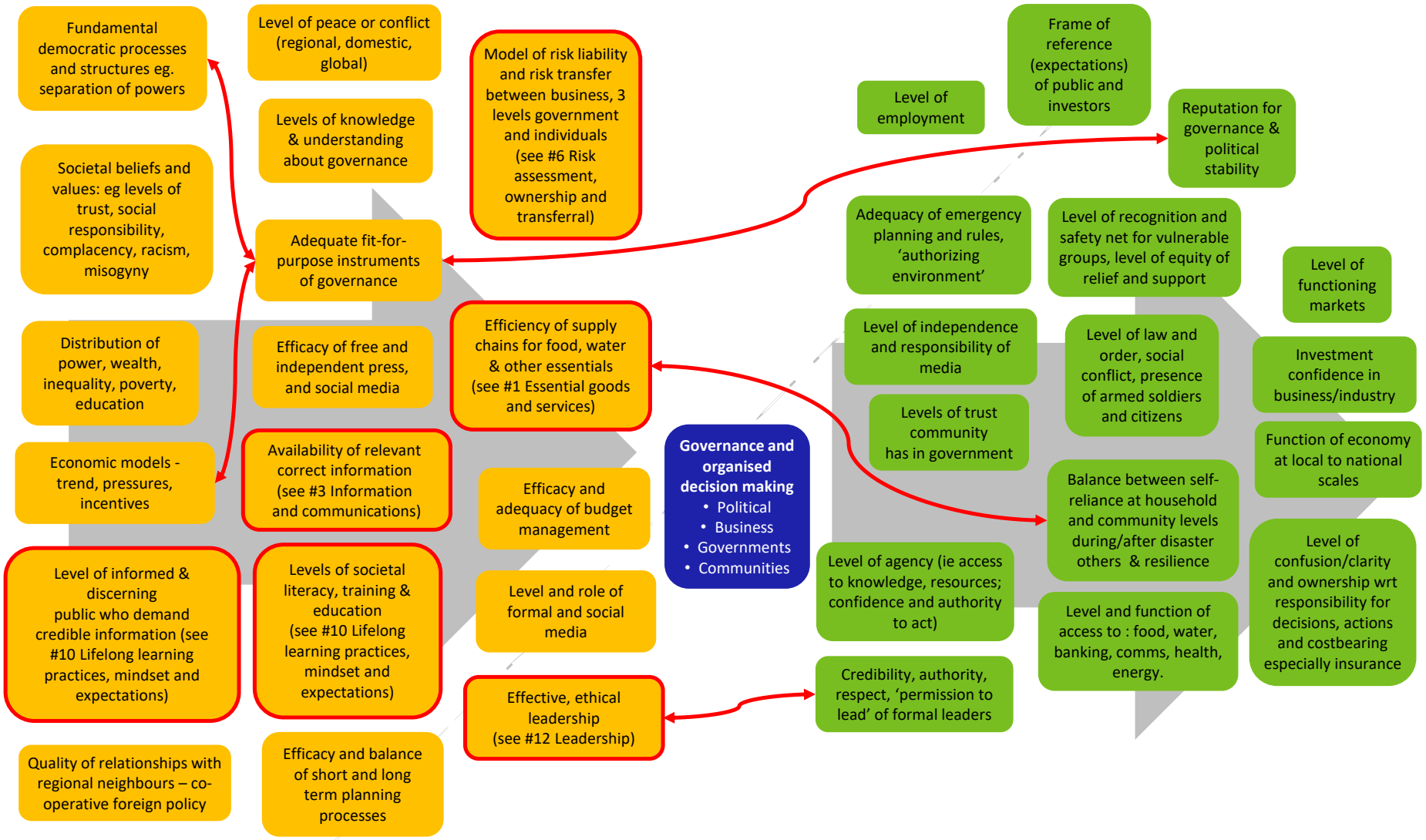


Figure 10 Governance and organised decision-making - cause and effect diagram, showing feedback loop.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows

11.3 Causes and effects

11.3.1 Causes (influences on)

Fundamental democratic processes and structures • e.g. separation of powers state, church and judiciary; free press and speech; free, fair and representative election processes
Adequate fit-for-purpose instruments of governance • Public sector - 3 levels of government (parliament and government agencies), policies, laws and legislation • Private sector - professional self-regulation and credibility, business models, codes of practice, standards etc. • Instruments of accountability and independent oversight checks / balances, e.g. anti-corruption commissions
Societal beliefs and values, e.g. • levels of trust, social responsibility, complacency 'she'll be right' vs preparedness, inequality, racism, misogyny
Distribution of power, wealth, equity, poverty, education
Economic models – trends, pressures, incentives for • Profit maximising • Smaller role for government • Deregulation • Economic efficiency • Planning horizons
Efficacy and adequacy of short and long term budget and planning processes
Efficacy and adequacy of budget management
Effective, ethical leadership (see #12 Leadership)
Quality of relationships with regional neighbours • Underpinned by co-operative foreign policy – enabling mutual respect. Mutual trust is ideal but may not be possible. Clear and agreed terms of engagement and compliance with these is useful and practical.
Level of peace or conflict (domestic, regional, global)
Levels of knowledge and understanding about governance • People in all roles have appropriate understanding of governance

Level of informed and discerning public who demand credible information (see #10 Lifelong learning practices, mindset and expectations) can distinguish opinions and preferences compared to technical or evidence-based perspectives
Efficacy and responsibility of free, independent and diverse press and media (including social media), e.g. • formal press, level of diverse ownership of press, accurate reporting which is accountable, public broadcasting relevant to all audiences • Public broadcasters – recognition and training for special roles during emergencies • Social media – diverse, used responsibly
Level and role of formal and social media
Levels of societal literacy, training and education (see #10 Lifelong learning practices, mindset and expectation)
Availability of relevant correct information (see #3 Information and Communications)
Efficiency of supply chains for food, water and other essentials

11.3.2 Effects (consequences of)

Adequacy of emergency planning and rules, 'authorising environment', e.g. who decides access to medical help, other essential supplies in emergency?
Level of recognition and safety net for vulnerable groups, level of equity of relief and support
Level of independence and responsibility of media
Levels of trust community has in government, and thus credibility, authority, respect, 'permission to lead' of formal leaders
Level of confusion / clarity and ownership with responsibility for decisions, actions and cost bearing especially insurance
Level of agency (i.e. access to knowledge, resources; confidence and authority to act)
Frame of reference (expectations) of public and investors
Level of employment
Reputation for governance and political stability
Level of functioning markets
Investment confidence in business / industry

Level of law and order, social conflict, presence of armed soldiers and citizens
Balance between self-reliance at household and community levels during / after disaster events and resilience
Level and function of access to: food, water, banking, communications, health, energy
Function of economy at local to national scales

11.4 Key vulnerabilities for *Governance and organised decision-making*

Main vulnerabilities:

- Economic model and trends (e.g. profit maximising, discount rates that skew against future costs and incommensurables, deregulation, economic efficiency, short-term planning horizons) have provided benefits during times of stability, but contribute to and will have very low resilience in times of disruption
- Societal beliefs and values which do not balance out complacency and preparedness, individualism and community cohesion etc.
- Rising levels of inequality
- Erosion of some of the fundamentals of democracy
- Root causes of vulnerability not previously manifested – i.e. that Australians value and rely on even if they don't realise it – such as the quality of relationships and levels of mutual respect with regional neighbours, co-operative foreign policy, and peace (regional and domestic) and law and order in Australia
- Underlying levels of inequality, racism and misogyny in the Australian community, amplified by fear, and the interplay with domestic law and order, as well as relationships with neighbours
- Erosion of trust in government, authority and information sources
- Levels of engagement and cooperation with regional neighbours
- Breakdown in fundamental democratic processes and structures (e.g. separation of powers state, church and judiciary, free press and speech)

12 Leadership (#12)

12.1 Summary

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

In times of stability, leadership structures and models in many domains have been characterised by hierarchical use of power and authority, command and control approaches to decision-making and implementation, investment in positional leadership (rather than informal or emergent leadership), a conflation of leadership and management, and often a stronger focus on 'leading from the top'. This type of leadership model is very well suited to some types of tasks, situations and constituencies. There are different models of leadership which are successful in other contexts and are related to task type, power, gender and social network dynamics (Stein et al., 1973) (Fletcher, 2004). For example, in some situations (e.g. non-hierarchical or flat structures), there is recognition that leadership comes at all levels in an organisation (e.g. constructive middle management, innovative early career individuals), and may not come with a formal 'position'. In situations where rapid change and innovation is required, different leadership structures, styles, skills and cultures may be more useful, and informal or emergent leadership may be a more useful approach. Leadership cohorts that include diverse demographics, perspectives, skillsets, and networks have demonstrably better outcomes for solving some sorts of problems, particularly the complex problems that lead to, or are manifest in times of disaster.

