SPECIAL REPORT

Bolstering national disaster resilience

What can be done?

Paul Barnes

April 2016

ASPI
AUSTRALIAN STRATEGIC POLICY INSTITUTE

RISK & RESILIENCE PROGRAM

Paul Barnes

Dr Paul Barnes joined ASPI as the Senior Analyst of the Risk & Resilience Program in September 2015. He was previously Deputy Director of the Centre for Emergency & Disaster Management (CEDM) at the Queensland University of Technology and led the Centre's Infrastructure Research Program.

He has wide experience in public sector and specialist management roles at both the state and federal levels. Within the emergency services arena, he was the inaugural Manager of the State Community Safety Unit of the Queensland Fire & Rescue Authority (QFRA) where he coordinated policy support on emergency response planning and oversaw the provision of legislative support for regulatory fire safety and fire prevention. During his period with the QFRA, he chaired the National Community Education Sub-Group of the Australasian Fire Authorities Council.

As Corporate Risk Manager of the Queensland Department of Primary Industries (QDPI), he represented the department on the State Disaster Mitigation Committee, high-level cross-government working groups on critical infrastructure protection and biosecurity, as well as the whole-of-government Multi-agency Threat Assessment Team. At a federal level he served as Director of Security Policy Development within the Defence Security Authority.

He has completed projects for the Pacific Economic Cooperation Council (PECC) and the Asia-Pacific Economic Cooperation (APEC) economies on gaps in counter-terrorism capability and capacity planning, and the Department of the Prime Minister and Cabinet on national risk assessment frameworks.

About ASPI

ASPI's aim is to promote Australia's security by contributing fresh ideas to strategic decision-making, and by helping to inform public discussion of strategic and defence issues. ASPI was established, and is partially funded, by the Australian Government as an independent, non-partisan policy institute. It is incorporated as a company, and is governed by a Council with broad membership. ASPI's core values are collegiality, originality & innovation, quality & excellence and independence.

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Cover image: An aerial view of floodwaters in Rockhampton, 4 January 2011. amana/EPA/JANIE BARRETT

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Homes are destroyed in Tully, North Queensland, 3 February 2011, as a result of category 5 tropical cyclone Yasi. © AAP/Dave Hunt

INTRODUCTION

The Risk & Resilience Program at ASPI is a new initiative. It's focused on examining options for enhancing national approaches to disaster resilience. It includes coverage of risk management and wider mitigation issues central to community safety.

But this area isn't entirely new to ASPI. In 2008, we published *Taking a punch: building a more resilient Australia*. That report emphasised the importance of strong leadership and coordination in disaster resilience policymaking, as well as the value of volunteers and family and individual preparation in managing the effects of major disasters.

In 2014, ASPI released a special report, *Working as one: a road map to disaster resilience for Australia*, which considered opportunities to advance the governance of disaster management in Australia.

Working as one set out 11 measures to build increased national resilience, which required the combined efforts of communities, the private sector, and federal, state and local governments.

This report outlines the goals of ASPI's Risk & Resilience Program. It introduces several broad areas to be covered and measures to strengthen mitigation, response and recovery options spanning the community, state and federal spheres (see box).

The ASPI resilience program will:

- promote an inclusive dialogue on ensuring readiness for complex emergencies through better planning and preparation, and considering capability needs for future emergency events
- engage practitioner and industry groups (including the civilian services and the ADF) with practical discussions aimed at improving policies and planning
- sponsor dialogues, issues papers and research on building resilience into future infrastructure
- explore capacity needs for disaster risk reduction in the Indo-Pacific region
- research the impacts of climate variability
- work to strengthen the resilience of critical supply chains (road, rail, aviation and maritime).

We aim to:

- develop fresh, innovating thinking about the principles of community resilience
- define better measures of resilient functioning across local, state and federal governments
- identify investments in disaster mitigation as a significant saving against future disaster recovery costs
- propose a National Resilience Strategy incorporating local, state and federal issues in a comprehensive all-hazards, all-agencies context.

CONTEXT

Over the past century, the human world has become demonstrably smaller, closer and more connected. With such changes have come prosperity and innovation aligned with cycles of industrial and technological development.

But along with the obvious benefits of such innovation has come a range of unexpected and often calamitous emergencies that remind us that certainty about safety is often a scarce commodity.

Australia and our near neighbours are on the front line in dealing with the effects of climate change. Rising sea temperatures and sea levels, varied terrestrial effects and increasingly frequent extreme weather will play a role in changing the likelihood of conflict, including competition for resources. This will increase the potential for the displacement of people, widespread damage and the degradation of essential services.

