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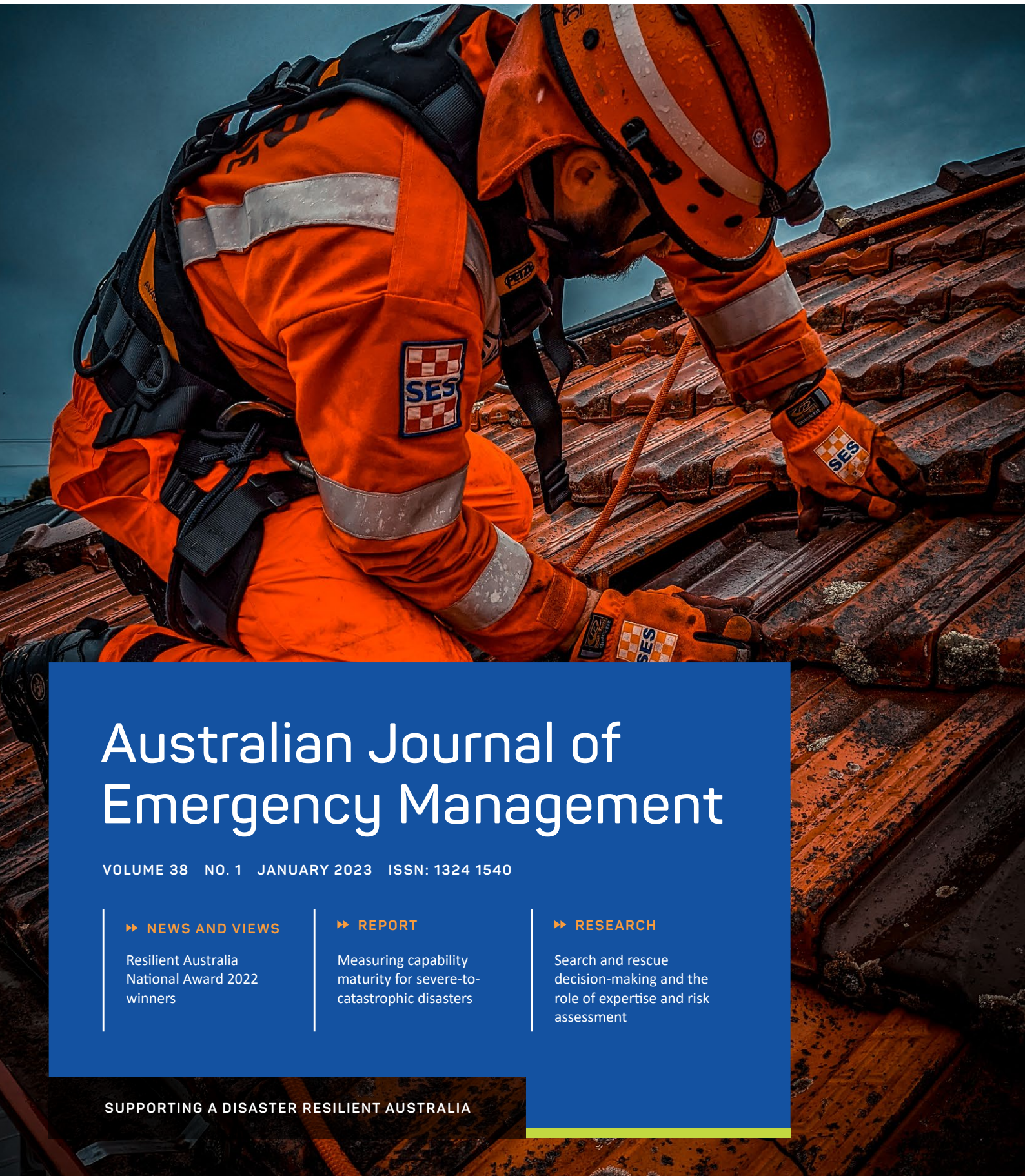
Australian Institute for Disaster Resilience



Australian Journal of Emergency Management

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NEWS AND VIEWS

Resilient Australia National Award 2022 winners

REPORT

Measuring capability maturity for severe-to-catastrophic disasters

RESEARCH

Search and rescue decision-making and the role of expertise and risk assessment

SUPPORTING A DISASTER RESILIENT AUSTRALIA

About the journal

The *Australian Journal of Emergency Management* is Australia's premier journal in emergency management. Its format and content are developed with reference to peak emergency management organisations and the emergency management sectors—nationally and internationally. The journal focuses on both the academic and practitioner reader. Its aim is to strengthen capabilities in the sector by documenting, growing and disseminating an emergency management body of knowledge. The journal strongly supports the role of the Australian Institute for Disaster Resilience as a national centre of excellence for knowledge and skills development in the emergency management sector. Papers are published in all areas of emergency management. The journal encourages empirical reports but may include specialised theoretical, methodological, case study and review papers and opinion pieces. The views in the journal are not necessarily the views of the Australian Government, Australian Institute for Disaster Resilience or its partners.

Aboriginal and Torres Strait Islander peoples are advised that this publication may contain images of deceased people.

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Foreword

Brendan Moon AM

Coordinator-General,
National Emergency
Management Agency

The last 3 years have presented critical challenges for emergency management and communities throughout Australia.

Repeat and competing, compounding and cascading disasters have stretched the capability and capacity of communities to respond and left them with little to no time to recover.

The effects from bushfires, floods and a pandemic, to name a few, have all threatened the interconnected nature of our communities, economies, infrastructure and natural systems. In 2022 alone, 315 local government areas suffered the impact of a third consecutive La Niña, some not just once, but multiple times.

Since the start of the most recent floods in September, I've visited flood-affected regions across NSW and Victoria and witnessed first-hand the damage and impact to communities.

The scale, duration and extent of last year's floods highlighted the challenges of living on our floodplains. The overwhelming message from affected communities is that they want to feel safer, stronger and more connected.

As our nation ages and population continues to grow along our coast and on our floodplains, we have important and urgent strategic decisions to make about where and how we live. To better prepare for a future filled with more frequent and intense disasters, our settlements and the systems that allow them to function and flourish will need to adapt. This will require all members of society to be part of the solution.

This is why the National Emergency Management Agency was established; to provide national leadership and to coordinate, drive and sustain collective action that enhances our capabilities, better integrates our systems, and reduces disaster risk.

We are guided by 3 strategic actions. First, we will work to ensure the nation has scalable emergency management capabilities that can be deployed in any location, at any time, and in the event of any threat, during the response, relief, recovery, reconstruction, risk reduction, prevention and preparedness phases. We have started by strengthening our national emergency workforce capability and capacity, which will provide additional resources to support relief and recovery during disasters of any scale.

