June 2014

SUBMISSION TO PRODUCTIVITY COMMISSION REVIEW OF DISASTER MANAGEMENT

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DIMENSIONS OF DISASTER MANAGEMENT

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The Productivity Commission has been tasked:

> *…to assess **the full scope** of current Commonwealth, state and territory expenditure on natural disaster mitigation, resilience, and recovery and to identify reforms which achieve an effective and sustainable balance between natural disaster recovery and mitigation funding to help communities better prepare for disasters.* (Emphasis added)

The terms of reference of the inquiry (PC, 2014), however, explicitly exclude consideration of disaster response except where it is "directly relevant to mitigation, relief and recovery and existing Commonwealth/state joint funding arrangements".

Much of the language of the task expressed above will be familiar to most disaster managers[1] although probably less so to the economically-focused commissioners of the Productivity Commission. In a conversation with the team undertaking the inquiry it was evident that some background on the process of disaster management, its evolution over the past few decades and a perspective on the actual breadth of "the full scope" would be beneficial. This submission aims to provide that background.

Evolution of Disaster Management

In 1984 the fledgling Emergency Management Australia (EMA) promulgated the concepts and principles of "emergency management" based on the approach followed by the US Federal Emergency Management Agency (FEMA). These were divided between four complementary approaches:

- the comprehensive approach (better known as PPRR: Prevent, Prepare, Respond and Recover)
- the all-hazards approach
- the all agencies (or integrated) approach; and
- the prepared community.

Each of these approaches is replete with its own vocabulary.

The United Nations declared the 1990s as being the International Decade for Natural Disaster Reduction (IDNDR). As part of Australia's contribution to the IDNDR two major research projects were undertaken by Commonwealth agencies. The Tropical Cyclone Coastal Impacts Program (TCCIP) was initiated by the Queensland Regional Office of the Bureau of Meteorology (BoM) in 1991 under the leadership of Mr Rex Falls, the Regional Director. Also closely involved were the Queensland Department of Emergency Services, the BoM Research Centre, James Cook University, the Centre for Resource and Environmental Studies at ANU, Cairns City Council, Mackay City Council and EMA – something of a prototype Collaborative Research Centre (CRC). The main focus of this project was on the risks posed by tropical cyclones, especially the threat of storm tide inundation.

[1] The term "disaster risk" and "emergency risk" are used interchangeably in different jurisdictions. While the more widely used term in Australia is "emergency risk" my preference is to follow the Queensland and international practice of referring to "disaster risk management".

The second major IDNDR project was the National Geohazards Risk to Urban Communities Project (more commonly known as the *Cities Project*) established by the Australian Geological Survey Organisation (AGSO – now Geoscience Australia), which commenced in 1996. This project was initiated by Dr Wally Johnson of AGSO and was undertaken in collaboration with the BoM, James Cook University, University of Queensland, EMA and 11 Queensland local government councils. I was project director for the first four years of the project. As with TCCIP, the *Cities Project* focused on the risks posed to urban communities. The *Cities Project*, with the encouragement of EMA, also provided significant methodological assistance to the *Pacific Cities Project* being run by the Suva-based South Pacific Applied Geoscience Commission (SOPAC).

Both of these projects adopted the approach to disaster risk analysis that had been first documented by a conference organised in 1979 by the UN Disaster Relief Organisation (UNDRO, 1980) which saw disaster risk as being the outcome of the interaction between a hazard phenomenon, the community elements that are exposed to the impact of that hazard (including people, buildings, infrastructure and ecosystems); and the degree to which those elements are more or less susceptible to that exposure. This relationship has been expressed in pseudo-mathematical terms as:

Risk = Hazard x Exposure x Vulnerability

To effectively reduce the level of risk it is necessary to reduce, as far as practical, the level of exposure of community elements and to reduce, as far as possible, the vulnerability of the community elements potentially exposed. With the possible exception of bushfires[2] it is not possible to reduce the frequency or severity of natural hazard events but it is possible to anticipate their likely impact through the process of monitoring and scientific modelling. The relationship of these three elements as the drivers of disaster risk is well recognised by EMA (2004) and internationally by bodies such as the Intergovernmental Panel on Climate Change (IPCC) as shown in Figure 1.