Along with climate change, public health problems and animal diseases, our increasing reliance on potentially unreliable information and communications technology and emergent interdependencies among infrastructure systems create significant problems of governance for the private and public sectors alike.[1]

Unmitigated disturbances from such sources have the potential to generate cascading secondary and tertiary impacts throughout our economy and society: institutions are unlikely to face single incidents, but rather a series of systemic failures, many concurrently.

Natural and technological hazards can both directly affect sociotechnical systems and be propagated by them as network events. Such events have been categorised as 'outside of the box', 'too fast' and 'too strange'.[2]

The current *National Partnership Agreement on Natural Disaster Resilience*[3] between the federal and state governments lapsed in June 2015. Governments are currently finalising an extension to continue this National Partnership Agreement. Last year, the National Strategy for Disaster Resilience was reviewed. The results of that review aren't yet available, but it's likely that there'll be emphasis on maintaining support for improving engagement with communities, enhancing cross-sectoral partnerships (including between levels of government), identifying and setting strategic policy, and improving future capability development for disaster risk reduction.

Resilience is also a central theme of the Critical Infrastructure Resilience Strategy, the Trusted Information Sharing Network, COAG's 2015 Counter Terrorism Strategy and the 2016 Defence White Paper.

Section 3.6 of the Defence White Paper identifies, as a basic strategic defence interest:

> A secure, resilient Australia, with secure northern approaches and proximate sea lines of communication … our interest in a secure, resilient Australia also means an Australia resilient to unexpected shocks, whether natural or man-made, and strong enough to recover quickly when the unexpected happens.

DISASTER TRENDS

International data on weather-related disasters establishes some significant trends. Between 1995 and 2015, 90% of global disasters were caused by floods, storms, heatwaves or other weather-related events.

Over that period, 6,457 weather-related disasters were recorded, claiming more than 606,000 lives and affecting more than 4 billion people. On average, 205 million people were affected by such disasters each year.[4]

In 2015, the UN Office for Disaster Risk Reduction reported 346 disasters affecting up to 98.6 million people and contributing to US$66.5 billion in economic damage. The Asia–Pacific region bore the brunt of 90 major storms, which included 48 cyclone-strength storms.[5]

A recent report from the Australian Business Roundtable for Disaster Resilience and Safer Communities prepared by Deloitte Access Economics found that up to $17 billion will be needed to replace critical infrastructure between 2015 and 2050 due to the impact of natural disasters in Australia.[6]

The study examined the financial costs of extreme weather events in Australia and the dramatic growth in expected costs to 2050. It found that in 2015 the total economic cost of natural disasters in Australia exceeded $9 billion, or about 0.6% of GDP. Those costs are expected to rise to an average of $33 billion per year by 2050.

Another key finding was that carefully targeted investment in resilience measures now will reduce Australian government expenditure on natural disaster relief and recovery by more than 50% by 2050.

These findings, along with the international data, support the thrust of the Productivity Commission's 2014 Inquiry into Natural Disaster Funding Arrangements.[7]

The commission recommended that steps be taken to address the inefficient historical bias towards funding the costs of recovering and rebuilding after damage caused by disasters, rather than funding preventive measures. It found that investing in mitigation makes sound economic sense.

ASPI'S RISK & RESILIENCE PROGRAM

Resilience as a desired capability applied to unexpected shocks can't be assumed. However, the ability to anticipate likely disturbances and their severity is a standard element of most approaches to disaster planning and preparation.

ASPI's Risk & Resilience Program will consider resilience and risk-based thinking as a concept and practice in communities and at the local, regional, state and national levels.

ASPI's work will consider disaster risk reduction from an all-hazards and all-agencies perspective.

The program will focus on several key areas:

- deepening national understanding of the benefits and challenges of using resilience as a central theme in effective disaster risk reduction practice across the public and private sectors
- expanding appreciation of the need for including resilience as a base-level design factor for critical infrastructure systems, looking at the continuity of essential services and vulnerability reduction
- promoting inclusive debate in communities and government on how to generate and sustain community resilience in modern Australia
- enhancing regional capacity building in humanitarian and disaster management practice in the Asia–Pacific.

The new program will cover a number of cross-cutting themes, which are detailed in this section.