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

12.2 Description

The central issues

The central issues of leadership cannot be separated from the context, and the question 'leadership of what or whom?' The formal positional leadership of many different sectors and different types of organisations provide different contexts for leadership and may operate very differently and require different skills (Seeley Brown and Duguid, 2002, Bazigos et al., 2016). For example, the workshop participants discussed the multiple contexts of political leadership at different levels of government, leading a political party or a committee, internal-facing leadership (e.g. of a cabinet) versus external facing leadership (e.g. for the public).

Leadership is often viewed as an individual's set of personal attributes and skills, for example, the ability to provide vision, strategy, make decisions, and communicate effectively. In the corporate context, effectiveness depends less on the traits of any one executive and more on the company's competitive challenges, legacies and shifting forces (Bazigos et al., 2016). The questions of what makes a 'good' leader, or 'ethical leadership', were also discussed by workshop participants, but there is limited understanding on how to evaluate leadership efficacy, especially within the broad range of contexts (Hannah et al., 2008).

In times of stability

In times of stability, leadership structures and models in many domains used to be characterised by hierarchical use of power and authority, command and control approaches to decision making and implementation, investment in positional leadership (rather than informal or emergent leadership), a conflation of leadership and management, and often a stronger focus on 'leading from the top'. In more recent times and with more knowledge-intensive economies, the theory and practice of leadership have shifted, and depend less on the heroic actions of a few individuals at the top and more on collaborative leadership practices distributed throughout an organisation (Fletcher 2004 citing many other authors).

While 'command and control', formal, positional, hierarchical or 'heroic' leadership is still present and this type of leadership model is very well suited to some types of tasks, situations and constituencies – for example, it is still quite present in some parts of emergency services, and works effectively in some types of disaster situations.

There is a parallel recognition that for other types of tasks or in other situations, leadership can be more egalitarian, more mutual, less hierarchical and that leader–follower interactions which are collaborative and fluid lead to better outcomes (Fletcher 2004). This sort of 'post-heroic' leadership comes at all levels in an organisation (e.g. constructive middle management, innovative early career individuals), and may not come with a formal 'position'. In situations where rapid change and innovation is required, different leadership structures, styles, skills and cultures may be more useful, and informal or emergent leadership may be a more useful approach. Leadership cohorts that include diverse demographics, perspectives, skillsets, and networks have demonstrably better outcomes for

solving some sorts of problems, particularly the complex problems that lead to, or are manifest in times of disaster.

Matching leadership models and skills with the context of leadership, representing a diversity of demographics, styles, skills and networks, and adequate governance structures to support the leaders is important. Effective, fit-for-purpose interactions and interfaces are needed between the leadership of different domains (e.g. public / private / community), levels (e.g. executive versus mid-level), sectors (e.g. agriculture, energy, manufacturing), roles (e.g. politician, bureaucrat, emergency or military, business innovator, public good advocate) and situations (times of stability, rapid change, crisis etc.)(Yukl and Mahsud, 2010). This would lead to improved outcomes in stable times as well as in a disaster.

The choices and trade-offs during stable times

The issue of leadership with respect to disaster mitigation requires a more nuanced view because it is highly context-dependent and co-dependent – leadership is more than a series of individuals leading. Discussion of leadership needs to take account of the domain – for example, the tasks, skills and personal qualities of leaders in the domains of politics, government agencies, emergency management, utilities providers, business, media, non-government organisation or civil society, community or representational roles vary greatly. Context is also determined by the situation – for example, in times of stability, a different type of leadership may be required in comparison to times of rapid change, crisis or disaster. Leadership cultures within organisations are important – the levels of trust, respect, credibility, legitimacy and ethical principles demonstrated are important expectations of most constituencies, especially the public. The nature of interactions between leaders in different domains and roles, with different constituencies, is also critical to obtaining good outcomes in times of stability or crisis.

Leading an open and inclusive knowledge production process can also present a challenge (Brugnach and Ingram, 2012). Instead of the managerial role based on authority and control, integrative or collaborative leadership requires different characteristics (Schruijer and Vansina, 2008). For example, rather than envisioning power as the ability of the leader to tell subordinates what to do, there are benefits in including a mutual influence across levels of hierarchy, and different ways of knowing. Leaders need empathy, skills at negotiating differences and managing conflict, facilitating translations, and bridging different forms and styles of communication, and must be adept at bringing in diverse voices and neglected nodes of knowledge together. Brugnach and Ingram (2012) state that "*Recruiting and retaining such leadership is often a hit or miss affair and deserves more attention*."

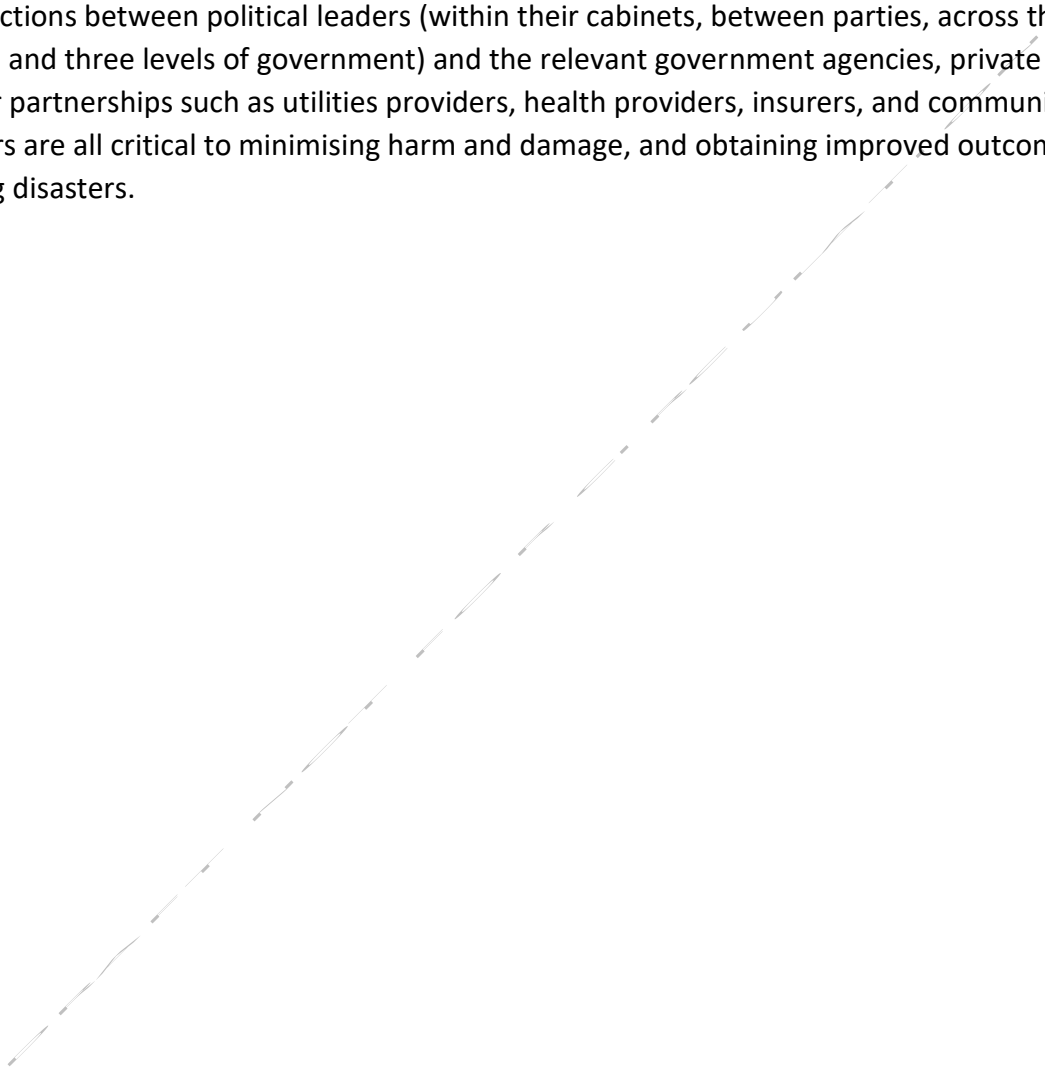
In a disaster

During emergencies and disasters, leadership models and the governance structures that underpin a declared crisis are both important to consider. Within formal leadership and governance structures, there are specific rules about how decisions are made and who makes them once an emergency or disaster is recognised. In governments, this relies on understanding and observing the separation of powers between political, government

agency and emergency management officers as well as the delegated hierarchies, responsibilities and authorities for decision-making.