Second, we will continue to champion and facilitate locally led response and recovery, which occurs when all groups – from individuals to households, industry, non-government organisations and local governments – take collective action so that communities become safer, stronger and more connected. While we continue to work closely with our partners across these groups, we're forging new partnerships and connections so that we can replicate the collective action that we've seen succeed in regions like the Northern Rivers, Western NSW, Victoria and Tasmania in the face of the 2022 floods. These are regions where close neighbours have been the first responders and members of the community, including individuals, the Australian Defence Force, local and state emergency services, and local business, worked house by house, street by street to commence clean-up and recovery.

Finally, we will increase investment in disaster risk reduction through a $1 billion Disaster Ready Fund so that we can build more resilient communities before disasters strike.

As emergency management practitioners and researchers, you are the Australian Government's partners in action. Your experience, expertise and research is critical to understanding how government invests in and strengthens collective and strategic action at a community, state and national level.

The *Australian Journal of Emergency Management* brings your ideas to the fore and, as the first Coordinator-General of National Emergency Management Agency, I am pleased to contribute to this important publication.

Natural hazards: the future of learning is already here

Dr Graham Dwyer

Swinburne University of Technology

The global phenomena of floods, fires, heatwaves and droughts (to name a few natural hazards) have given rise to capacity and capability challenges for emergency services organisations as well as communities. In recent times, natural hazards, as noted by the AIDR Major Incidents Report[1], have been 'concurrent, consecutive and compounding'. This creates complex challenges for preparing for, responding to and recovering from the losses and damages that inevitably arise from such phenomena.

While many of the challenges that surround such events are known, there are always novel unknowns that will make it difficult to prevent damages and losses from their effects. This is rarely acknowledged in public commentaries surrounding hazard events, which continue to suggest that there ought to be ways of learning from such events in ways that prevents them.

A balanced approach would recognise that there is little by way of agreed definitions about what learning actually means beyond a focus on addressing a need for improvement from a standpoint of what went wrong. Despite this framing of failure, the arrangements for emergency management have remained stable with a focus on prevention, preparation, response and recovery (PPRR). This suggests there may be more right than wrong in terms of the policies, procedures and practices to operationalise the PPRR framework. An analysis of public inquiry reports related to natural hazards shows that recommendations have remained stable across decades and even recur.

This is good news insofar that we know what the future might be in terms of findings and recommendations that reviews and inquiries will recommend to emergency management organisations after such events. These will most likely be recommending improvements relating to:

- leadership
- interagency and governmental collaboration/ partnerships
- interoperability across jurisdictions
- capacity and capability of aerial management of hazard events
- review of emergency management arrangements at local, state and national levels
- warnings and information to communities
- evacuation and sheltering arrangements for displaced communities
- land management, use and development
- safety policies of the states and territories
- relief and recovery
- education related to community planning for hazard events.

In an era where public and media commentaries are quick to frame high-risk hazard events as 'unprecedented' and call for lessons to be learnt, these areas of focus show that emergency management, as a discipline, continues to learn how to learn from the challenges it faces. They provide an important foundation for collaborative learning between state, national and local governments across Australia, the emergency service agencies, our volunteers and for industry. More importantly, they offer pathways towards keeping our communities safe as hazards continue to be concurrent, consecutive and compounding.

1. Major Incidents Report, at https://knowledge.aidr.org.au/resources/major-incidents-report/.

Introducing the new AIDR Executive Director

Margaret Moreton

Australian Institute for Disaster Resilience

'Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.'
— Margaret Mead (Cultural Anthropologist)

It is my privilege as the Executive Director of the Australian Institute for Disaster Resilience (AIDR) to work with the professional and dedicated team at AIDR, and to collaborate with the many individuals and organisations who work tirelessly to strengthen community resilience to extreme weather events and other emergencies.

By collaborating and sharing knowledge, skills, and experience we all build on the resilience of Australian communities, increasing everyone's individual and collective capacity to face a shared and challenging future. Together, we share ideas, celebrate successes and create sustainable and scalable knowledge and resources to support this endeavour.

My professional experience includes time working within government, in the not-for-profit sector, in private enterprise, in the philanthropic sector and, for the most recent decade, as an independent disaster resilience practitioner and advisor. I bring my humanity and compassion as a friend, a daughter, a sister, an aunt, a mother and a grandmother. I strive to do all that I can to build on the work of those who preceded me, to collaborate with others, to be curious and to learn from every encounter. I work to build a future where all of our grandchildren and their grandchildren can thrive.

Throughout my life I have witnessed the power of individual and community-led action to build capacity and strengthen resilient and sustainable communities. I experienced the consequences of my first significant bushfire in my teens. My family's farm was spared by a change of wind direction. My parents worked as part of the community response to that fire; fighting the flames using our water tank on our 'always at the ready' truck and then sharing our hay and household resources to support others who were affected.

Much has changed since that time. Extreme weather events have become increasingly intense, frequent and devastating. We are now experiencing compounding events, with insufficient time and resources to recover between them. We live, learn and work within an increasingly complex system that exposes more of us to disaster risk. Systemic disaster risk affects all aspects of our lives - from where and how we build our homes, how we and our families often learn and work separately from where we live, how we build and use infrastructure, how we travel across the landscape, how we engage with and enjoy our natural environment to grow our food and to refresh our body and our spirit and how we communicate with each other and share information. We have sought to separate ourselves from the natural world upon which we rely, believing that we can control the elements of nature or protect ourselves from them. Many people in Australia usually live separated from Indigenous knowledge and culture. As a society, we have increasingly isolated some groups; the poor, the geographically isolated, those living with disability, those who speak another first language or practice different values and beliefs, children and young people as well as the elderly. People and institutions such as the media now tend to divide the world around us, into 'us' and 'other'. Trust in governments, organisations and in many sources of information and assistance has eroded, or is at the very least complex.

While unintentional, by living in these ways, we have increased our exposure to the risks, effects and costs of disasters. The focus of decision-making at all levels has been on the short term, rather than actively considering the long-term consequences of each decision. Thinking and action have frequently been siloed, with economic benefits prioritised over social and environmental concerns. There has

been limited change in rural, regional and urban land use planning practice. We need to find a new way forward.

There are voices that challenge these ways of thinking and acting, sometimes loudly and sometimes quietly, asking us to reassess what we value, how we protect what we value, and how we live and interact with one another. Some wonderful work is happening to change how we think and act to build resilience. Some approaches place people at the centre of resilience practice, including people with disability, Indigenous groups and those with diverse cultural backgrounds. Locally led community resilience action is visible in several communities. Emergency services agencies are partnering with schools and community groups. Indigenous groups now lead cultural burning and other practices to care for the environment in regions across the country. We need to amplify these voices and these examples of collaboration, demonstrating their value and success and encouraging their broader uptake. Further examples of collaboration and creative action can be found on the AIDR Knowledge Hub, and we build on this valuable resource each year. Resilient Australia Award nominees provide additional examples of good practice collaborative projects and demonstrate the innovation and resilience that occurs across Australia.