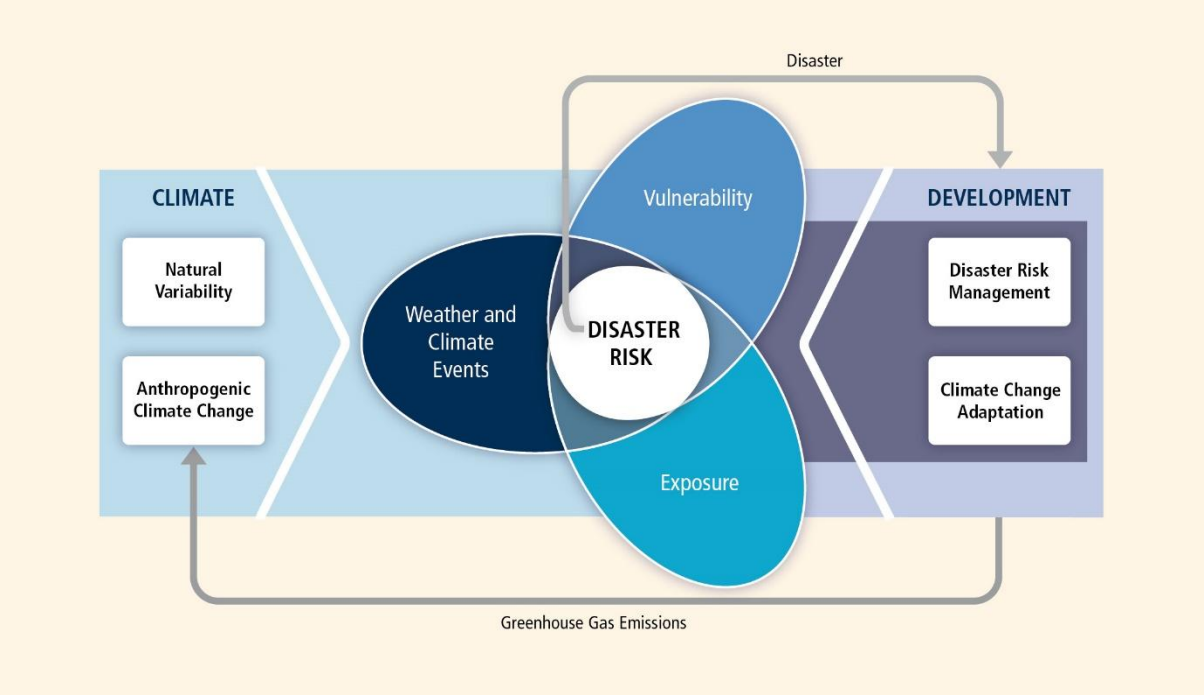

Figure 1: IPCC SREX climate change risk diagram (IPCC, 2012, Figure SPM.1)

[2] In some circumstances it is possible to reduce the intensity and extent of fires by reducing the available fuel.

The publication of the first edition of the Australia and New Zealand Standard AS/NZS 4360 *Risk management* in 1995 (SA/SNZ, 1995) led to the formal introduction of the risk management process in to the traditional disaster management paradigm in 1996. The process of "disaster/emergency risk assessment" was established with yet another set of concepts, principles and vocabulary.

The period from 2001 to 2004 saw a number of key developments in disaster management. Not least of these developments was the response to the terrorist attacks in the US in September 2001, which saw a considerable shift in focus from natural disasters to counter terrorism. A considerable effort was expended in developing data on critical infrastructure by GA and the security services, for example, to better understand the potential impact of a terrorist attack on power or water supplies. This was essentially the same type of information gathered by the TCCIP and *Cities Project* as input to their assessments of the risks posed by natural hazards. Unfortunately none of the information gathered by the security services was made available to disaster managers because of "national security". That meant that the same information has had to be collected a second time to support disaster risk studies.

In 2002 the Council of Australian Governments (COAG) commissioned a review of Australia's approach in dealing with natural disasters, with a focus on "mitigation to guard against disasters, response during a disaster event, and post-disaster relief and recovery". The review, published in 2004 (COAG, 2004), was conducted by a high level group of officials who identified strengths and weaknesses in disaster management across Australia and concluded that:

> *…current arrangements could be improved to ensure that Australia has a world-class national framework for natural disaster management – thus achieving safer, more sustainable communities[3], and reduced risk, damage and losses.*

A new national framework, based on 12 reform commitments, was articulated as the foundation for this new approach. Central to that approach was:

> *..a systematic and widespread national process of disaster risk assessments and, most importantly, a fundamental shift in focus towards cost-effective, evidence-based disaster mitigation.*

The first two of the reform commitments were:

1. *develop and implement a five-year national programme of systematic and rigorous disaster risk assessments.*
2. *establish a nationally consistent system of data collection, research and analysis to ensure a sound knowledge base on natural disasters and disaster mitigation.*

Over the ensuing decade a large number of disaster risk assessments were undertaken, mostly at local government level, funded jointly by the Commonwealth, the states and territories, and local governments. A "standard" risk assessment process was not promulgated until publication of the National Emergency Risk Assessment Guideline (NERAG) in 2010 (EMA, 2010), by which time most studies has been completed and the funding programs supporting them had been wound up. The lack of quality control or guidance as to how those studies were to be conducted, the lack of monitoring and

[3] The "safer, sustainable communities", that was adopted by EMA as their slogan for a period between 2000 and 2008 or so, came from the terminology that I developed as the aim of the AGSO Cities Project in 1997 *viz*, "to facilitate safe, sustainable and prosperous communities" (Granger, 1999). My argument at the time was that you could not have prosperous communities unless they were sustainable and you could not have sustainable communities unless they were safe.

review of study outcomes, and the implementation of identified risk reduction strategies meant that the many millions of dollars spent on that program were largely wasted. A "nationally consistent data collection" has still yet to be developed.

In 2004 EMA updated its "concepts and principles" manual (EMA, 2004), which condensed the four approaches that had been in place since 1984 into two as:

> *Australia has adopted a **comprehensive** and **integrated approach** to the development of its arrangements and programs for the effective management of emergencies and disasters.*
>
> *This approach is:*
>
> - ***comprehensive**, in encompassing all hazards and in recognising that dealing with the risks to community safety, which such hazards create, requires a range of prevention/mitigation, preparedness, response and recovery (PPRR) programs and other risk management treatments; and*
> - ***integrated**, in ensuring that the efforts of governments, all relevant organisations and agencies, and the community, as a prepared community, are coordinated in such programs.*
>
> *Ultimately, the goal of all such arrangements and programs is to contribute to the development and maintenance of a safer, sustainable community.*

Also in 2004 COAG received the report that it had commissioned on bushfire mitigation and management (Ellis, Kanowski & Whelan, 2004) following the 2003 Canberra fires. This report recommended that the PPRR paradigm be expanded and re-labelled "Five R" – **R**esearch, information and analysis; **R**isk modification, **R**eadiness, **R**esponse and **R**ecovery. This was proposed as a "better basis for understanding the integrated elements of [hazard] mitigation and management".

The relationship between the conventional disaster management process, with its two approaches, and disaster risk management, to my understanding, has never been clearly articulated. Some argue that they are two separate issues, indeed some disaster managers see no value in moving away from the "tried and tested" PPRR paradigm. I would observe, however, that the majority of managers that still hold that view are entirely focused on the response phase.

My own view is that the disaster risk assessment process constitutes the dominant part of the *Risk, information and analysis* phase of the Five R paradigm, which provides the essential input to the *Risk modification* phase; informs the *Readiness* phase; underpins the *Response* phase; and informs and is informed by the *Recovery* phase.

The year 2004 also saw the transfer of EMA from the Department of Defence to the Department of the Attorney General with an attendant change in organisational culture.

In 2007 the then Australian Department of Climate Change and Energy Efficiency published the *National Climate Change Adaptation Framework* (DCCEF, 2007). In discussing "natural disaster management" the Framework refers to the COAG *Mitigation, relief and recovery* report (COAG, 2004) and identifies two areas for potential action:

> a) *Undertake research to improve knowledge on the nature and expected extent of changes to existing risk profiles as a result of climate change for key events such as bushfires, flooding, cyclones, storm surges, wind and hail damage.*

b) *Incorporate climate change impacts into planning for natural disaster response management, in particular the risk and changing behaviour from bushfires, flooding, cyclones, storm surges, wind and extremes in temperature. This will include:*

- *incorporating climate change issues in the review of the Natural Disaster Mitigation Programme and proposals submitted under the Programme; and*
- *improving information for emergency services and communities to foster awareness of climate change and adaptation responses.*

Granger, Bridger and Rosewall (2014) observed that a major difficulty exists in incorporating climate change adaptation into the disaster risk assessment framework given that information on all three risk elements - the hazard phenomenon, the community elements exposed and their level of vulnerability to that impact - will be hypothetical. They observed that:

> *It is certainly possible to postulate a climate change-influenced inundation regime and base event scenarios on that regime; however, knowing where development will have been established 25 or 50 years into the future and what changes there will have been in the vulnerability of an aged population and built inventory is essentially guess work.*