During disasters, however, there is a parallel need for flexible, adaptive and emergent informal leadership. For the formal leaders as well as in the public arena. The skill sets required to respond rapidly, make and communicate decisions under pressure and in situations of uncertainty are vital. The public are in many cases the first responder and may need to be for a significant period, and in this case informal or emergent leadership is a critical skill.

Interactions between political leaders (within their cabinets, between parties, across the whole and three levels of government) and the relevant government agencies, private sector partnerships such as utilities providers, health providers, insurers, and community leaders are all critical to minimising harm and damage, and obtaining improved outcomes during disasters.



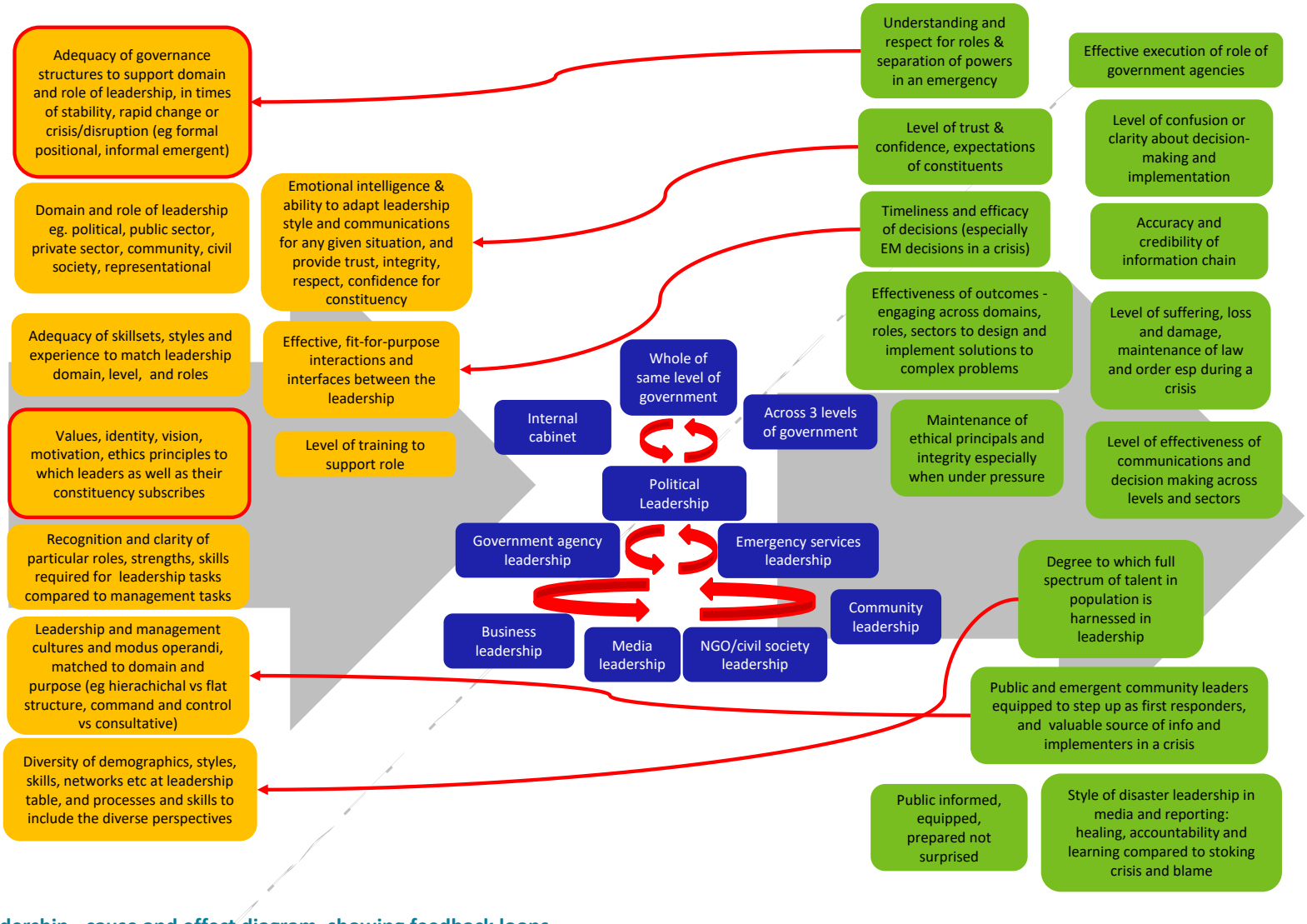


Figure 11 Leadership - cause and effect diagram, showing feedback loops.

The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows.

12.3 Causes and effects

12.3.1 Causes (influences on)

Domain and role of leadership, e.g. political, public sector, private sector, community, civil society, representational
Adequacy of governance structures to support domain and role of leadership, in times of stability, rapid change or crisis / disruption (e.g. formal positional, informal emergent)
Adequacy of skillsets, styles and experience to match leadership domain, level, and roles
Values, identity, vision, motivation, ethics principles to which leadership subscribes and adheres
Recognition and clarity of particular roles, strengths, skills required for leadership tasks compared to management tasks
Leadership and management cultures and modus operandi, matched to domain and purpose (e.g. hierarchical vs flat structure, command and control vs consultative)
Diversity of demographics, styles, skills, networks etc. at leadership table, and processes and skills to include the diverse perspectives
Level of training to support role
Emotional intelligence and ability to adapt leadership style and communications for any given situation, and provide trust, integrity, respect, confidence for constituency
Effective, fit-for-purpose interactions and interfaces between the leadership of • Different domains (e.g. public / private / community) • Different levels (executive vs mid-level) • Different sectors (agriculture, energy, manufacturing etc.) • Different roles (e.g. politician, bureaucrat, emergency or military, business innovator, public good advocate) • Different situations (times of stability, raid change, crisis etc.)

12.3.2 Effects (consequences of)

Understanding and respect for roles and separation of powers in an emergency
Timeliness and efficacy of decisions (especially emergency management decisions in a crisis)
Level of trust and confidence, expectations of constituents
Effective execution of role of government agencies
Level of confusion or clarity about decision-making and implementation
Accuracy and credibility of information chain
Level of effectiveness of communications and decision making across levels and sectors
Level of suffering, loss and damage, maintenance of law and order especially during a crisis
Maintenance of ethical principles and integrity especially when under pressure

Degree to which full spectrum of talent in population is harnessed in leadership
Effectiveness of outcomes –engaging across domains, roles, sectors to design and implement solutions to complex problems
Public and emergent community leaders equipped to step up as first responders, and valuable source of info and implementers in a crisis
Public informed, equipped, prepared not surprised
Style of disaster leadership in media and reporting: healing, accountability and learning compared to stoking crisis and blame

12.4 Key vulnerabilities for *Leadership*

Key vulnerabilities include:

- Lack of understanding and implementation of different types of leadership constructs and styles to be fit-for-purpose in the rapidly changing contexts of current times.
- Declining confidence from the segments of the public in political and business leadership, perception of lack of ethics, integrity, courage, legitimacy or interest in public good outcomes.
- Increasing contestation around values, identity and ideology, and combative and acrimonious communication rather than evidence-based or reasoned arguments on different perspectives between leaders of polarising constituencies. This diminishes the level of public understanding and discourse about the root causes and necessary adjustments required to meet the challenge of complex problems.
- Lack of appropriate fora, and therefore a lack of operational models of effective interaction between all of the different leadership groups required to do the long-term planning for disaster mitigation (e.g. political leaders – within their cabinets, between parties, across whole of government, across the three levels of government – and the relevant government agencies, private sector partnerships such as utilities providers, health providers, insurers, and community leaders).
- Low willingness and capacity for the public and media to have a deeper discourse about complex issues with no easy solutions – the stated need is for short sharp 'sound bytes' and this does not engender the deeper understanding and discourse. Media frequently sensationalise or drive conflict and blame rather than accountability and learning. A key vulnerability is the amplifying feedback between what the media delivers, and what the consumers of the media say they want, and pay for.
- Lack of diversity in executive leadership in public and private sectors which reduces capacity to take multiple perspectives and problem-solving approaches, particularly when faced with novel and complex problems.