Research is critically important to inform, support and scale up effective and meaningful resilience-building practice. New research can amplify and incorporate those voices and perspectives that have been traditionally marginalised or neglected. I therefore propose the following:

- Let's ask questions both new and old to focus our research, policy, and conversation on encouraging a vibrant, diverse debate about what community resilience looks like and how to achieve it. Let's learn from the past and reimagine the future.
- Let's collaborate and coordinate our efforts, even when this makes it challenging to progress our work. Let's do this even if, and perhaps especially if, we don't understand one another. This diversity may be what we need most if we are to successfully face the future.
- Let's continue to challenge ourselves to place communities at the centre of our efforts more frequently. Not as passive recipients of what we do, but as active partners in this endeavour.
- If we don't know where to begin, or how to proceed, let's say so. Our greatest opportunity may come from confessing vulnerability and opening our minds and our doors to work on this problem together.

The Australian Institute for Disaster Resilience is Australia's primary institute for the development and activation of knowledge and information to build capacity and strengthen networks focused on strengthening community resilience to disasters. In addition to the Knowledge Hub, AIDR supports networks of likeminded people, including disaster resilience practitioners in government and the non-government sectors, emergency services volunteers and personnel, researchers based in various institutions, and many others involved in exploring, understanding and building disaster resilience. Established in 2015, AIDR is funded by the National Emergency Management Agency (NEMA) on behalf of the Australian Government and works closely with its partner organisations – AFAC and the Australian Red Cross.

Collaboration, partnership and relationship is at the core of how we work and this approach underpins our products and the events that we host. We are expanding our network of partners every year. Most recently, we strengthened relationships with Gender and Disaster Australia, with Natural Hazards Research Australia, with partners such as the Red Cross and various individuals and groups who work or conduct research that supports AIDR aims or who have a commitment to strengthening community capacity and disaster resilience. We will work harder to increase indigenous participation in disaster resilience; to include the needs of infants, children and young people and give agency to people living with a disability.

I am committed to including and promoting diverse voices in our work. Since joining AIDR, I have had a role in key advisory groups and projects to progress these efforts.

I believe that we are stronger together. I encourage researchers and practitioners to explore the questions we most need answered, including how we successfully work together to undertake and share innovative research and to include diverse voices in solving the challenges of our shared future. I invite everyone to find ways to collaborate with one another, even (and perhaps especially) with those who may have very different experiences and perspectives, as we continue to build disaster resilience at an individual, local, regional, state and national level.

Access resources on the AIDR Knowledge Hub at www.knowledge.aidr.org.au.

Resilient Australia National Award 2022 winners

Molly Price

Australian Institute for Disaster Resilience

The 23rd Resilient Australia Awards celebrated initiatives that inspire community connections and foster community resilience to disasters and emergencies. Initiatives came from schools, communities, local and state governments and business across Australia.

Australian Institute for Disaster Resilience Executive Director Dr Margaret Moreton opened the awards event. She said the awards are an important moment to champion resilience in our communities.

'Australians continue to prove themselves to be resilient in the face of adversity – but we are not unbreakable.

'Our work to build up and support the resilience of communities across Australia is never done, so it's important we seize these moments to encourage each other and to share success,' she said.

Coordinator-General of the National Emergency Management Agency Brendan Moon AM attended the event and presented the awards. Mr Moon commended the efforts of the national award finalists who displayed 'wonderful examples of community resilience'.

'Resilience building must become business as usual for all of us if we are going to be able to continue to have our communities function and flourish into the future. This is the clear message and this is the wonderful opportunity. And these are the wonderful achievements that we celebrate here today,' he said.

National Award

The National Resilient Australia Award was awarded to 2 finalists who excelled in their initiatives. The Multi Agency Community Resilience Films Project by the Northern Territory Emergency Service developed films in languages for remote communities that are at high risk of hazards occurring. Created for the Wugularr (Beswick), Kintore, Groote Eylandt, Wurrumiyana and Pirlangimpi communities, the films are narrated in the relevant local language with English subtitles. The topics and solutions are appropriate to the issues occurring in the community, including health, first aid and the dangers of cyclones, floods and bushfires.

Safer Together Victoria also received the national award for the Community Based Bushfire Management (CBBM) project. A flagship project within the Victorian Government's Safer Together program, CBBM is a bushfire risk reduction community engagement initiative that takes a place-based, community-development approach to working with community. With a long-term approach, CBBM communities can develop trust and respect, which results in meaningful conversations and mutually acceptable approaches to risk reduction. CBBM allows decisions made and actions taken to be truly community-based.

In 2022, the Queensland Department of Education Aboriginal and Torres Strait Islander Aspirations Program (ATSIAP) afforded students a unique, rich learning experience by providing opportunities to investigate real-world disaster resilience challenges. This 'GetReady! Disaster risk and preparedness in our community' challenge was highly commended in the national category.

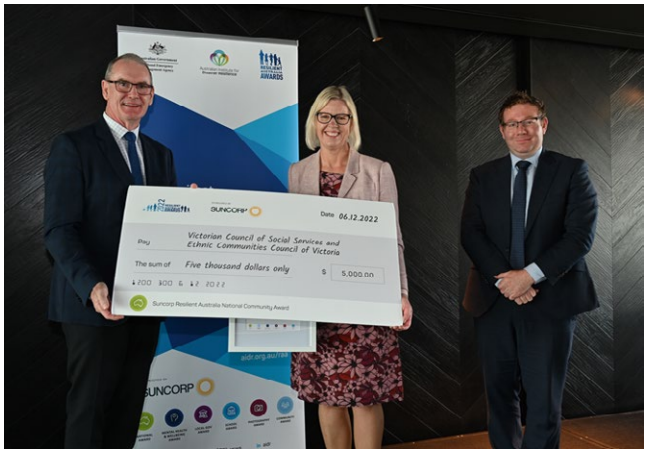
Sixty Queensland school students in years 10-12 teamed up to develop a communication plan and campaign material to inform a target audience in their local community about risks, preparedness and disaster resilience. Students participated in regional webinars and interviews with local emergency management experts to inform their communication plan.

Suncorp Resilient Australia National Community Award

Suncorp sponsored the Resilient Australia National Community Award and Manager Government,

Safer Together Victoria accepted the Resilient Australia National Award from Brendan Moon.

Dan Kaggelis, Smithfield State High School, accepted the Resilient Australia National School Award from Brendan Moon.



Suncorp Manager Government, Public Policy & Sustainability, Corporate & Regulatory Affairs, Lachlan Rees, awarded Emma King, on behalf of VCOSS and ECCV, with $5,000 for winning the Suncorp Resilient Australia National Community Award.

Public Policy & Sustainability, Corporate & Regulatory Affairs, Lachlan Rees, said Suncorp was proud to have been a part of the Resilient Australia awards since 2020.

'When you go out to a community that's been impacted by a disaster, there's a common thread of resilience, of a community's incredible capacity to band together in the face of, and following disasters.

'This history of protecting what matters and a shared experience of recovery drives us to be there, supporting our customers and their communities soon after disaster strikes, and with them on that long road to recovery,' he said.