National readiness for dealing with major catastrophes

Australia invests considerable resources and policy effort into preparing for and responding to a range of emergencies and disasters. But are these efforts enough? Could we do more to be prepared for the 'big one'?

In pursuing effective emergency management, especially with the prospect of more frequent disruptions, we need to ensure synergies in the protection of critical infrastructure and assets, crisis management and business continuity capacities to ensure the resilience of communities.

The program will support dialogue on ensuring readiness, including planning and preparation for complex emergencies, and the consideration of capability needs for future emergencies.

Designing resilience into infrastructure systems

Because disaster impacts can cascade, institutions are unlikely to face single incidents. Rather, they'll confront a series of systemic failures and related damage within and across functional areas, often concurrently.

Can infrastructure be designed to be more resilient to the effect of disasters? Cyclones and other extreme weather systems aren't preventable, but we should be able to prevent or reduce damage to critical infrastructure by adding vulnerability reduction to design thinking and by building in resilience.

Changes to the way infrastructure systems are designed and maintained are needed, particularly in the face of expected weather variability.

We need to complement impact-resistant infrastructure design (hardening) with resilient design.[8] Building robustness into infrastructure is standard practice, but the complexity of interdependent systems and the increased incidence of extreme weather require a shift towards having energy and telecommunications infrastructure operating under a 'safe-fail' approach: key parts of the infrastructure should remain intact and functional to support the continuity or resumption of services, even if large segments of the systems fail.[9]

A capacity to anticipate emergent needs from a policy context and for the public and private sectors is central to the Risk & Resilience Program.

Anticipating emergency management challenges

A capacity to anticipate emergent needs from a policy context and for the public and private sectors is central to the Risk & Resilience Program.

The program will engage with practitioner and industry groups (including the civilian services and the ADF) to sponsor open and closed-door dialogues, issues papers and research on a range of topics. This work will cover areas such as options for designing resilience into future infrastructure systems, capacity needs for disaster risk reduction in our region, the impacts of climate variability, and the resilience of critical supply chains (road, rail, aviation and maritime).

OPTIONS FOR NEW THINKING

The program will examine five broad areas to strengthen Australian emergency and disaster management.

Understanding the concept of resilience

A significant challenge in the Australian private and public sectors is the lack of a standardised definition of 'resilience' as a concept and practice.

There's inconsistency in the term's application by regulators, businesses, disaster managers and policymakers, and establishing an accepted operational definition of resilience, particularly as it applies to communities affected by disasters, is a hard nut to crack.

The definition of resilience is set out in the 2009 National Partnership Agreement on Natural Disaster Resilience as 'the capacity to prevent/mitigate, prepare for, respond to and recover from the impacts of disasters'.[10]

The Productivity Commission inquiry into natural disaster funding arrangements in 2014 defined resilience as 'the ability of communities to continue to function when exposed to hazards and to adapt to changes rather than returning to the original pre-disaster state'.[11]

The UN Sendai Framework for Disaster Risk Reduction (2015–2030) defines resilience as the 'ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions'.[12]

The US Department of Homeland Security defines resilience as 'the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions; includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents'.[13]

These differences in wording and intent highlight the importance of interpretation as a variable in effective practice and policy thinking.

The growing prevalence of official strategies, policies and published national and international guides focusing on disaster resilience highlights the significant interest in the concept as it applies to disasters and related impacts on communities.

But not being clear on a basic set of underlying principles of community resilience is problematic for disaster planning.

Without understanding the underlying principles of what a resilient community is, and how it functions, it's difficult to set out indicators of supportive activity and, ultimately, measures of resilient functioning.

As an applied concept, resilience is studied in many diverse settings: social resilience in relation to communities and their exposure to natural hazards;[14] the vulnerability of cities;[15] patterns of migration;[16] management processes

in institutions and theories of social change;[17] famine and assessments of vulnerability of food systems;[18] and the emergence of tipping points and the behaviour of social systems.[19]

In addition to the varying scientific bases of many of these applications, there are variations in interpretations of the concept of resilience. This adds to the confusion when attempts at policy planning and the application of the concept are needed.

Generically, resilience could be described as the capability of an organisation or institution to withstand the impacts of disturbances (from external or internal sources) while maintaining some acceptable degree of functionality or service delivery and, when able, to regain any lost capacity.

Recovery is often complicated, and it often takes time for a community to function with a semblance of pre-disturbance normality. Physical damage to essential lifelines, losses of housing stock and the difficulties caused by evacuation add significantly to community and regional impacts.