13 Nature and people (#14)

13.1 Summary

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

In times of stability or disaster, every human's wellbeing is tightly coupled to natural systems for the provision of clean air, water, food and other essential goods, to regulate our climate, assimilate our waste, provide protection from extreme events (e.g. flood protection) and maintain productive land and water resources. Natural resources also underpin much of the national income, whether it be from resource extraction, agricultural production, fisheries or tourism. People value nature for a variety of reasons, including nature values (e.g. biodiversity, trees), social values (e.g. social interactions), cultural values (e.g. cultural heritage), experiential values (e.g. spirituality, relaxation) and production values (e.g. food production and mining).

In terms of putting a monetary value on nature's contributions, there has been limited success owing to the multiple and interrelated benefits, values, and trade-offs that it provides. While nature provides protection from extreme events, it also can pose an increased risk for those living in or near natural landscapes (e.g. bushland – bushfires; floodplain – flooding; coast – storm surges). People who live in high-risk areas may be doing so by choice, or it may be necessary for cultural, spiritual, family, community or livelihood reasons. As the climate changes and the risk profile of natural hazard changes rapidly, it means that people who have not previously been 'living amidst nature' are now also increasingly at risk of impact from natural hazards (for example, storms, floods, fires or heat waves in cities). They may have much lower levels of awareness than those who live in regional areas or on urban fringes.

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

healing, as well as building positive relationships across different levels of government and business.

13.2 Description

The central issues

The central issue of this typical system pattern relates to how society and individuals realise the existential dependence of economy and society upon nature; value their connection to nature and the contributions that nature provides; how they mitigate the threat to life and property from disasters related to natural hazards; and how they cope with disaster in natural areas.

Many Australians have a deep connection with nature, but as the country becomes increasingly urbanised a disconnection is growing between many people and nature (Miller, 2005, Soga and Gaston, 2016, Shanahan et al., 2017). This is important because there is strong evidence that links interactions with nature with positive physical, psychological and social wellbeing (Hartig et al., 2014, Shanahan et al., 2017).

Every person's wellbeing is tightly coupled to natural systems for the provision of clean air, water, food and other essential goods, to regulate our climate, assimilate our waste, provide protection from extreme events (e.g. flood protection) and maintain productive land and water resources (Costanza et al., 1997, Sandstrom et al., 2006, Basnou et al., 2015). Natural resources also underpin much of the national income, whether it be from resource extraction, agricultural production, fisheries or tourism. People value nature for a variety of reasons including; nature values (e.g. biodiversity, trees), social values (e.g. social interactions), cultural values (e.g. cultural heritage), experiential values (e.g. spirituality, relaxation) and production values (e.g. food production and mining)(Kendal et al., 2015). In terms of putting a monetary value on nature's contributions, there has been limited success owing to the multiple and interrelated benefits, values, and trade-offs that it provides (Chee, 2004).

While nature provides protection from extreme events, it also can pose an increased risk for those living in or near natural landscapes (e.g. bushland – bushfires; floodplain – flooding; coast – storm surges). People who live in high-risk areas may be doing so by choice, or it may be necessary for cultural, spiritual, family, community or livelihood reasons (Gren and Helander, 2017).

In times of stability

In times of stability, people living in high-risk areas (e.g. in or near bushland, flood-prone waterways or storm-exposed beaches) do so despite the potential risk of a natural hazards. Most high-risk areas are safe for long periods between disastrous events, so many people living there may not realise the risk, or choose to ignore it, deciding that the benefits of living there outweigh any potential risk.

How people think they will act in a disaster depends in part on how they view their own responsibilities to manage and mitigate risk and to tolerate the residual risk. It also depends on how much trust they have in their emergency services to do a good job (Reinhardt, 2017). While many people living in high-risk areas prepare emergency survival plans, many do not. Some people fear frightening events and so avoid thinking about how they will act in a disastrous situation. Other people are unaware of the risk, or downplay it. Some people are unsure how to prepare an emergency survival plan, while others are complacent, lack the resources, or need help to prepare one. Some people have excuses like 'I'm too busy', 'It won't happen to me' or 'I'll just leave (Mayberry, 2015). Lack of preparation, particularly for those who live in remote areas where they are a long way from help, or have limited access / departure routes, may leave residents highly vulnerable.

The choices and trade-offs during stable times

With a growing population, increasing living standards, and a desire for people to live close to nature, urban areas are increasingly encroaching into natural landscapes. This makes the challenge of preparing for and managing natural hazards increasingly difficult for emergency services.

Individuals make trade-offs in their values with respect to controlling nature (e.g. to protect people and assets) and the protection of natural assets and landscapes (e.g. for conservation and aesthetic reasons). Hazard reduction can be contentious when it conflicts with values around biodiversity and ecosystem integrity. For example, waterway barriers constructed to reduce flooding can affect fish and benthic invertebrate populations by impeding fish migration and interrupting breeding, and by reducing habitat availability for fish and benthic invertebrates (Queensland Department of Agriculture and Fisheries, 2018). Another contentious issue is around hazard reduction burning, with contradictory evidence around the impact of different levels of burning on hazard reduction (Thornton, 2015). This is complicated by competing objectives; differing ecosystems and constantly changing demographics and land use, in addition to a lack of understanding of the impacts of burning on biodiversity and other natural values. Burning regimes to minimise the impact of bushfires are not always compatible with maintaining the integrity of ecosystems. This has not been helped by heavy smoke, or several hazard reduction burns that have escaped causing extensive loss of houses and placing lives at risk (Thornton, 2015).

Risk transfer is another issue that can be controversial when decisions made by one group of people increases the risk to others. In high-risk areas, risk transfer could endanger lives and property (links to #6 Risk assessment, ownership and transfer). For example, a lack of hazard reduction on a property in a bushfire prone area may increase the risk to neighbouring properties, or the use of power-tools in the open on extreme fire days increases the fire risk to nearby properties. Risk transfer can also be across time and space; where the impacts of decisions made by one generation can be felt by subsequent generations when land-use decisions in one jurisdiction can create risks for neighbouring jurisdictions. Cumulative impacts from distributed, diffuse causes present particularly difficult governance challenges. These include social dilemmas where many small

individually rational decisions lead to collectively worse outcomes ('tragedy of the commons').

In a disaster

It has been previously recognised that living among nature has its benefits, but it presents challenges during a natural hazard event, especially if dwellings are in remote locations. As the climate changes and the risk profile of natural hazard changes rapidly. It means that people who have not previously been 'living amidst nature' are now also increasingly at risk of impact from natural hazards (for example, storms, floods, fires or heat waves in cities). Furthermore, they may have much lower levels of awareness than those who live in regional areas or on urban fringes.

Failing to prepare and act on an emergency survival plan can increase the risk of injury and death, and the loss of livestock and property. Many houses in natural areas are in remote locations with limited access, or narrow, steep and poorly surfaced roads (Whittaker, 2008). In a disaster, poor access can make it difficult for emergency services to reach residents, increasing the danger and potentially leaving residents stranded for extended periods. In these circumstances making the decision to leave early is usually the safest option. During a bushfire road travel is a leading cause of death. Death most commonly occurs after late evacuation, with flames, smoke, fallen trees and traffic increasing the likelihood that drivers will become disorientated, trapped or involved in an accident (Tibbits et al., 2008). This presents dangers for fire-fighters and for residents. Limited access to water and power in remote locations can also impede the ability to fight the fire.