The Suncorp Resilient Australia National Community Award was given to the Victorian Council of Social Services and Ethnic Communities Council of Victoria Multicultural Resilience Program, based in Melbourne. The program brought together multicultural communities and emergency management leaders to learn from one another, helped strengthen community resilience and reduced the disruptive effects of COVID-19 in multicultural communities. It also increased mutual understanding and trust between multicultural communities and emergency management organisations. It is working toward greater cultural safety for all who work in and with emergency management organisations.

Harrington Crowdy Head Community Resilience Team was highly commended for their work to lead and support the community in efforts to build resilience following the 2019–20 bushfires and a major flood in March 2021 that threatened lives, homes and caused significant environmental and economic losses. Through research and community consultation, the Harrington Crowdy Head Community Resilience Team aims to grow community awareness and stronger community networks.

National School Award

Tropical North Learning Academy Smithfield State High School, Cairns, won the National School Award for their initiative, Cairns in Your Hands. Cairns is a beautiful, tropical area, but it is vulnerable to natural hazards as well as the increasing effects of sea level rise and climate change. It is essential not only to plan to ensure resilience, sustainability and safety for the community, but to provide youth with the critical thinking, collaborative and creative skills to solve future problems. The Cairns in Your Hands program aimed to empower the youth of Cairns through geographical inquiry and 21st-century thinking skills, to develop a coastal hazards adaptation plan to ensure the future of their city.

St Columba's Memorial School in South Australia was Highly Commended for their project, Southern Yorke Peninsula First Aid for Kids. The initiative delivered age-appropriate first aid, disaster resilience and wellbeing sessions for over 350 primary school aged children and their teachers. The sessions covered basic first aid and supporting wellbeing after an emergency event, with each family receiving a first aid kit and a copy of the Red Cross *Helping children and young people cope with crisis* resource booklet.

Jeremy Miller, on behalf of AdaptWest, accepting the Resilient Australia National Local Government Award from Brendan Moon.

Alexandra Howard, Phoenix Australia, accepted the Resilient Australia National Mental Health and Wellbeing Award from Brendan Moon.

Bellingen Shire Council accepted the Resilient Australia National Local Government Award from Brendan Moon.

National Local Government Award

There were 2 winners in the National Local Government Award category. The first was AdaptWest - on behalf of the cities of West Torrens, Charles Sturt and Port Adelaide Enfield, for AdaptNow! Changing for Climate Change. Built on a co-design process, the partnership sought to understand how diverse communities would respond in a crisis. They developed resources with community representatives, key agencies and businesses. They documented this process with a local filmmaker through interviews and storytelling to highlight messages of hope, connection and capacity building.

The second award was presented to Community-led Disaster Response by Bellingen Shire Council. As a regional community with limited services, Bellingen Shire Council knew they'd have to advocate and coordinate to support their community through the COVID-19 pandemic. Council brought together a local and vocal group of community and services for a response, focusing efforts on clinical support, community preparedness and resilience, information and business support.

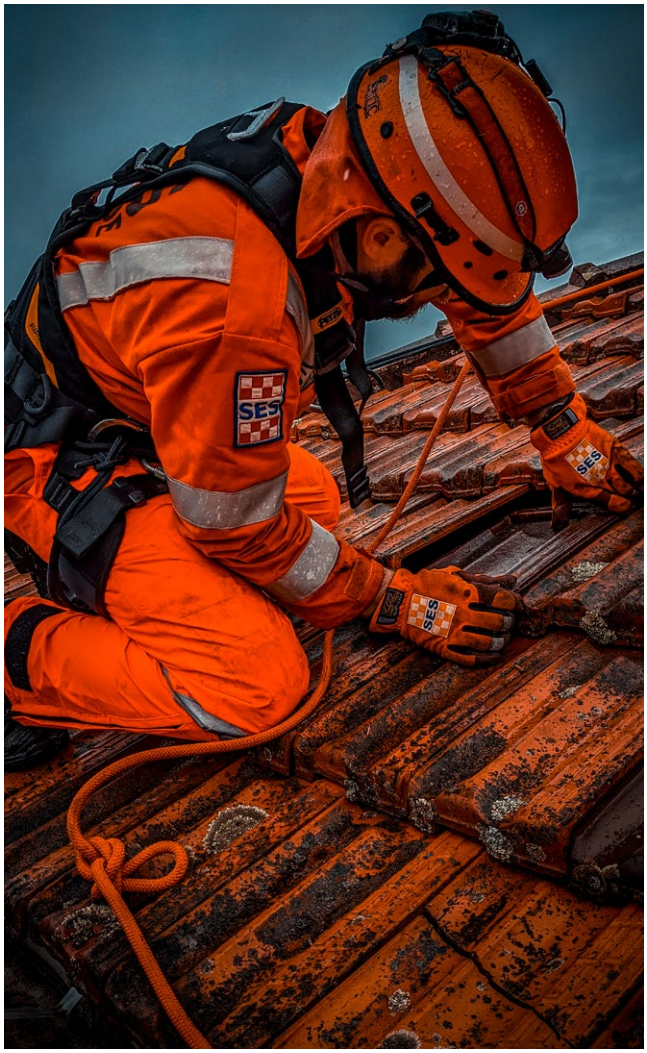
National Mental Health and Wellbeing Award

The winner of the Resilient Australia National Mental Health and Wellbeing Award was Phoenix Australia's Victorian Bushfire Recovery Project. It has helped equip more than 1,800 frontline workers, health professionals and community leaders to better support their community members' recovery from the 2020 summer bushfires, promote their resilience, as well as support the wellbeing of their teams and organisations.

After consultation, Phoenix Australia tailored and delivered a suite of online and in-person training and mentoring programs that aligned with a stepped-care approach to providing support after disaster. This approach allowed Phoenix Australia to upskill a diverse range of community members so they can, within their own community, provide the right support at the right time to match the individual's needs.

Mackillop Family Services program was highly commended for their Stormbirds program about disaster resilience mental health and wellbeing. As with other grief and trauma experiences, exposure to disaster has deleterious effects on mental health and wellbeing, substantially affecting children and young people's outcomes in the short and longer term. The Stormbirds program helps children to build an understanding of change and loss and grief, while developing skills in communication, decision-making and problem-solving.

Also highly commended was South West Hospital and Health Service for the South West Queensland Birdie Calls Collaborative Project. This initiative features the characters Birdie and Mr Frog who visit libraries, playgroups and primary schools to spread stories of resilience, feelings and support through hard times including 'the virus', drought, storms, very hot days and fire. Birdie and Mr Frog encourage children to emulate their resilience through their stories of facing difficult times, recognising their feelings and how things improve through the support of friends, family and community.



National Photography Award winner 'Cracked but never broken' by Rose-Anne Emmerton.

Highly commended photograph 'Contrast' by Johanna Mahon.