The most recent shift in approach (and terminology) flowed from the international conference held in Kyoto (Japan) in January 2005 to finalise the work undertaken during the IDNDR. From that conference came the *Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters* (ISDR, 2007). This framework has three strategic goals:

(a) *The more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction;*

(b) *The development and strengthening of institutions, mechanisms and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards;*

(c) *The systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response and recovery programmes in the reconstruction of affected communities.*

The definition of "resilience" adopted by that conference was:

> *The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organising itself to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures.* (ISDR, 2004)

In adopting the *Hyogo Framework*, the Australian Ministerial Council for Police and Emergency Management agreed in 2008 that the future direction for Australian disaster management should be based on "achieving community and organisational resilience". To build on this work, COAG agreed to adopt a whole-of-nation resilience-based approach to disaster management, which recognised that a national, coordinated and cooperative effort was needed to enhance Australia's capacity to withstand and recover from emergencies and disasters. The *National Strategy for Disaster Resilience* was published in 2011 (COAG, 2011).

It is interesting to note the shift in language from "sustainability" in COAG (2004) to "resilience" in COAG (2011). I have difficulty separating the two concepts, as, I suspect, do many others. The Ohio State University's Center for Resilience (www.resilience.osu.edu), for example defines resilience as:

> *…the capacity of a system to survive, adapt, and grow in the face of unforeseen changes, even catastrophic incidents.*

While sustainability is seen as:

> *…an attribute of dynamic, adaptive systems that are able to flourish and grow in the face of uncertainty and constant change.*

Interestingly, in spite of the fact that the word "resilience" appears in the COAG (2011) 135 times there is no definition of "resilience" other than the statement:

> *Disaster resilience is the collective responsibility of all sectors of society, including all levels of government, business, the non-government sector and individuals.*

It was left to the National Partnership Agreement on Natural Disaster Resilience (COAG, 2014) to provide the following definition:

> ***Resilience** – the capacity to prevent, mitigate, prepare for, respond to and recover from the impact of natural disasters.*

This definition appears to simply restate the old PPRR doctrine and lacks any emphasis on the need for communities to be adaptable to, and learn the lessons from, disaster impacts. I would certainly like to see the disaster management bureaucracy adopt a better definition of resilience such as that suggested in CARRI (2013), namely:

> *Community resilience is the capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change.*

COAG (2011) also marks a significant shift to the view that community safety is a "shared responsibility". This approach was raised in the final report of the Victorian Bushfire Royal Commission (Victorian Parliament, 2010), which stated:

> *The Commission uses the expression "shared responsibility" to mean increased responsibility for all. It recommends that state agencies and municipal councils adopt increased or improved protective, emergency management and advisory roles. In turn, communities, individuals and households need to take greater responsibility for their own safety and to act on advice and other cues given to them before and on the day of a bushfire.*
>
> *Shared responsibility does not mean equal responsibility ... there are some areas in which the state should assume greater responsibility than the community. For example, in most instances state fire authorities will be more capable than individuals when it comes to identifying the risks associated with bushfire; the state should therefore assume greater responsibility for working to minimise those risks.*

While the shift from "sustainability" to "resilience" is perhaps somewhat semantic; the shift from "the government" being responsible for community safety (the "nanny State" approach) to one of "shared

responsibility" is profound and sits at the heart of the Productivity Commission's inquiry. A look at where the investment in disaster management across the five areas described above (the Five Rs) is made, and by whom, may provide some perspective to the "shared responsibility" approach.

Research, information and analysis

A vast amount of both public and private investment is already being made in disaster-related research, information and analysis. The quantum of this investment possibly exceeds that made for the remaining four elements combined. An exhaustive listing of these investments would take too much space here, however, a flavour of how large the investment is and how diverse its sources are should suffice.

The two main Commonwealth agencies directly involved are the BoM and Geoscience Australia (GA). The BoM undertakes the severe weather-related activities required of it under the *Meteorology Act 1995*. Those activities include the fundamental research in to the weather phenomena, recording and analysing the impact of past events, monitoring current and developing weather patterns so as to provide warnings of likely severe events such as cyclones, fire weather and floods. It also provides very close liaison at the regional level with state and territory disaster management agencies and local governments. It also produces and promotes a wide range of community information designed to enhance community awareness. The BoM also provides input to standard resources such as Probable Maximum Precipitation (PMP) data that provide the essential input to the design of dams and other flood management structures. They also provide the destructive wind data used in the development of building code standards for wind loads. It is also a major source of information and analysis on climate change.