Ensuring that all people have access to the information required for disaster preparation including; how to recognise and respond to warnings and alarms, how to act and stay safe in a disaster, and where to find safe places to evacuate to will help people to be prepared. However, the ultimate responsibility for preparing and acting on this information usually lies with individuals.

In a disaster, extreme events can provide an opportunity to rethink interactions with nature and 'build back better' in recovery. Actively seeking opportunities to use the recovery period to connect with post-trauma activities that are safe, instil confidence and help with reconnecting people with nature and place, can contribute to individual and community healing – as well as building positive relationships across different levels of government and business.

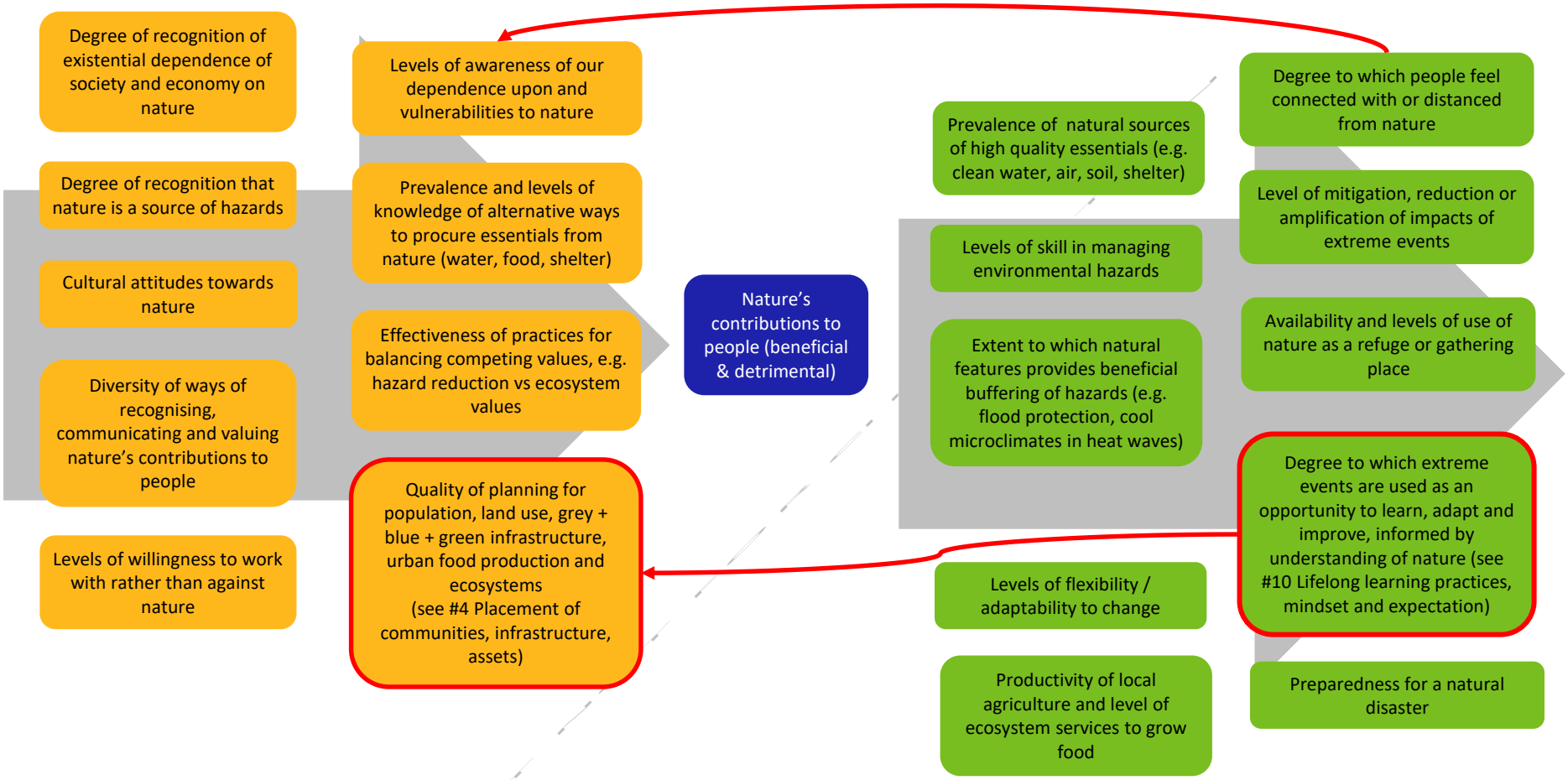


Figure 12 Nature and people - cause and effect diagram, showing feedback loops.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows

13.3 Causes and effects

13.3.1 Causes (influences of)

Degree of recognition that nature is a source of essentials we depend upon
Degree of recognition that nature as a source of hazards
Prevalence of different cultural attitudes towards nature: command and control of nature, or competitive – people vs nature: • Nature subservient, there to serve us • Connection with nature, seeking harmony with nature, attuned to natural hazards • Nature valued for its services to humans, and contributions to the economy
Levels of awareness of our dependence upon and vulnerabilities to nature (e.g. Canberra located on fire path to coast)
Levels of willingness to work with rather than against nature
Diversity of ways of recognising, communicating and valuing nature's contributions to people
Effectiveness of practices for balancing competing values, e.g. balancing property protection from fire and ecosystem values.
Quality of planning processes for: (links to #4 Housing, infrastructure and assets) • Population • Land use • Grey infrastructure • Blue infrastructure (e.g. flood control, cooling, ecological benefits, recreation) • Green infrastructure (e.g. mitigate heat island effect, flood control, coastal protection, ecological benefits) • Food production • Managing nature / ecosystems
Prevalence and levels of knowledge of alternative ways to procure essentials from nature (e.g. water, food, shelter) in a range of environments

13.3.2 Effects (consequences of)

Prevalence of natural sources of high quality essentials (e.g. clean water, air, soil, shelter)
Levels of awareness, understanding and skill in operating with the environmental hazards
Degree to which people feel connected with or distanced from nature (e.g. healing value of nature, grief of loss of loved places, places for shared experiences such as celebration or memorial)
Level of mitigation, reduction or amplification of impacts of extreme events (e.g. flood protection, cool urban microclimates, accumulated fuel load)
Availability and levels of use of nature as refuge or gathering place for humans, animals etc. (e.g. beach or river refuge from fire)
Extent to which natural features provide beneficial buffering of hazards (e.g. riparian zones, coastal dunes) – are they regulating or exacerbating natural hazard events (e.g. flood, tsunami, sea level rise, storm surge, heat wave)?

Degree to which extreme events are used as an opportunity to learn, adapt and improve, informed by understanding of nature. (Links to #10 Lifelong learning practices, mindset and expectations)
Levels of flexibility / adaptability to change
Productivity of local agriculture and level of ecosystem services to grow food (e.g. availability and quality of water and soil, prevalence of pollinators)
Preparedness for a natural hazards and potential disaster

13.4 Key vulnerabilities for *Nature and people*

Key vulnerabilities include:

- Challenges in reconciling and balancing different values, attitudes and management objectives towards nature and the threat that it poses held by different people or sectors.
- Poor mechanisms for assessing and allocating levels of investment and effort in knowledge dissemination, awareness-raising and acquisition around the risks of natural hazards and how to prepare for them. In particular, knowledge tends to be separated by sector or domain of expertise (government, industry, groups, individuals); (links to #3 Information and communications and #10 Lifelong learning).
- Encroachment of urban areas into natural landscapes, making the challenge of preparing for and managing disasters increasingly difficult for emergency services.
- Failure by the public to prepare adequate emergency survival plans (including evacuation) before disaster strikes possibly through ignorance of the risk, complacency, downplaying the risk, lack or resources, or the person needing help to prepare a plan.
- Incompatibility between objectives for hazard reduction and for managing for ecosystem values.
- Limited access for escape or for attendance by emergency services due to remote locations, few roads and narrow, steep and poorly surfaced roads. This can present dangers for fire-fighters and for residents.
- Lack of information required for disaster preparation and survival, e.g. how to recognise and respond to warnings and alarms, how to act and stay safe in a disaster and where to find safe places to evacuate to.
- Risk transfer issues when decisions by some increase the exposure by others' to natural hazards, endangering lives and property (links to #6 Risk ownership and transferral). Transfers can also be across time (e.g. impacts of decisions made by one generation are felt by subsequent generations) and space (e.g. land-use decisions in one jurisdiction can create fire risks for neighbouring jurisdictions). Cumulative impacts from distributed, diffuse causes present particularly difficult governance challenges. These include social dilemmas where many small individually rational decisions lead to collectively worse outcomes ('tragedy of the commons').