Disaster mitigation includes improving the safety of community members, reducing damage to property, rapid recovery, and a reduction in overall costs to national, state and regional economies.

Disaster mitigation includes improving the safety of community members, reducing damage to property, rapid recovery, and a reduction in overall costs to national, state and regional economies. The National Strategy for Disaster Resilience provides high-level policy guidance, but it doesn't establish clarity on the underlying principles of community resilience.

The Torrens Resilience Institute suggests that communities will prove resilient to severe emergencies or disasters when members are closely linked and work together so that, as a collective, they are able to:

- function and sustain critical systems, even under stress
- adapt to changes in the physical, social and economic environments
- be self-reliant if external resources are limited or cut off
- learn from experience to improve over time.[20]

The institute's findings focus on what communities need to be able to do once they've been affected by a disruptive event.

There's a pressing need to better understand what constitutes a cohesive and resilient community, and from that understanding to develop effective measures of resilience and resilient practice.

The experience of living through a disaster challenges the wellbeing and sense of safety of all who are affected. Sometimes, it's particularly disruptive to community cohesiveness and viability.

Such experiences are always personal and can be difficult to understand and engage with institutionally: they cut to the core of an individual's sense of safety and profound dislocation and loss.

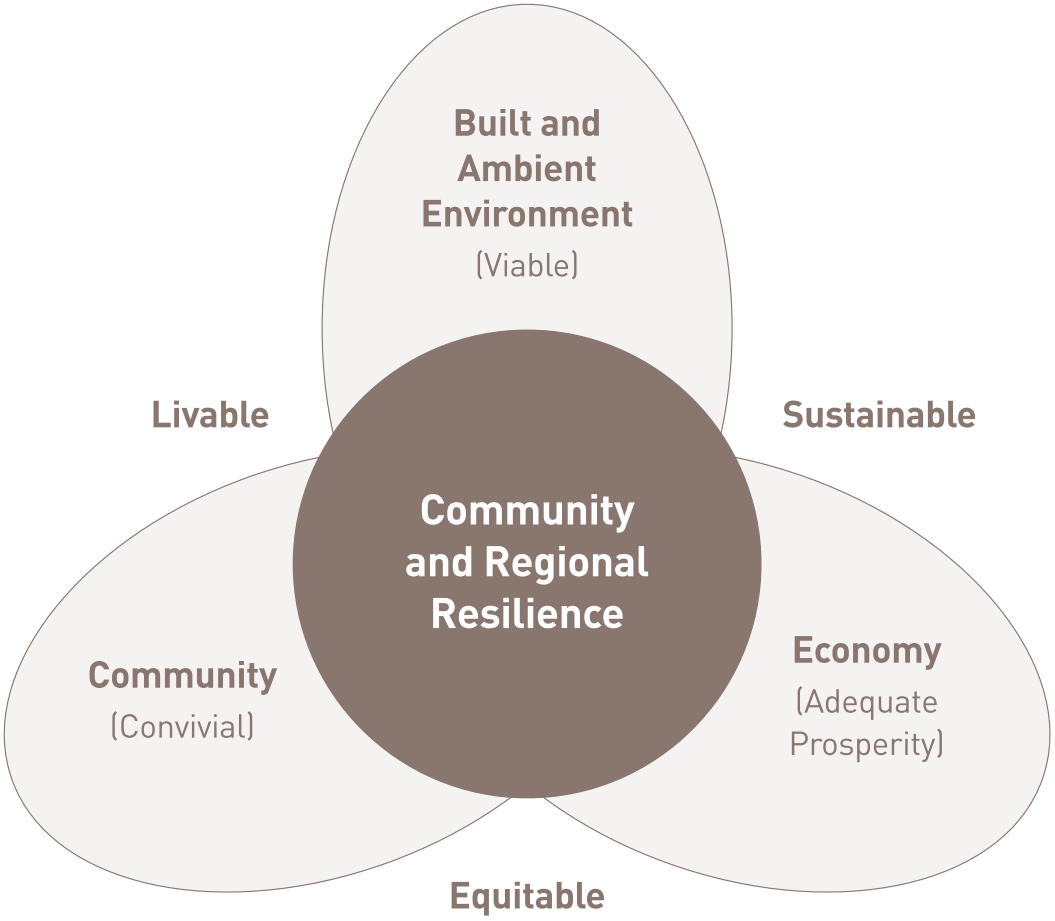
So, while 'community' resilience is referred to in many reports and institutional strategies, a key question is whether resilience is understood well enough as a social phenomenon to support and nurture its regrowth in devastated communities.