Highly commended photograph 'Autumn burning – a return to normality' by Andrew Haselden

National Photography Award

Finalists for the Resilient Australia National Photography Award were selected via a people's choice vote conducted through the Australian Institute for Disaster Resilience Facebook page. The winning image features on the cover of this edition of the *Australian Journal of Emergency Management*.

Rose-Anne Emmerton's winning image 'Cracked but never broken' depicts a volunteer who has recently attended a fatality, answering their pager for another call.

The highly commended image 'Contrast' by Johanna Mahon depicts the resilience of trees withstanding the blaze of a bushfire. They are burnt and covered in ash, but in months to come the bushland will regerminate and flourish again.

Andrew Haselden was also highly commended for his photo 'Autumn burning – a return to normality'. It was taken at the end of a hazard reduction burn conducted in early autumn and shows the calm of the dying intensity of a fire which burnt in a heavily fuel loaded block. As the smoke clears and the sun shines through the newly burnt bush, it is with a quiet sense of relief that the crew once again happily pitch in to get the job done as a team.

Details of the 2022 Resilient Australia Awards finalists are at www.aidr.org.au/resources/resilient-australia-national-awards-2022.

Outcomes from the Asia-Pacific Ministerial Conference on Disaster Risk Reduction

Alexandra Nichols
Tricia Addie

National Emergency Management Agency

Lara Franzen

Department of Foreign Affairs and Trade

Australia and its regional partners have reaffirmed commitment to the *Sendai Framework for Disaster Risk Reduction 2015-2030* (Sendai Framework) and readiness to listen and learn from others on best practice approaches to addressing climate and disaster resilience.

The Asia-Pacific Ministerial Conference for Disaster Risk Reduction was held in September 2022 in Brisbane. The conference brought together ministerial representatives and delegates from government, civil society, academia, the private sector, not-for-profit organisations and communities. The conference attracted 2,500 registered delegates and 2,150 in-person participants from 58 countries.

Taking place in the midst of the midterm review of the Sendai Framework[1], the conference allowed attendees to discuss where and how global communities can accelerate action to reduce disaster risk and build resilience in-line with the framework.[2] The midterm review will culminate in a high-level meeting in New York in May 2023. The conference noted the importance of senior representation at this meeting where member states will be asked to adopt an action-oriented political declaration to renew commitment to and accelerate the global collective implementation of the Sendai Framework.

Outcomes

Following the conference, Australia and the United Nations Office for Disaster Risk Reduction jointly released a Co-Chair's Statement[3] that captured the takeaways from the conference. This statement emphasises the commitments of delegates to the Sendai Framework through:

- better integration of disaster risk reduction and climate change adaptation to increase community resilience
- inclusive and transformative approaches that elevate the voices of marginalised groups
- increased risk-informed decision-making that takes into account existing and emerging challenges
- increased and innovative investment into disaster risk reduction and climate change adaptation
- greater collaboration and consultation across sectors including the private sector, insurance and industry.

The Conference Report[4] is a summary of the insights from each of the conference sessions and makes recommendations for prioritising investment in disaster risk reduction, pathways for investment and the roles of different actors.

Welcome Ceremony for Asia-Pacific Ministerial Conference on Disaster Risk Reduction

Image: UN Office for Disaster Risk Reduction

This was the first time the conference recognised Pacific Island countries as full participants.

Image: UN Office for Disaster Risk Reduction

Formal recognition of Pacific engagement

Shortly before the conference, the Nadi Declaration[5] was adopted at the inaugural meeting of the Pacific Disaster Risk Management Ministers in Fiji. This informed many of the discussions held at the Brisbane conference.

This was the first time the conference recognised Pacific Island countries as full participants. The Pacific Pavilion was a dedicated space at the conference for learning and sharing Pacific-led and owned innovations and cultural and traditional knowledge.

Pacific voices are an active part of the conversation and the global community has much to learn from their disaster preparation and management experience. For example, the integrated approach to addressing climate and disaster risk through the Framework for Resilient Development in the Pacific.

Strong ministerial participation

Ministers, deputy heads of government and representatives from 36 countries, regional organisations (e.g. Pacific Islands Forum Secretariat), international financial institutions (including the World Bank and Asian Development Bank) and other groups (e.g. youth and the private sector) participated. Australia's Minister for Emergency Management, Senator the Hon Murray Watt, and UN Special Representative for the Secretary-General on Disaster Risk Reduction, Ms Mami Mizutori. co-chaired the conference.

The National Emergency Management Ministers' Meeting was also held in Brisbane on the side lines of the conference. Members considered challenges such as approaches to high-risk weather seasons, current flood recovery efforts and facilitating risk reduction initiatives.

Messages across the international and domestic forums were strikingly consistent, in that climate change has fundamentally changed the disaster risk profile. Urgent, transformative action is needed to mitigate risks and improve resilience. We can no longer rely on historic models of disaster response and recovery. The midterm review affords a rethink of disaster risk reduction on a global scale. As the most disaster-prone region in the world, Asia and the Pacific play an important role to shift the focus in our region. During the Ministerial Forum Ms Mizutori said, 'the global battle to reduce disaster losses by 2030 will be won or lost in Asia and the Pacific'.

Conference resources

Session video recordings are at www.youtube.com/playlist?list=PLBDwPnveHho-dlc9iMc0pmVGiBPU50bbP.

Session summaries are at https://apmcdrr.undrr.org/sites/default/files/inline-files/APMCDRR%20-%20Session%20Summaries_consolidated_Final.pdf.

Endnotes

1. *Sendai Framework for Disaster Risk Reduction 2015-2030*, at www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf.

2. To support the midterm review, the Australian Government led the development of Australia's national midterm review. The report is at https://nema.gov.au/sites/default/files/inline-files/Australia%27s%20National%20Midterm%20Review%20of%20the%20Sendai%20Framework%20for%20Disaster%20Risk%20Reduction%202015-2030%20Report.pdf.

The accompanying annex is at https://nema.gov.au/sites/default/files/inline-files/Annex%20to%20Australia%27s%20midterm%20review.pdf.

3. Co-chair's Statement, at https://apmcdrr.undrr.org/sites/default/files/inline-files/Co-chairs%E2%80%99%20Statement_APMCDRR%202022_0.pdf.

4. Conference report at, https://apmcdrr.undrr.org/sites/default/files/inline-files/APMCDRR%20Conference%20Report%20%5BFinal%5D.pdf.

5. Pacific Ministers for Disaster Risk Reduction Declaration, at https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/09/0974574b394f1a6eac878ff283fcf9c5.pdf?sv=2015-12-11&sr=b&sig=HcifB9KI%2BxyZpXA3BmCBuoCFeuZEkyCnJVbfzql1ILc%3D&se=2023-05-30T05%3A35%3A52Z&sp=r&rscc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400&rsct=application%2Fpdf&rscd=inline%3B%20filename%3D%22Declaration_Inaugural_PDRRMM_September_2022_FINAL.pdf%22.

6. Framework for Resilient Development in the Pacific, at www.resilientpacific.org/en/framework-resilient-development-pacific.