GA is responsible for monitoring seismic and geomagnetic ("space weather") events and maintaining records of past earthquakes and landslides. It is also responsible for modelling the likely development of tsunami events that could threaten Australia and issuing warnings that are transmitted through the established BoM weather warning system. Warnings of potentially severe "space weather" events and volcanic ash cloud development are also channelled through the BoM warning system. It is also responsible for providing community awareness material and advice on how to cope with a severe geohazard event. GA is also the national mapping agency responsible for setting a range of standards for topographic mapping and navigation systems without which it would not be possible to accurately locate events or the affected communities. They also provide input to the development of building code standards for earthquake loads and continue to develop the risk assessment methods developed under the *Cities Project*.

Other Commonwealth agencies that make a significant contribution include the Australian Bureau of Statistics (ABS), which collects and publishes a wide range of data on community demographic, social and economic aspects that are relevant to understanding issues of community vulnerability. EMA provides training and undertakes research that feeds into the various national and state-level policies and procedures. It also maintains data on past disaster events. Various CSIRO divisions undertake research on bushfires, building construction standards and communications technologies.

State and local governments undertake or commission research in to specific areas of disaster risk such as flood proneness or coastal zone management and maintain risk registers specific to their respective areas of jurisdiction. Some states maintain their own seismic monitoring networks as well as weather and stream gauging systems. Most importantly they maintain the detailed property-level information from which the detailed road network and built environment data is derived and without which detailed disaster risk assessments could not be made.

Academic institutions provide significant input to the research and analysis areas as well as training for professional disaster managers. Among the main academic institutions in this field are Macquarie University (especially the insurance industry-supported Risk Frontiers), James Cook University (Disaster Research Centre and Cyclone Testing Station), RMIT University, the Australian National University, Queensland University and so on. Many of the lead researchers involved in the various disaster-related CRCs are drawn from these institutions.

Professional institutions such as Engineers Australia and the Geomechanics Society of Australia sponsor research and publish reference manuals to guide and standardise the analysis of a wide range of hazards including floods, storm tide and landslides. The Australian Local Government Association has commissioned research to provide guidance to local governments on issues such as land use planning and risk mitigation (SMEC & IID, 2006).

The private sector is also major contributor. The major utility providers such as Telstra and Optus undertake a range of research and analysis programs to better understand the risks posed to their assets. Major engineering consultancies such as SKM and SMEC undertake internally-funded research to provide them with a market edge in the provision of services such as flood and storm tide modelling. ERSA is perhaps unique in this area in that we cover the full range of disaster risk management (hazard, exposure and vulnerability) and audit functions and maintain our expertise through ongoing internal research and methodology refinement.

Risk Modification

The investment in risk modification, or mitigation, can be divided in to two parts: the modification of exposure; and the modification of vulnerability.

Exposure Modification: The most common method of modifying exposure is the construction of works such as levees, flood detention basins, dams and sea walls to a specific design level so that exposure to the more frequently occurring events do not impact on the community involved. These works are typically very expensive to construct and maintain and do not necessarily provide the degree of protection that the community expects or believes. The case of the “failure” of Wivenhoe Dam to prevent the flooding of Brisbane in 2011 is a case in point. Structural measures can only reduce exposure to events up to their design level and then only if they are maintained, the design level has been accurately determined and there is no change in the hazard environment (e.g. an increase in flood frequency through climate change). The successful development of structural mitigation measures relies very heavily on input from the Research, information and analysis stage. The flood or storm tide regime should also be modelled after the development of the structural defences to feed back into this stage and their performance in subsequent events audited. This feed-back and audit process appears to be rarely undertaken.

The second common method of modifying exposure is the use of planning regulations to prevent or limit development in areas where there is a hazard impact potential. This approach can only be effective for “green field” developments because existing development cannot be easily or economically changed. This approach is typically governed by state planning legislation and regulations and implemented by local governments. Here again an effective planning scheme must rely very heavily on the output from the Research, information and analysis stage to determine, for example, the extent of the design level flood event or the areas of high bushfire potential.

The development industry is often antagonistic to planning restrictions that limit their profit potential and will use legal appeal mechanisms to have their way – usually at significant cost to the local government

involved. The requirement imposed by some local governments that developers provide a percentage of their development area as public open space can also produce problems. For example, where steeper country is left as a "wildlife corridor, it will eventually become a "wildfire corridor" because councils are unable to manage the fuel loads that build up there.