14 Overarching synthesis

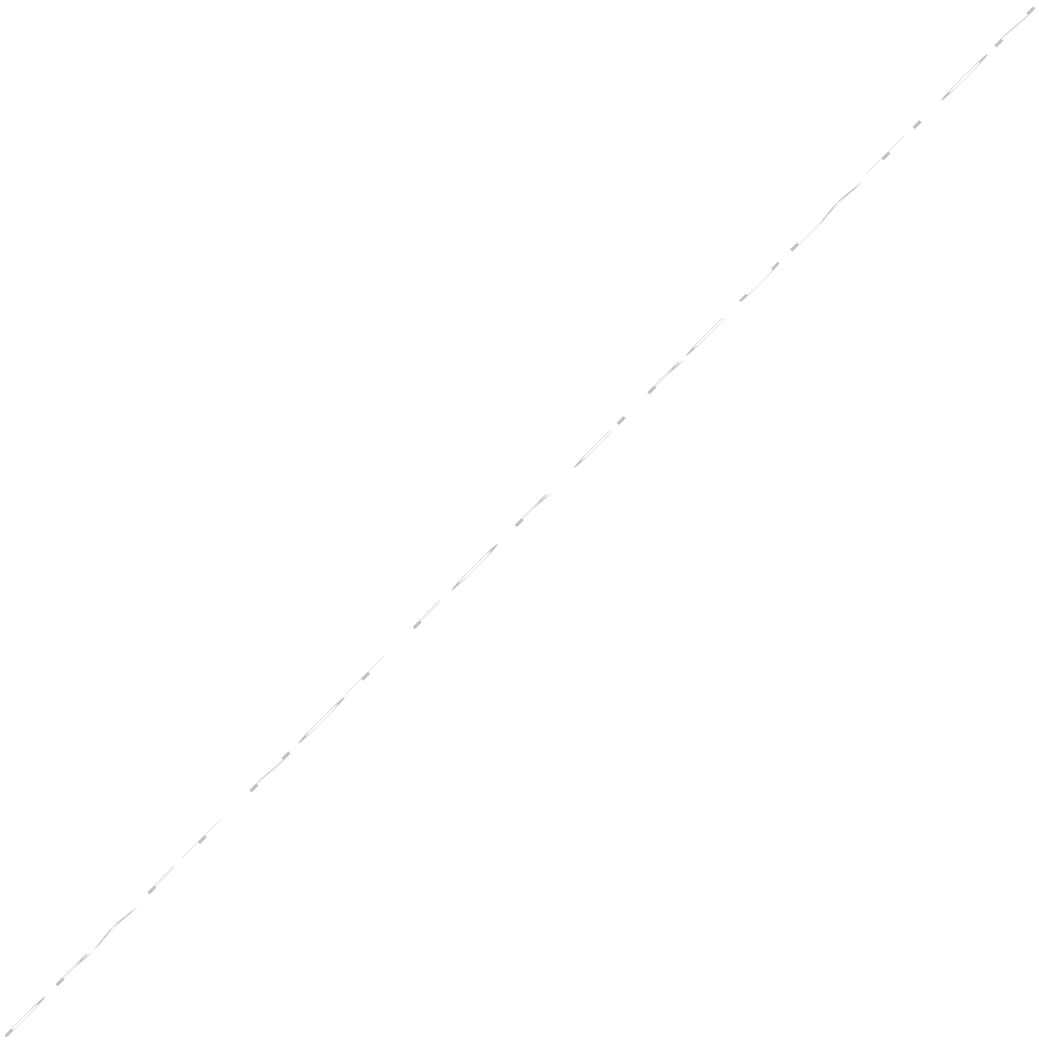
14.1 Summary

All of the diagrams from the typical system patterns were listed, and then compared in pairwise fashion to distil the consequences. These fell into a consistent set, which are illustrated in a synthesis diagram (Figure 13).

This list can be considered to be a complementary set of things (or attributes / indicators of those things) that are outcomes, and affected by all of the typical systems patterns in a disaster:

- Functionality or loss of property / infrastructure
- Awareness of the event and what to do pre-, during and post-event; authorising environment for decisions
- Loss of access to essential needs (food, water, shelter, health, safety, critical infrastructure)
- Social connection and cohesion, inclusiveness of places, values and networks
- Trust in government, institutions, service providers and each other
- Participation and inclusive of range of values in deciding actions and priorities, and appreciation of timescales
- Level of opportunities and viability of communities? Or local regional industries?
- Degree of self-reliance or helplessness
- Irreversible environmental or social change (transformation)
- Business confidence for investment, industry recovery, jobs etc.
- Capacity to deal with relocation issues (temporary or permanent)
- Level of equity of relief and support
- Level injury and mortality
- Business continuity post-disaster
- Types and costs of recovery; degree to which seen as economic opportunity
- Availability of alternatives for procuring services, and requisite knowledge and ability to do so
- Sanitation, public health, infectious disease
- Clarity and ownership of roles and costs, public, private, community, insurance

- Civil peace or unrest, maintenance of law and order
- Level of adaptive capacity (self, community, institutions, governments)
- Emotional and psychological wellbeing versus suffering
- Level of crime, domestic violence in next decade
- Level of safety net and inclusion for marginalised groups (people with disabilities; Lesbian, Gay, Bisexual, Transgender, Queer or Questioning, and Intersex; culturally and linguistically diverse; non-English speaking background; and migrants