Natural Hazards Research Forum: where the present meets the future

Professor Deborah Bunker

Natural Hazards Research Australia

The Natural Hazards Research Forum held in October 2022 in Brisbane (Yuggera and Turrbal Country), challenged our thinking on the management of natural hazards.

The goal of the forum was to bring people together to contribute to the future of natural hazards research, including what is being done and what the solutions are for the future. In attendance were almost 300 delegates from 124 different organisations – an impressive reunion of partners, researchers, government representatives and others invested in driving change through research.

Across 3 days and 65 speakers, themes to emerge were resilient communities and built environments, Aboriginal and Torres Strait Islander science, evidence-informed policy and strategy, learning from disasters, sustainable landscapes and situational and operational capability.

The forum encouraged attendees to:

- define and build community resilience in the face of climate change
- acknowledge our connection to Country and listen to perspectives of Aboriginal and Torres Strait Islander peoples
- evaluate the impact of human activity and the hidden (and not so hidden) effects on the land and on us
- plan for a future of extreme, compounding and cascading events, including how best to harness community skills and resources.

Emergency management has traditionally used 'command-and-control', response-oriented systems and structures to deal with emergencies, disasters or threats. However, in a changing world, 'systemic' failures have been experienced in areas of response and community resilience.

There are several factors that underpin such failures[1]:

- Dynamic characteristics of the disaster/threat, including timing, amplitude, magnitude and containment. Disaster events vary in their characteristics even by type (i.e. what is a 'normal' bushfire, flood, cyclone or earthquake?).
- Dynamic stakeholder characteristics, which can often be complex with each affected organisation, group or person having their own culture, structure and ways of doing things.
- Geographic spread of disasters and their monitoring rely on prediction modelling, geo-spatially related information and situational awareness.
- Information and communication complexity means information on local conditions and individual requirements and needs can be difficult to obtain and are often centrally managed.

Professor Mary O'Kane presented 'Insights for Research in Disaster Risk Reduction and Resilience'. She noted the imperative to extend imagination to encompass how a future might look for high-risk hazards and their effects. She stressed the need for a research agenda that includes the use of a common language by practitioners and researchers for problem-solving, the creation and use of methods and means to understanding the impact of research on practice and the opportunities and challenges that technology presents. She spoke of the need to include communities, including Aboriginal and Torres Strait Islander peoples and their representatives, in the development and deployment of research solutions. This was particularly so in areas of public warnings, risk management, education and training, dealing with trauma, land management and housing solutions.

There were other excellent speakers on topics of the consequences of the new era of disasters, climate change, evidence-informed policy and strategy, systems interoperability, co-existence with hazards, land management, Aboriginal and Torres Strait Islander women's role in protection

Andrew Gissing led the forum, which attracted attendance from 300 delegates.

Image: Natural Hazards Research Australia

of Country, cultural burning practices, learning from disasters, the value of royal commissions and inquiries, workforces and communities of the future, as well as connection to Country and the impact of natural hazards on Aboriginal and Torres Strait Islander peoples, young people and those at risk.

The forum highlighted some tensions that exist between current critical responses and a vision for the future. These must be resolved if we are to develop future-oriented, innovative, useful and used research solutions. Areas for resolution include:

- a future focus on developing complex systemic approaches that build hazard resilience, rather than the current use of many resources to produce specialised research and solutions that are generally agency specific
- development of future-oriented solutions that reflect and incorporate Aboriginal and Torres Strait Islander custodianship and accumulated knowledge of Country, rather than being dependent on research approaches built on Western research methodologies
- use of larger-scale, inter- and multi-disciplinary research approaches to problem solve across organisations, jurisdictions and communities, rather than reliance on smaller, fast research and solution development cycles that come under resource and time pressures
- development of a common understanding of problems and the language to describe them as well as the application of co-developed research to produce integrated, transformational adaption and risk reduction, rather than piecing together domain and jurisdictionally specific research outcomes for integrated solutions.

These tensions are aggravated by:

- the difficulty in applying lessons learnt (i.e. minimal knowledge transfer occurs beyond specific events and participants resulting in extensive and expensive shelf-ware
- playing a blame game rather than seeking solutions to problems
- not identifying, codifying or applying patterns of response across all hazards to address risk
- the overlapping of links between phases of prevention, preparation, responding and recovery that can occur concurrently and can cloud the identification and understanding of critical issues
- the lack of effort and resources applied to developing trans-disciplinary research to hazards management and community resilience, which are required to mitigate the impacts of natural hazards on social, environmental and financial situations.

Practical and effective ways emerged where the present can meet the future through embracing Aboriginal and Torres Strait Islander knowledge, being open to change and moving on from describing research problems to developing effective and translatable research solutions. Specifically:

- identifying and addressing dynamics in hazard management from a systemic viewpoint
- analysing the effects of these dynamics on systems governance, from response agency and community perspectives (data sourcing and use, organisational and management processes as well as technology use and risk management)
- understanding patterns of failure to better manage, build and operate future information technologies and systems of systems
- creating new systems that help us act in future disaster events when the known range of management command-and-control activities are ineffective.

So, what is the way forward? The forum highlighted the need to focus on effective understandings of complex systems; responsive, flexible, collaborative and contextualised community-based approaches; and theories and approaches to trans-disciplinary, translational and transformative solutions.

If the present is to meet the future, it is critical that we develop agile institutional responses and solutions to complex crisis management, community resilience building and disaster risk reduction. This forum gathered broad input and support for developing a national research agenda for high-risk hazards.

Endnote

1. Bunker D, Levine L & Woody C 2015, *Repertoires of collaboration for common operating pictures of disasters and extreme events. Information Systems Frontiers, vol. 17, pp.51–65. doi:10.1007/s10796-014-9515-4*

Wi-fi for good wins inaugural Disaster Challenge

Nathan Maddock

Natural Hazards Research Australia

An innovative idea to use wi-fi to provide tourists with localised disaster preparedness information while on holiday has won the inaugural Natural Hazards Research Australia Disaster Challenge Final.

Dr Kamarah Pooley and Mark Owens are behind the winning concept, which addresses the wicked problem posed by the Disaster Challenge: how can disaster preparation engage with the unengaged, the moving or the hard to reach?

Dr Pooley, a researcher from Fire and Rescue New South Wales, explained, 'Our solution to the wicked problem is to use wi-fi captive portals to reach tourists and tourism workers with disaster preparation and prevention information'.

The idea focuses on positive and practical information that people can use while on holiday to stay safe from floods, bushfires, cyclones and other natural hazards.

The concept is that a short video plays before tourists access wi-fi services at their accommodation or eateries. The video would include tips about how to access emergency information and what to do if a disaster struck – all customised to the local area.[1]

Mark Owens, a researcher from the Country Fire Authority, said, 'Accessing free wi-fi is essential for holiday makers and our approach is another way to reach people who are hard to reach through current communication channels.