It is common practice for planning schemes to differentiate the design threshold for residential areas from those for "community infrastructure" such as hospitals; however, such thresholds are meaningless unless access to those facilities is constructed to the same design threshold. For examples, the Mater Hospital in Mackay remained flood free but was isolated because the only access route was flooded for three days. The new Sunshine Coast University Hospital, currently under construction by the Queensland Government on a site within the 100 year ARI flood zone will, according to a statement made to the State Parliament, be constructed to be flood free to the 500 year ARI design level; however, the road access will only be built to the 100 year ARI threshold.

A third method of reducing the exposure of people is to either evacuate them ahead of a forecast hazard impact or to move them temporarily to a place of greater safety such as a "community safer place", a fire shelter or cyclone "safe haven". The relocation of potentially exposed people and their most important assets, such as personal papers and pets, out of the risk zone must be well planned and preferably practiced. It requires considerable and ongoing community engagement effort. In some instances the effective relocation of people may also require development or maintenance of lower risk "escape routes" and/or the construction of purpose-built shelter facilities.

Warning systems, such as those operated by the BoM and some emergency services (e.g. the Country Fire Authority in Victoria), are an essential element in the evacuation process, whether it is a directed evacuation or a precautionary self-evacuation. The recipients of the warning information must, however, be able to relate that information to their own locality and situation. Some larger local governments, such as Brisbane City, have invested in systems that make flood warning information available in a form that any resident can see where the forecast flood will reach in relation to their own residence. The use of social media by councils and emergency service agencies is a growing and valuable trend.

Reducing the exposure of the road network to inundation hazards is usually impractical and/or uneconomical, especially in rural areas. The great majority of the road network is made up of local roads that are the responsibility of local governments. National and state roads are generally constructed to higher standards and are for the most part, flood free. The notable exception is the Bruce Highway in north Queensland, which is regularly closed by flood each wet season. The road network that developed to meet the needs of transport in the 19th and 20th centuries is now struggling to meet the demands of modern transport and local governments in the more remote rural areas tend to rely on NDRRA payments to maintain their roads.

Vulnerability Modification: The modification of vulnerability is less straight forward. The definition of "vulnerability" used here follows that provided by EMA (1998), namely:

> *The degree of susceptibility or resilience of the community and environment to hazards.*

An updated version of this definition is given in NERAG (EMA, 2010), which itself has been taken from the UN definition in ISDR (2004):

> *The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.*

Both definitions see "vulnerability" as a continuum from total susceptibility to total resilience.

For structures, the need for design and engineering to the standards under the Building Code of Australia is generally well understood. These construction standards are designed to provide a high degree of resilience to the impact of wind and earthquake loads. A standard for construction in bushfire-prone areas is also available while a standard for construction in flood-prone areas is under development. There are also guidelines for the retrofit or upgrade of building constructed before the standards came into effect to bring them up to current construction standards.

Up until the 1990s, council building inspectors were responsible for seeing that the construction standards under the Building Code were maintained. With the introduction of the Competition Policy, most councils ceased to undertake compliance inspections and this role was taken over by private building certifiers. There is some anecdotal evidence that there has been a general decline in conformance to the standards since the inspection role was taken over by private certifiers, resulting in some more modern buildings being less resistant to wind or earthquake damage than older buildings in the same community.

Other elements of the built environment, including power, water and telecommunications infrastructure are also required to meet published construction standards. However, these "lifeline" networks are more vulnerable where there is little or no redundancy in their design, so that a break in one link will cause the whole network to fail.
The interdependence of utilities is also an issue. Failure of the power supply, for example, will have an impact on most other lifeline infrastructures including water supply, sewage systems, telecommunications and logistic systems, such as fuel and food supplies.

Reducing the vulnerability of people is rather more complex. There are clearly attributes that make people more susceptible to harm in disasters such as age, physical disabilities and economic circumstances. I have been using a suite of 14 characteristics derived from census data for some years to produce a series of "vulnerability indices". While each of these criteria has an influence on an individual's susceptibility to harm, not all can be changed or improved to increase resilience. They are grouped into four broad classes.