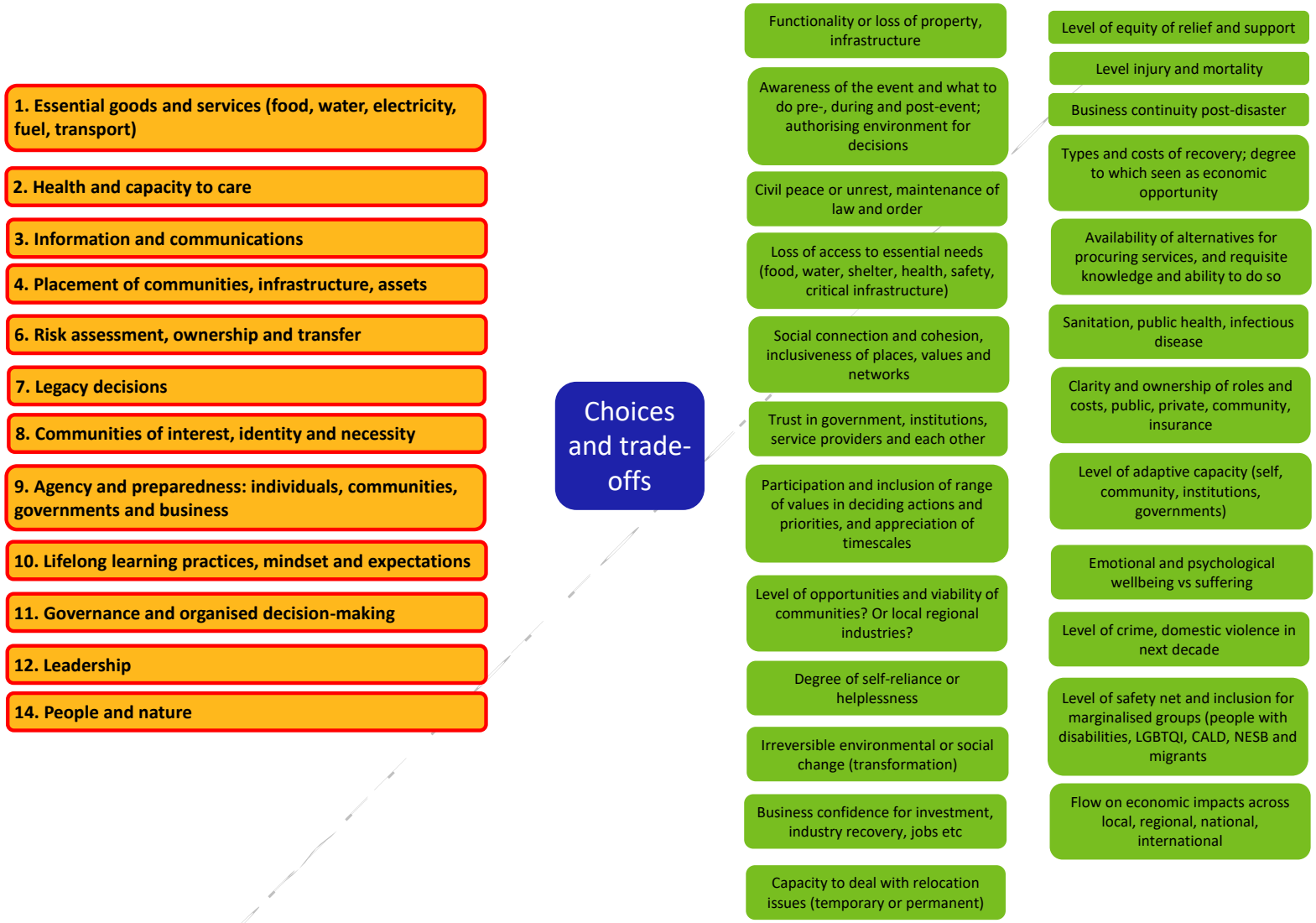


Figure 13 All of the typical system patterns are in orange boxes. The green boxes are the impacts that were aggregated and summarised across all the workshop diagrams and typical system patterns – there was a fairly stable set.

References

AIHW 2016. Australia's health 2016: Burden of disease and injury in Australia. *Australia's health series no. 15.* Canberra: Australian Institute of Health and Welfare,.

AIHW 2017. Elective surgery waiting times 2016–17: Australian hospital statistics. Canberra: Australian Institute of Health and Welfare,.

AIHW. 2018a. *Deaths in Australia: Life expectancy* [Online]. Australian Institute of Health and Welfare, Australian Government. Available: https://www.aihw.gov.au/reports/life-expectancy-death/deaths-in-australia/contents/life-expectancy [Accessed 24 July 2018].

AIHW. 2018b. *Deaths in Australia: Trends in deaths* [Online]. Australian Institute of Health and Welfare, Australian Government. Available: https://www.aihw.gov.au/reports/life-expectancy-death/deaths-in-australia/contents/trends-in-deaths [Accessed 24 July 2018].

AUF DER HEIDE, E. 2004. Common Misconceptions about Disasters: Panic, the "Disaster Syndrome," and Looting. *In:* O'LEARY, M. (ed.) *The First 72 Hours: A Community Approach to Disaster Preparedness.* Lincoln, Nebraska, USA: iUniverse Publishing.

BANDURA, A. 2000. Exercise of human agency through collective efficacy. *Current directions in psychological science,* 9**,** 75-78.

BANDURA, A. 2018. Toward a psychology of human agency: Pathways and reflections. *Perspectives on Psychological Science,* 13**,** 130-136.

BASNOU, C., PINO, J. & TERRADAS, J. 2015. Ecosystem services provided by green infrastructure in the urban environment. *CAB Reviews,* 10**,** 1-11.

BAZIGOS, M., GAGNON, C. & SCHANINGER, B. 2016. Leadership in context. *McKinsey Quarterly* [Online]. Available: https://www.mckinsey.com/business-functions/organization/our-insights/leadership-in-context.

BROWN, B. 2017. Braving the wilderness: The quest for true belonging and the courage to stand alone. New York: Random House.

BRUGNACH, M. & INGRAM, H. 2012. Ambiguity: the challenge of knowing and deciding together. *Environmental Science & Policy,* 15**,** 60-71.

BRYANT, R. A., GALLAGHER, H. C., GIBBS, L., PATTISON, P., MACDOUGALL, C., LOUISE HARMS, BLOCK, K., BAKER, E., VIKKI SINNOTT, IRETON, G., RICHARDSON, J., FORBES, D. & LUSHER, D. 2017. Mental Health and Social Networks After Disaster. *American Journal of Psychiatry,* 174**,** 277-285.

BRYNIELSSON, J., GRANASEN, M., LINDQUIST, S., QUIJANO, M. N., NILSSON, S. & TRNKA, J. 2018. Informing crisis alerts using social media: Best practices and proof of concept. *Journal of Contingencies and Crisis Management,* 26**,** 28-40.

BUREAU OF COMMUNICATIONS RESEARCH 2016. The communications sector: recent trends and developments. Canberra, ACT.

CEBR 2017. The cost of disconnected communities. *Report for The Big Lunch.* Centre for Economics and Business Research Ltd.

CHAFFIN, B. C., GOSNELL, H. & COSENS, B. A. 2014. A decade of adaptive governance scholarship synthesis and future directions. *Ecology and Society,* 19.

CHAMLEE-WRIGHT, E. & STORR, V. H. 2010. Expectations of government's response to disaster. *Public Choice,* 144**,** 253-274.

CHEE, Y. E. 2004. An ecological perspective on the valuation of ecosystem services. *Biological Conservation,* 120**,** 549-565.

COSTANZA, R., DARGE, R., DEGROOT, R., FARBER, S., GRASSO, M., HANNON, B., LIMBURG, K., NAEEM, S., ONEILL, R. V., PARUELO, J., RASKIN, R. G., SUTTON, P. & VANDENBELT, M. 1997. The value of the world's ecosystem services and natural capital. *Nature,* 387**,** 253-260.

CROSWELLER, M. 2015. How a change in thinking might change the inevitability in disasters. *Australian Journal of Emergency Management,* 30**,** 48-55.

DELOITTE ACCESS ECONOMICS 2015. The economic value of informal care in Australia in 2015. Barton, Australia.

DEPARTMENT OF HEALTH AND HUMAN SERVICES 2017. Review of the Vulnerable people in emergencies policy. Victoria, Australia: Victoria State Government Health and Human Services.

EMERGENCY MANAGEMENT VICTORIA 2017. Victorian emergency management strategic action plan: Update #2 2017 - 2020/.

FLETCHER, J. K. 2004. The paradox of postheroic leadership: An essay on gender, power, and transformational change. *The Leadership Quarterly,* 15**,** 647-661.

FOLKE, C. 2007. Social–ecological systems and adaptive governance of the commons. *Ecological Research,* 22**,** 14-15.

FORBES, D., ALKEMADE, N., WATERS, E., GIBBS, L., GALLAGHER, H., PATTISON, P., LUSHER, D., MACDOUGALL, C., HARMS, L., BLOCK, K., SNOWDON, E., KELLET, C., SINNOTT, V., IRETON, G., RICHARDSON, J. & BRYANT, R. 2015. *The role of anger and ongoing stressors in mental health following a natural disaster*.

GREN, S. & HELANDER, S. 2017. Why do people live in high-risk areas? - A field study in Samar, Philippines. Report 5034. Lund, Sweden: Faculty of Engineering, Lund University.

HANNAH, S. T., AVOLIO, B. J., LUTHANS, F. & HARMS, P. D. 2008. Leadership efficacy: Review and future directions. *The Leadership Quarterly,* 19**,** 669-692.

HARTIG, T., MITCHELL, R., DE VRIES, S. & FRUMKIN, H. 2014. Nature and Health. *Annual Review of Public Health, Vol 35,* 35**,** 207-+.

HIKICHI, H., AIDA, J., TSUBOYA, T., KONDO, K. & KAWACHI, I. 2016. Can community social cohesion prevent posttraumatic stress disorder in the aftermath of a disaster? A natural experiment from the 2011 Tohoku earthquake and tsunami. *American journal of epidemiology,* 183**,** 902-910.

HOWARD, A., AGLLIAS, K., BEVIS, M. & BLAKEMORE, T. 2017. “They’ll tell us when to evacuate”: The experiences and expectations of disaster-related communication in vulnerable groups. *International Journal of Disaster Risk Reduction,* 22**,** 139-146.