State and federal policies and practices give considerable attention to enhancing the response and recovery aspect of communities in need, but we need a deeper understanding of the underlying principles that make up a truly resilient community.

Two surprising places to find a different approach are studies of the environmental aspects of public health (integrating social, environmental and economic factors)[21] and the World Commission on Environment and Development's *Our common future* (known as the Brundtland Report).[22]

Figure 1 sets out the principles for establishing a baseline of enabling factors active within resilient communities and their surrounding regions.

Figure 1: Principles of community and regional resilience



In an idealised form, communities thrive when people live in viable built and ambient environments, benefit from prosperous local and nearby economies and participate in convivial community life.

Together, these principles support sustainable, livable and equitable livelihoods.

As underlying principles, these elements may be seen as surrogate measures of ongoing community resilience and as recovery targets after disasters. No two communities should be deemed the same, but there's a need to describe more consistent universal principles that can be applied to the diversity of social and cultural life in a real community.

Developing metrics

Just as definitions of resilience vary, so do measurements of it, from probabilistic models to those using simpler attributes.

There's a need to review and standardise resilience measures in use and to evaluate their effectiveness.

One important question is whether they are understood and standardised enough to be used in a wide variety of communities.

A further consideration in rethinking community resilience from a 'principles' basis is measuring policy outputs and outcomes across scales (local, state, national) to determine value-for-money investments, particularly in disaster mitigation.

Such an alignment would support program evaluation, the coordination of effort and efficient investment in mitigation.

An additional benefit of exploring measures of resilience across the three scales (as shown in Table 1) is that it would facilitate evaluations of Australia's alignment with the goals set out in *Transforming our world: the 2030 agenda for sustainable development*, adopted at the UN Sustainable Development Summit in September 2015, and the Sendai Framework for Disaster Risk Reduction 2015–2030.

Table 1: Alignment of scaled resilience: community, state and federal

Level (factors)	Activity indicators	Robust measures
Local		
Community		
Built & natural environment		
Economy		
State		
Community-related		
Environmental		
Economic		
Federal		
Community-related		
Environmental		
Economic		

The definition and assessment of surrogate indicators/measures for resilience related to community, built and natural environment and economic factors would be needed.

There's more work to be done in Australia to develop consistent indicators and standardised measures of resilience relevant to these levels. As shown in Table 1 these indicators/measures for resilience would address relevant community, built and natural environment and economic factors. ASPI's program hopes to contribute here.

Operationalising mitigation

The Turnbull government's recent Northern Australia Insurance Premiums Taskforce found that mitigating the risk of damage is the only sustainable way of lowering insurance premiums in cyclone-prone regions of northern Australia, saving lives and reducing property damage.[23]

Mitigation, as opposed to a government cyclone mutual or reinsurance pool, could reduce premiums by up to 15%.

The mitigation options outlined in the taskforce's report include stronger building standards, better retrofits for older homes, mitigation awareness campaigns and making insurance more responsive to mitigation.

In 2015, the Productivity Commission identified natural hazard risk as the key driver of insurance premiums and recommended a fivefold increase in annual mitigation funding, the phasing out of stamp duty on insurance, and improved land-use planning laws.

The cost of insurance can be high in higher-risk areas, such as flood plains and cyclone-prone areas. But the best way to lower premiums and reduce losses from natural disasters is through public investment in mitigation to protect infrastructure—not government intervention.

Suncorp, the biggest insurer in Queensland, recently introduced a new insurance initiative to provide a real incentive for disaster risk mitigation by Queensland homeowners from Rockhampton to the north of the state. The Cyclone Resilience Benefit provides a range of options to reduce the cost of home insurance if homeowners carry out some or all of the mitigation actions suggested by James Cook University's Cyclone Testing Station.

When it comes to safeguarding our communities against natural disasters, prevention is always better than cure. ASPI's Risk & Resilience Program will explore options for promoting the view that mitigation as a current investment can return significant savings in future disaster recovery costs. Benefit–cost ratios for disaster mitigation efforts have been estimated to be as high as 4 to 1 ($1 of investment provides $4 of future benefit).[24]

Difficulties in establishing the future benefits of funding mitigation costs ahead of disasters may be caused in part by an absence of relevant datasets that allow accurate estimates of saving[25] or by the absence of appropriate governance mechanisms to evaluate the effectiveness of investment.[26]

Examining governance arrangements

State and federal arrangements for emergency and disaster response work efficiently, but a number of changes in state-based governance arrangements suggest opportunities to enhance them.