'Wi-fi portals are a way that holiday makers can receive the vital information they need to make informed decisions during a natural hazard,' he said.

The inaugural Disaster Challenge was held on 13 October, the United Nations' International Day for Disaster Risk Reduction, as part of the Natural Hazards Research Forum. The challenge invited postgraduate students and early career researchers to present solutions to the wicked problem.

Natural Hazards Research Australia CEO Andrew Gissing said that the Disaster Challenge highlighted the new research and creative thinking Australia needs to face future disasters.

'Emergency management is full of wicked problems and new thinking is our way forward. We cannot keep doing things the same way and expecting a different result.

'The 3 innovative solutions we saw in the Disaster Challenge drew on the creativity of our best and brightest minds. We saw the benefits of combining new thinking with existing expertise, as well as the next generation – whether that be younger people starting out their careers – or others bringing their experiences into disaster management for the first time.

'There is so much we can learn and it is concepts like these that will make a difference and keep Australians safe,' he said.

Natural Hazards Research Australia will now work with Dr Pooley and Mr Owens over the next 12 months to explore their concept further.

Runner up in the Disaster Challenge went to Griffith University postgraduate students Jane Toner, Sheridan Keegan, Ahmed Qasim, Lynn Lue-Kopman, Yunjin Wang and Manori Dissanayaka, alongside Cristina Hernandez-Santin from RMIT University. Their pitch was a disaster-activated information hub that harnessed the value of creative place making and art to bring communities together and provide emergency information to tourists, titled Beacons of Hope.

Disaster Challenge winners Dr Kamarah Pooley (middle) and Mark Owens (right) with Natural Hazards Research Australia CEO Andrew Gissing (left).
Image: Natural Hazards Research Australia

Second runner up was awarded to Queensland University of Technology PhD students, Jyoti Khatri K C and Mohammed Alqahtani. They drew on their personal experience of the 2022 Queensland floods with their proposal to harness community connections with culturally and linguistically diverse communities to increase emergency preparedness amongst migrant communities whose knowledge of potential natural hazards in Australia may be low.

The inaugural Disaster Challenge was coordinated by Natural Hazards Research Australia, hosted with support from universities and emergency management organisations in Queensland: Australian Red Cross, CQUniversity, Griffith University, Healthy Land and Water, Inspector-General Emergency Management Queensland, James Cook University, Office of the Queensland Chief Scientist, Queensland Fire and Emergency Services, Queensland Police Service, Queensland Reconstruction Authority, Queensland University of Technology, University of Queensland, University of Southern Queensland and University of the Sunshine Coast.

The Disaster Challenge will next take place in 2023. For more information, see www.disasterchallenge.com.au.

Endnote

1. See an example of how this would work at https://youtu.be/EdsmSPhQ9iM.

Building resilience not ramparts: Reimagining emergency management in the era of climatic disasters

Briony Rogers

CEO, Fire to Flourish; Associate Professor, Monash Sustainable Development Institute, Monash University

What has emergency management learned from global movements like #metoo and local heroes like Dylan Alcott? That the demands of people with lived experience cannot be silenced and the status quo and its systems must change. 'Nothing about us without us,' is the mantra and call-to-action.

Over the past 2 years, I have been immersed in designing a new model of disaster resilience at Fire to Flourish: a collaboration between 4 bushfire-affected communities, and a wonderful mix of frontline workers, academics and philanthropists. I have seen up close, what a response led by the local community - their ideas and their solutions - would look like. And what scaffolding, in the form of external expertise and resources, they need. Early indications suggest a potentially transformative effect.

Fire to Flourish is not alone in this vision. Community-led innovations around the country following the 2019–20 bushfires show similar promise. What does this look like in practical terms? Like Mallacoota's community-led recovery program[1], run by a committee elected by an estimated 500 locals, and even registered to take public donations. Like Cobargo's community-run incorporated association[2], which receives funds and supports collective decision-making about grants for community projects. And like Kangaroo Island's community[3], equipping residents with the knowledge, skills and assets to be self-sufficient in the event of another bushfire disaster.

What do we all have in common? An emerging consensus that community-led is the key principle.

'Nothing about us without us.'

The case for change

Systems have long been at the heart of emergency management. As we know, they enable speed, efficiency and scale. But in recent years, it's become clear that business-as-usual forms of support for community recovery and resilience are flawed.

Flawed because they have traditionally operated through power-based hierarchies, with government and its agencies at the top, and communities at the bottom. While well intentioned, this unwittingly reinforces a model of community as the helpless recipient of benevolent policies dictated from a distant capital. What's more, this model is often wasteful, as it directs funds to cookie-cutter 'solutions' rather than targeted at localised needs. And it is often harmful, as it disempowers local skills and knowledge, buttressing the status quo and reinforcing disadvantage.

Never has the need to change this model been more urgent. But never has it been more challenging. As Greg Mullins, former NSW Fire and Rescue Commissioner and a serving volunteer firefighter recently pointed out, climate-change-driven extreme weather records have been broken on every continent on Earth[4] in the past 12 months. 'To put it bluntly, Australia's disaster planning, management and recovery systems are regularly overwhelmed,'[5] said the founder of Emergency Leaders for Climate Action.

It would be easy to stay in reactive mode in the face of this new warp-speed disaster cycle. Instead, we should take stock, join up the innovative projects dotted around the country and outline the future systems we need to bolster this new model. A new model in which community-led disaster resilience is enabled and supported.

And then we need to muster our collective strength to drive the change and ensure the transformation is strategic and sustainable.

The birds-eye view

The seeds of Fire to Flourish's model of recovery germinated in the experiences of communities affected by the 2019–20 bushfires. These insights, coupled with evidence from policy, practice and literature reviews, gave shape to the program.

In 2021, we conducted a survey of people's preparedness for and resilience to disasters. The findings[6] confirmed our lived-experience-led program was not only right, it was critical.

Stunningly, more than two-thirds of those surveyed who survived a disaster felt more confident their communities were prepared for the next one. While a sizable third of respondents did not share this confidence, the research suggested the two-thirds majority offered an unrealised asset in helping the broader community. To help them not only recover from disaster, but build pre-disaster resilience.

Armed with this insight, Fire to Flourish established partnerships with communities in East Gippsland in Victoria (Gunaikurnai, Monero and Bidawel land), and in 3 sites in New South Wales: Eurobodalla (Walbunja and Djiringanj land), Clarence Valley (Bundjalung, Gumbaynggirr and Yaegl land) and Tenterfield (Kamilaroi and Bundjalung land).

Fire to Flourish has a 4-stage process, taking time to build strong community foundations and trusting relationships. Initial scoping and co-design allows us to connect with local people from a diverse range of backgrounds and drill down into what the community identifies as their strengths and needs (we deliberately avoid the deficit language of 'gaps' and 'failures' common to disaster planning). Priorities for building capacity, so far, have varied from needing emergency UHF radios, to tackling trauma from previous emergencies, to creating leadership opportunities for young people.