ISO 2009. *ISO 31000: 2009 Risk Management – Principles and Guidelines,* Geneva, Switzerland, International Organization for Standardization (ISO).

JONES, R. N., PATWARDHAN, A., COHEN, J. S., DESSAI, S., LAMMEL, A., LEMPERT, R. J., MIRZA, M. M. Q. & VON STORCH, H. 2014. Foundations for decision making. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Cambridge University Press, Cambridge, UK and New York, NY, USA.

KENDAL, D., FORD, R. M., ANDERSON, N. M. & FARRAR, A. 2015. The VALS: A new tool to measure people's general valued attributes of landscapes. *Journal of Environmental Management,* 163**,** 224-233.

KNOWLES, S., COMBS, R., KIRK, S., GRIFFITHS, M., PATEL, N. & SANDERS, C. 2016. Hidden caring, hidden carers? Exploring the experience of carers for people with long-term conditions. *Health & social care in the community,* 24**,** 203-213.

LATIMER, C. 2018. Sydney city blackout 'a close run thing', energy transmission boss says. *The Sydney Morning Herald.*

LEA, M. 2017. *Communication Problems in Disaster Situations* [Online]. Available: https://martinlea.com/communication-problems-in-disaster-situations/ [Accessed 14 July 2018].

LUKASIEWICZ, A., DOVERS, S. & EBURN, M. 2017. Shared responsibility: the who, what and how. *Environmental Hazards,* 16**,** 291-313.

MARTIN, N. & RICE, J. 2012. Emergency communications and warning systems: Determining critical capacities in the Australian context. *Disaster Prevention and Management,* 21**,** 529-540.

MAYBERRY, R. 2015. 5 Excuses Why People Don't Prepare For Disasters. Mather, CA, USA: California Governor's Office of Emergency Services.

MILLER, J. 2005. Biodiversity conservation and the extinction of experience. *Trends in Ecology & Evolution,* 20**,** 430-434.

NATIONAL RURAL HEALTH ALLIANCE 2016. The health of people living in remote Australia. Deakin West, ACT.

NORRIS, F. H. 2016. *Disasters and Domestic Violence* [Online]. National Center for PTSD, U.S. Department of Veterans Affairs. Available: https://www.ptsd.va.gov/professional/trauma/disaster-terrorism/disasters-domestic-violence.asp [Accessed 24 July 2018].

O'CONNELL, D., LIN, B., CAPON, T. & STAFFORD SMITH, M. 2015. Disaster resilience and mitigation. Technical report on current and future capacity to deliver on risk assessment and mitigation needs. Australia.: CSIRO, Australia.

O'CONNELL, D., WISE, R., WILLIAMS, R., GRIGG, N., MEHARG, S., DUNLOP, M., DOERR, V. & MEYERS, J. 2018. Approach, methods and results for co-producing a systems understanding of disaster: Technical Report Supporting the Development of the Australian Vulnerability Profile. Canberra, Australia: CSIRO.

OLSSON, P., GUNDERSON, L. H., CARPENTER, S. R., RYAN, P., LEBEL, L., FOLKE, C. & HOLLING, C. S. 2006. Shooting the rapids navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society,* 11.

OSTROM, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*, New York: Cambridge University Press.

OWEN, C., BOSOMWORTH, K., BEARMAN, C., BROOKS, B., FOGARTY, L. & CONWAY, G. Politics, Policies and Paradigms: Challenges of Change in Future Emergency Management. . AFAC13: Shaping tomorrow today, 2013 Melbourne. 2-5 September

PARLIAMENT OF AUSTRALIA 2015. Australia's transport energy resilience and sustainability. Canberra: Parliament of Australia.

PROUST, K. & NEWELL, B. 2012. Introduction to Collaborative Conceptual Modelling. ANU Research Publications.

QUEENSLAND DEPARTMENT OF AGRICULTURE AND FISHERIES. 2018. *Human impacts on wetlands* [Online]. Queensland Government, Department of Agriculture and Fisheries. Available: https://www.daf.qld.gov.au/business-priorities/fisheries/habitats/freshwater-wetlands/human-impacts-on-wetlands [Accessed 21 July 2018].

REINHARDT, G. 2017. Why people stay in disaster-prone cities. *The Conversation.*

RICHARDSON, A. 2018. Australia imports almost all of its oil, and there are pitfalls all over the globe. *The Conversation*

SANDSTROM, U. G., ANGELSTAM, P. & MIKUSINSKI, G. 2006. Ecological diversity of birds in relation to the structure of urban green space. *Landscape and Urban Planning,* 77**,** 39-53.

SARRICA, M., FARINOSI, M., COMUNELLO, F., BRONDI, S., PARISI, L. & FORTUNATI, L. 2018. Shaken and stirred: Social representations, social media, and community empowerment in emergency contexts. *Semiotica***,** 321-346.

SCHRUIJER, S. & VANSINA, L. 2008. *Psychodynamics for Consultants and Managers: From Understanding to Leading Meaningful Change*, John Wiley & Sons.
SEELEY BROWN, J. & DUGUID, P. 2002. *The Social Life of Information,* Cambridge, Massachusetts, Harvard Business School Press.
SHANAHAN, D. F., COX, D. T. C., FULLER, R. A., HANCOCK, S., LIN, B. B., ANDERSON, K., BUSH, R. & GASTON, K. J. 2017. Variation in experiences of nature across gradients of tree cover in compact and sprawling cities. *Landscape and Urban Planning,* 157**,** 231-238.
SHARMA-WALLACE, L., VELARDE, S. J. & WREFORD, A. 2018. Adaptive governance good practice: Show me the evidence! *Journal of Environmental Management,* 222**,** 174-184.
SIMONSEN, S. R., BIGGS, R., SCHLÜTER, M., SCHOON, M., BOHENSKY, E., CUNDILL, G., DAKOS, V., DAW, T., KOTSCHY, K., LEITCH, A., QUINLAN, A., PETERSON, G. & MOBERG, F. 2014. Applying resilience system: Seven principles for building resilience in social-ecological systems.
SOGA, M. & GASTON, K. 2016. Extinction of experience: evidence, consequencesand challenges of loss of human-nature interactions. . *Frontiers in Ecology andthe Environment,* 14**,** 94-101.
STEIN, R. T., GEIS, F. L. & DAMARIN, F. 1973. Perception of emergent leadership hierarchies in task groups. *Journal of Personality and Social Psychology,* 28**,** 77-87.
TEUTSCH, K. 2010. Effective Disaster Management Strategies in the 21st Century. *Emergency Management* Folsom, CA, USA: e.Republic.
THORNTON, R. 2015. AFTER ACTION: To burn or not to burn. *Wildfire.* International Association of Wildland Fire.
TIBBITS, A., HANDMER, J., HAYNES, K., LOWE, T. & WHITTAKER, J. 2008. Prepare, stay and defend or leave early: evidence for the Australian approach. . *In:* HANDMER, J. & HAYNES, K. (eds.) *Community bushfire safety.* Collingwood: CSIRO Publishing.
VAN KESSEL, G., GIBBS, L. & MACDOUGALL, C. 2015. Strategies to enhance resilience post-natural disaster: a qualitative study of experiences with Australian floods and fires. *Journal of Public Health,* 37**,** 328-336.
VIVODA, V. 2014. Running on empty: Australia's risky approach to oil supplies. *The Conversation*
WATERS, J. & ADGER, W. N. 2017. Spatial, network and temporal dimensions of the determinants of adaptive capacity in poor urban areas. *Global Environmental Change,* 46**,** 42-49.
WHITTAKER, W. 2008. *Vulnerability to bushfires in south-eastern Australia: a case study from East Gippsland, Victoria.* PhD, RMIT University.
WILKINSON, R. & PICKETT, K. 2010. The spirit level. *Why equality is better for*.
YOUNG, C. & JONES, R. N. 2016. Owning the future: risk ownership and strategic decision-making for natural hazards. *Australian Journal of Emergency Management,* 31.
YOUNG, C. K., JONES, R.N., SYMONS, J. 2016. Understanding values at risk and risk ownership workshop synthesis report. Melbourne, Victoria.
YUKL, G. & MAHSUD, R. 2010. Why flexible and adaptive leadership is essential. *Consulting Psychology Journal: Practice and Research,* 62**,** 81-93.

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