Both Queensland and Victoria have established Inspectors-General for Emergency Management (IGEMs). These roles are independent of the emergency services, whose capability and capacity they 'inspect'.

Each IGEM provides confirmation of defined levels of readiness in their state for sustained capability and capacity across a range of response and support agencies that are active before, during and after disaster responses.

The Queensland IGEM is responsible for providing the Premier, government and people of Queensland with an assurance of public safety by establishing and implementing an assurance framework to direct, guide and focus work of all agencies across all tiers of government to the desired outcomes of the disaster and emergency management arrangements in that state.[27]

Similarly, the functions of the Victorian IGEM include monitoring and assessing the capability, capacity and performance of the emergency management sector, as well as undertaking system-wide reviews of the state's emergency management arrangements.[28] The IGEM seeks to promote a sector-wide culture of continuous improvement. This includes identifying what's working well and where change is required, and monitoring the implementation of desired changes.

While these positions are currently in place only in Queensland and Victoria, the same role is carried out in different ways in other states and territories.

ASPI's program will examine whether this 'assurance of readiness' should be developed at the national level and, if so, by what governance or mechanism that could be achieved.

Exploring the benefits of a national resilience strategy

The National Strategy for Disaster Resilience,[29] adopted by COAG in February 2011, was created to provide high-level guidance on disaster management to federal, state, territory and local governments, business and community leaders, and the not-for-profit sector.

The strategy identified seven priority outcomes to enhance Australia's disaster resilience:

- leading change and coordinating effort
- understanding risks
- communicating with and educating people about risks
- partnering with those who effect change
- empowering individuals and communities to exercise choice and take responsibility
- reducing risks in the built environment
- supporting capabilities for disaster resilience.

The strategy called for an integrated whole-of-nation effort encompassing enhanced partnerships; shared responsibility; a better understanding of communities' risk exposures, environment and disaster impacts; and adaptive and empowered communities that have the capability to act on that understanding.

The evolution in understanding how our sense of 'safe modernity' might be disrupted has led to a new realisation that the 'all-hazards, all-agencies' approach may be pointing to a different level of strategy for dealing with national risk exposures.

The National Strategy for Disaster Resilience and the Critical Infrastructure Resilience Strategy remain relevant in design and function and have served us well, but if an all-hazards and all-agencies 'ruler' were applied to their core focus a more inclusive level of strategic overview could be needed.

A national resilience strategy would need to be flexible, as it would have to address a suite of hazards, including natural, technical and man-made ones.

The Risk & Resilience Program will consider the possible benefits of a national resilience strategy incorporating local, state and federal issues in a wide all-hazards, all-agencies context.

CONCLUDING REMARKS

Natural disasters are partly surprises: while we can't predict when they'll occur, we know that they will happen.

To prepare, we must plan ahead, but we re-relearn lessons and often make the same mistakes. Given the many royal commissions and other investigations into disasters over the past few years, the lesson book is a thick one.

The cost of disasters looks set to rise, as does the potential for impacts on the essential services and environmental systems that are central to viable community life.

Prevention is important: we need to be doing more to 'sweeten the pot' by creating better incentives for mitigating the impacts of disasters with better planning and preparation. But capacity for effective response, recovery and remediation also needs to remain strong.

When disruptions occur, businesses, owner-operators of critical infrastructure, and the state and federal governments must continue to band together and coordinate their efforts.

That's why ASPI's Risk & Resilience Program will contribute to our long-term thinking on how best to prepare for and recover from disasters.

As stated in ASPI's *Working as one: a road map to disaster resilience for Australia*:

> We need a new and continuous conversation about resilience that can be translated into long-term thinking to increase the nation's ability to prepare for and recover from disasters. Unless we do so, the cost of disasters will continue to rise, as will losses in the social and environmental systems that our communities rely on.

NOTES

1 US Department of Homeland Security, *National Critical Infrastructure Protection Research and Development Plan*, Washington DC, 2015, online; Organisation for Economic Co-operation and Development (OECD), *Emerging systemic risks: an agenda for action*, OECD, Paris, 2003; OECD, 'Denmark (assessing societal risks and vulnerabilities)', *OECD Studies in Risk Management*, OECD, Paris, 2006.