Physical vulnerability: Four characteristics are selected to reflect the relative concentrations of people identified in many studies as being more physically susceptible to injury or death:

- the very young (children under 5 years) are more susceptible to physical injury and to exposure to extreme conditions. Susceptibility will be reduced where adequate care is provided.
- the elderly (typically regarded as those 65 years and over) are similarly susceptible to disaster impact. Susceptibility will be reduced where adequate care is provided.
- elderly folk who are living alone are especially vulnerable because of isolation during sudden onset events. Susceptibility will be reduced where their welfare is monitored by family, neighbours or other carers.
- people with disabilities are likely to be more vulnerable than the able-bodied. Susceptibility will be reduced where their welfare is monitored by family, neighbours or other carers.

Social and economic vulnerability: Five socio-economic characteristics are selected to reflect the financial capacity to recover from the impact of any disaster:

- households living in rented accommodation are less likely to have insurance or the resources to recover quickly from the loss of their accommodation and its contents.

- households with low household incomes (less than $600 a week) are likely to have no or inadequate insurance and will be more likely to rely on government or charity support for a long period.
- the unemployed and underemployed will have difficulty recovering without external assistance because there will be a loss of employment opportunities immediately following a disaster.
- the level of volunteering by people over 14 is seen by some social researchers as a good indicator of social cohesion - the greater the level of social cohesion the more resilient the community will be.

Strengthening local economic circumstances is probably the best overall strategy to reduce socio-economic vulnerability.

Mobility vulnerability: Three characteristics are selected to indicate those households or families that would be more likely to have difficulty where an evacuation or relocation is required:

- households with no private vehicle will need to rely on others to transport them out of an area at risk. Their susceptibility can only be reduced by the provision of transport assistance.
- single parent families will have greater difficulty in moving quickly than a household with two parents/carers present.
- large families (i.e. with three or more dependent children) will have difficulty moving quickly without assistance.

Awareness vulnerability: The disaster management adage holds that "an aware community is a prepared community" so three characteristics that indicate a potentially low level of awareness are selected:

- new residents in an area, i.e. those who were living in a different locality at the previous census, will have established fewer linkages in the community and be less aware of the hazard history of the area. Susceptibility can be reduced by community groups and neighbours providing new residents with an awareness of local issues.
- those with little or no English will have only a limited ability to understand disaster messages. Production of awareness material and warning messages in a range of languages will reduce their susceptibility.
- those who have limited or no access to technologies such as the internet, where warning messages and emergency alerts are increasingly made available, are at a distinct disadvantage. Ensuring that awareness and warning messages are communicated by as wide a range of technologies as possible will reduce susceptibility.

It is important to note that under some circumstances the use of structural defences to reduce exposure may, in fact, reduce resilience because people become complacent and believe that the risk has been eliminated. Reliance on structural defences also makes it imperative that warning information is as accurate and as timely as possible to ensure that if an event is likely to exceed the design level of the system, adequate time and resources are available to effect a relocation of the community at risk before the impact. This failure was starkly illustrated by the impact of Hurricane *Katrina* on New Orleans, where the levee system failed to keep the flood and storm tide waters out of the city and authorities failed to act quickly enough.

Readiness

Undoubtedly the greatest way to ensure that communities are ready for the likely impact of a disaster event is by empowering them with knowledge and experience. The "community right to know" philosophy is not well practiced when it comes to natural disasters. For example, government bodies (especially local governments) have been reluctant to make flood mapping available to the public for fear that the council would be sued because of the perceived impact on property values or because council permitted a development in a flood-prone area. By making the output from the Research, information and analysis stage widely available and in appropriate language, the community can be in a far better position to make their own decisions and choices. Unless that information is freely available and understandable community members are not in a position to share the responsibility for disaster risk management but remain dependent on the responsible government body.

Community engagement is also important to encourage people to become involved in the community groups that strengthen community resilience. Involvement in church, school, cultural or sporting groups creates the linkages within the community that give it greater cohesion and strength. Participation in organisations such as Red Cross, St Vincent's, St John's Ambulance, SES and rural fire brigades, either in an active "front line" or a support role, is a significant multiplier in community resilience **before** disaster strikes.

The output from the Research, information and analysis stage will have provided the right information by which to train and resource the emergency service personnel and volunteers that will be prepared to respond when needed. It is always helpful to test that readiness periodically by holding exercises, including some that call for an actual "evacuation" of the community. Such exercises should not just involve the emergency services but should engage the whole community. The benefit of such exercises was demonstrated during the volcanic eruption that destroyed much of the PNG town of Rabaul in 1994. The community was so well prepared that they actually commenced an evacuation several hours before the warning system ordered one.