2 P Lagadec, 'Crisis: a watershed from local, specific turbulences, to global inconceivable crises in unstable and torn environments. Future crises, future agendas: an assessment of international crisis research', delivered at an international workshop, 24–26 November 2004, Nice, France.

3 National Partnership Agreement on Natural Disaster Resilience, circa 2013, online.

4 Centre for Research on the Epidemiology of Disasters, UN Office for Disaster Risk Reduction (UNODRR), *The human cost of weather-related disasters, 1995–2015*, 2015, online.

5 UNODRR, 'The human cost of the hottest year on record', media release, 11 February 2016, online.

6 Deloitte Access Economics, *Building resilient infrastructure*, Australian Business Roundtable for Disaster Resilience and Safer Communities, March 2016, online.

7 Productivity Commission 2014, *Natural disaster funding arrangements*, inquiry report no. 74, Canberra, 2014, online.

8 Swiss Re Corporate Solutions, *Building energy infrastructure for extreme weather*, Zurich, 1 October 2015, online.

9 World Energy Council, *The road to resilience: managing and financing extreme weather risk*, London, 2015, online.

10 National Partnership Agreement on Natural Disaster Resilience (circa 2009), online. Note: The current National Partnership Agreement doesn't define resilience and states that the agreement will be implemented consistently with the National Strategy for Disaster Resilience (NSDR). The NSDR defines attributes of community resilience but makes no specific reference to resilience *per se*. The NSDR's references to 'community' resilience are very similar to the definition given in the 2009 National Partnership Agreement.

11 Commonwealth of Australia, *Natural disaster funding arrangements*, inquiry report no. 74, volume 1, Productivity Commission, 2014, online.

12 United Nations, *Sendai Framework for Disaster Risk Reduction, 2015–2030*, 2015, online.

13 US Department of Homeland Security, *National Critical Infrastructure Security and Resilience Research and Development Plan*, online.

14 WN Adger, 'Social and ecological resilience: are they related?', *Progress in Human Geography*, 2000, 24:347–364.

15 M Pelling, *The vulnerability of cities*, James & James / Earthscan, 2003.

16 C Locke, WN Adger, PM Kelly, 'Changing places: migration's social and environmental consequences', *Environment*, 2000, 42:24–35.

17 F Westley, 'The devil in the dynamics: adaptive management on the front lines', in LH Gunderson, CS Holling (eds), *Panarchy: understanding transformations in human and natural systems* (333–360), Island Press, Washington DC, 2002.

18 EDG Fraser, 'Social vulnerability and ecological fragility: building bridges between social and natural sciences using the Irish potato famine as a case study', *Conservation Ecology*, 2003, 7(2):9; EDG Fraser, W Mabee, F Figge, 'A framework for assessing the vulnerability of food systems to future shocks', *Futures*, 2005, 37:465–479.

19 WA Brock, 'Tipping points, abrupt opinion changes, and punctuated policy change', in R Repetto (ed.), *Punctuated equilibrium and the dynamics of US environmental policy* (47–77), Yale University Press, New Haven, Connecticut, 2006.

20 P Arbon, K Gebbie, L Cusack, S Perera, S Verdonk, *Developing a model and tool to measure community disaster resilience*, Torrens Resilience Institute, October 2012.

21 T Hancock, 'Ecological sanity and social justice; public health in the Age of Osiris', *Alternatives*, 1981, 9:11–18; 'Sustaining health', background paper, York Conference on Health–Environment–Economy, Faculty of Environmental Studies , York University, Toronto, 1989.

22 UN, *Report of the World Commission on Environment and Development: Our common future*: transmitted to the general assembly as an annex to document A/42/427—*Development and international co-operation: Environment*, online.

23 Commonwealth of Australia, *Northern Australia Insurance Premiums Taskforce: final report*, November 2015, online.

24 CM Shreve, I Kelman, 'Does mitigation save? Reviewing cost–benefit analyses of disaster risk reduction', *International Journal of Disaster Risk Reduction*, December 2014, 10(A):213–235.

25 The National Academies, *Disaster resilience: a national imperative*, National Academies Press, Washington DC, 2012.

26 National Commission of Audit, 'Towards responsible government', appendix to the *Report of the National Commission of Audit*, volume 2, 2014, online.

27 www.igem.qld.gov.au/.

28 IGEM, *What we do*, online.

29 Council of Australian Governments, *National Strategy for Disaster Resilience,* 2011, online.

ACRONYMS AND ABBREVIATIONS

ADF	Australian Defence Force
COAG	Council of Australian Governments
GDP	gross domestic product
IGEM	Inspector-General for Emergency Management
UN	United Nations

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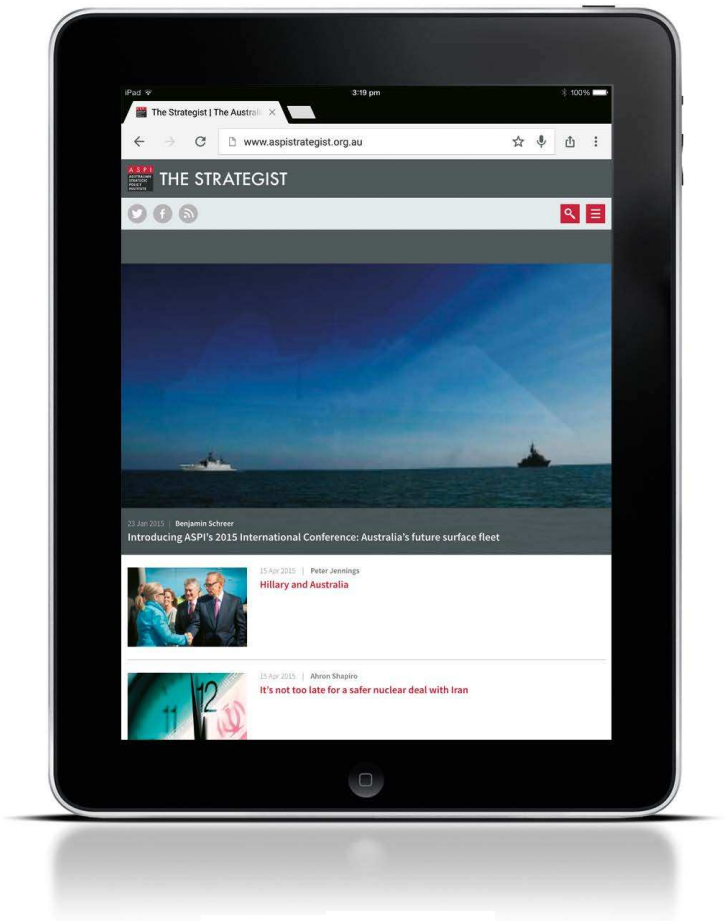

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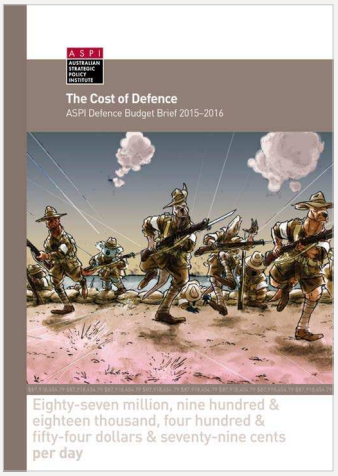

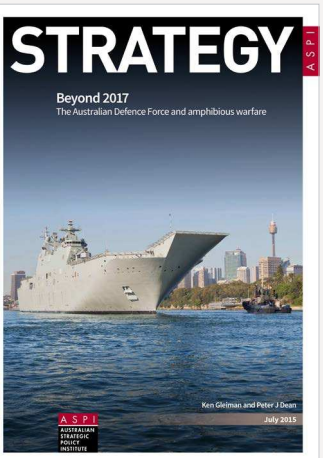

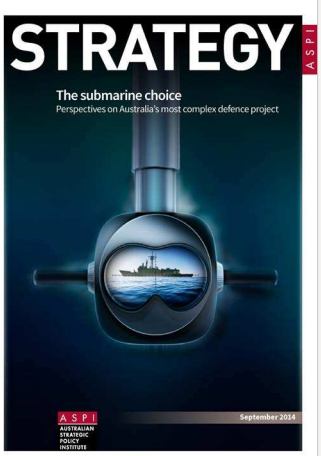

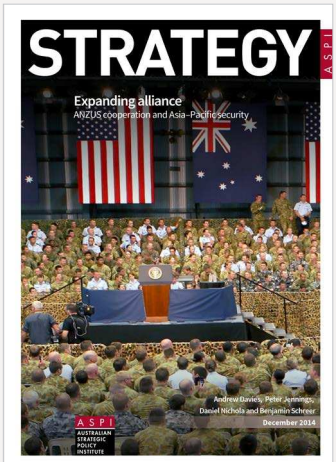

Bolstering national disaster resilience

What can be done?

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