Auditing the state of readiness also helps to provide confidence to the community that government bodies are ready to do their part. Auditors General in NSW (NSW Audit Office, 2014) and Victoria (VAGO, 2014) have both recently reported on performance audits of the engagement of volunteers in emergency management. A more broad-scale performance audit was undertaken by the Auditor General of British Columbia (Canada) into *Catastrophic Earthquake Preparedness* (BC Auditor General, 2014). This report found that preparedness was poor, due to poor funding of agencies responsible for emergency management planning and coordination, and the Auditor took the unusual step of advising individuals to make their own arrangements to prepare for a catastrophic earthquake.

Audits of management systems can also be valuable at the local and entity scale, and serve the purpose of promoting continuous improvement in readiness. Simple compliance audits should form a part of all evacuation exercises, to strengthen the management systems that support emergency decision-making.

I have avoided discussion of the role of insurance in the Readiness stage because it is an area in which I have little knowledge; however, it is clear that as the insurance industry moves more to a risk-rating approach some properties and assets will become uninsurable. For example, it will be uneconomical for many rural local governments to insure their road networks, even if cover were on offer. There are several natural hazards for which insurance is already unavailable including storm tide, tsunami and landslide, while flood insurance remains a vexed issue in some areas.

Response

If the Research, information and analysis, the Risk modification and the Readiness stages have been undertaken diligently then the Response phase should be almost automatic. There should be no room for a politician or community leader to state that the current disaster was "unprecedented".

Perhaps the most critical factor in the Response phase is having the right information available from the outset. I once wrote (Granger, 2000):

> *There is nothing more certain in the disaster management business than the fact that once a disaster starts to unfold it is too late to start looking for the information needed to manage it.*

A poorly informed response is more likely to exacerbate the impact of the disaster event than a well informed and prepared response.

Recovery

The Recovery phase can last for years, if not decades and typically does not involve the emergency services whose role is "completed" by the end of the response phase. The key participants in the Response phase are typically quite heterogeneous, ranging across health and welfare services, engineers and planners, scientists, administrators, psychological councillors, educators, economic and financial advisers and so on. It embraces the totality of the things that allow the affected community to "bounce back".

Throughout the whole process there is a need for the community to be encouraged and assisted to "build back better"; to demonstrate true resilience by adapting and evolving in response to the disaster event. To do so effectively **they** must be the decision-makers rather than some outside administrator. This is one of the major points made by Alan Stretton in his account of the response to the impact of Cyclone *Tracy* on Darwin in 1974 (Stretton, 1976).

The most important factor, however, is for the detailed analysis of the disaster impact in all its dimensions to be fed back into the Research, information and analysis stage so as to inform the decision-making that drives the Recovery stage. For examples, if a decision is taken to develop structural defences their design should be based on a revised assessment of the hazard and a cost/benefit analysis of the proposed project. Community engagement at all stages in this process is essential so that there is absolute clarity as to what level of protection will be afforded and what the direct and indirect costs to the community will be.

Again, audit can play an important part in building confidence in government action during the response phase. The NZ Auditor General (2012) publicly reported on the effectiveness of Canterbury (Christchurch) Earthquake Recovery within two years of the February 2011 earthquake that killed 185 people, providing some confidence in key government agencies just as community impatience with restoration was starting to build. The Canterbury Earthquake Recovery continues to be one of the most significant economic drivers for New Zealand, with publicly funded works scheduled beyond 2020.

The economic recovery of the community, especially smaller rural communities, can be set back greatly if the flow of donated goods, such as white goods, clothing and haberdashery, has an impact on local businesses where the goods could have been purchased locally. While it is human nature to "get things back to normal" as quickly as possible, precipitate action will often mean that the opportunity for the community to adapt and evolve, that is to build resilience, will be negated.

Conclusions

Disaster risk management is an incredibly complex activity and involves a seemingly endless cast of actors. This is because disaster resilience involves "the collective responsibility of all sectors of society, including all levels of government, business, the non-government sector and individuals" (COAG, 2011). This approach has been described as "mainstreaming", where disaster management is recognised and treated as an integral part of community governance rather than an afterthought as it has been in many areas of government to date, at least until it is needed. Mainstreaming is likely to be the next paradigm to make its mark on disaster management, an outcome that, in my mind, cannot come soon enough.

The bottom line is that regardless of what funding arrangements are recommended in the Productivity Commission's inquiry report, it will be the community that carries the cost, be it directly, or in taxes, levies, rates and insurance premiums.

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