The next stage is to build on these insights to co-design visions for better community preparedness and resilience. Getting this right means capturing the community's diversity in the people who lead each project: Aboriginal and Torres Strait Islander peoples representation, people living with disability, people from non-English speaking communities, young people, community elders and people from the isolated parts of the region. We strive for a balanced gender representation too. We have heard from communities that women have tended to lead long-term recovery projects while men led the immediate disaster response. Through this process, community co-designers identify where they need to access resources or acquire new skills.

We are well underway with these stages. In 2023, we look forward to supporting each community to put its plans into action, including through decision-making about grant funding allocation.

Communities will then implement their resilience-building projects, networking with others in the community, ranging from local councils to service providers, from non-government organisations and to volunteer communities. This broad participation will help foster stronger social cohesion as a critical foundation for long-term community thriving.

Qualitative and quantitative evaluation will help us understand what works, why and for whom. Community empowerment will be tested through quarterly surveys and metrics such as participant diversity, skills and capabilities, and resilience tools calibrated to assess economic, social and environmental outcomes.

This will generate an important evidence base to support the scaling of community-led approaches across Australia - achieving what command-and-control systems do in terms of coverage and outcome, but with localisation that means the legacy for communities is profound, fit-for-purpose and long-term.

The grass-roots view

> *I think that if I hadn't done Fire to Flourish, on a very personal level, when the floods hit, the despair … could have been insurmountable. The projects that we funded through Fire to Flourish have already started to have some definite benefits to community.*
>
> *Cate, Community Co-designer, Whiporie, Clarence Valley, Bundjalung Country*

Cate is one of the co-designers from Fire to Flourish's early pilot in the Clarence Valley. Her testimony demonstrates what participant-led, locally-focused disaster resilience means in practice.

Other early practical outcomes include the employment of 7 leaders from Indigenous communities among our 13 community staff members, including 3 of the 4 community leads. Such employment practices are crucial, as we know Indigenous communities are significantly and disproportionately affected by disasters, including the 2019–20 bushfires and 2022 NSW floods, and yet historically there have been systemic barriers to their leadership. Their voices are vital to removing these barriers, growing their influence and ensuring the entire community's priorities are heard.

This can be challenging for some community members, accustomed to seeing programs led by non-Indigenous peoples or seeing programs as binary – as either indigenous- or non-indigenous focused. The opportunity is to change mindsets and practices beyond the important role of jobs and skills. How? By embedding caring for Country within disaster resilience practices, for example – a key goal of our new 4-year National Indigenous Disaster Resilience Project.

So much attention to emergency management is on the hard, physical stuff - the levee walls and sandbags, the firetrucks and shelters. These are all, of course, critically important at moments of acute crisis. But it is the 'softer' side of resilience, things like improving social cohesion and reducing disadvantage, that is crucial to a community flourishing in the long months and years after the acute phase of a crisis has passed. Thinking holistically about disaster resilience – across social, economic, built, natural and wellbeing indicators – is where the real systemic opportunities lie.

Fire to Flourish staff, including community teams from Clarence Valley, Tenterfield and Eurobodalla.

Image: Wayne Carberry

As we bed down the co-design phase, and look forward to kicking off broader participation in our four localities in 2023, we are so energised by early responses from community members and colleagues who work in disaster resilience. The principles that guide us – including self-determination, foregrounding indigenous wisdom, tackling inequality and being strengths-based – are critical ingredients for creating an Australia that is resilient to disasters and disrupting cycles of disadvantage.

By the community, of the community, for the community. As one participant in a recent review session said: '[Bringing] lived experience of the challenges [means] you see things others can't see.'

Now, doesn't that sound familiar?

Fire to Flourish is seeding a national Resilient Communities Network, building a growing movement of people and communities connecting with each other, learning together and driving systems change. Activities are gearing up in 2023 and the community-led action group is keen to expand its membership from the Network's group of founding members. If you are interested in finding out more, please email kate.fawcett@monash.edu.au.

Fire to Flourish is a partnership between Monash University, Paul Ramsay Foundation, Metal Manufactures Pty Ltd and The Australian Centre for Social Innovation (TACSI). Additional philanthropic funding is provided by the Lowy Foundation.

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1. Mallacoota recovery program at https://madrecovery.com.

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Who is worst off after a disaster?

Dr Kate Brady

Australian Red Cross

Professor Lisa Gibbs

University of Melbourne

Professor Louise Harms

University of Melbourne

It's well established that disasters result in a wide range of consequences that are felt unevenly by those affected. This research looked at what people who had experienced disasters in Australia and New Zealand found helpful and unhelpful in their recovery.

This article draws on a longer paper published by Brady, Gibbs and Harms (2021).[1] In that study, participants mentioned comparing their experiences to others who had been affected by the same disaster to figure out where they should be in their recovery. Participants also indicated they felt judgement about how badly they had been affected compared to others. The findings from this study were used to adapt an existing model of hierarchies of affectedness. It is important to understand how hierarchies of affectedness are formed, how they can be used and how negative consequences can be reduced because of how they affect people and communities.

A hierarchy of affectedness emerges when the level or type of disaster experienced by an individual, family or community is compared to others in the same or different events (Andersen 2013[2]). Examples of where these formal hierarchies develop include the creation of eligibility criteria for accessing financial assistance (such as grants) and other forms of aid after events. Hierarchies of affectedness are not commonly referred to in emergency and disaster policy and doctrine. Nonetheless, both explicit and implicit hierarchies are formed after such events to determine who are the most and least affected.

One of the ways that governments, not-for-profit organisations, the media and the public determine the proportionality of their response to extreme events is by comparing it to previous events. These comparisons form a ranking. 'Is this event worse than the last one, or is it not as bad?' This leads to other decisions about how much funding should be allocated, should people donate, should services be expanded, should news crews be sent to cover the event, should an appeal be established.

These comparisons and subsequent hierarchies have practical implications for people affected. In the immediate aftermath of an extreme event, it is common to use language like 'those worst affected', 'those hardest hit' and 'unprecedented damage' as a way to explain how resources are allocated. Even though the concept of 'hierarchies of affectedness' is not widely discussed in emergency management and its research, these social comparisons are used in other areas of social research, such as explorations of hierarchies of grief and hierarchies of harm from war. There is a lot to learn from these fields:

- To have a hierarchy, some effects need to be elevated in importance and others need to be diminished: some people's experiences will be recognised more than others.
- Hierarchies are used to determine eligibility for resources such as financial assistance and compensation: by making some people eligible, others will be considered ineligible.
- Hierarchies formed by 'outsiders' such as government are rarely nuanced enough to reflect the complexities experienced by affected communities: 'outsiders' rank impacts to determine where to allocate resources but such assessments do not tell the whole story.
- Hierarchies create categories that can create or exacerbate divisions that can be detrimental to community recovery.

In 2013, Blom Andersen[2] developed a model of hierarchies of affectedness after disasters following research into the aftermath of an explosion in a fireworks factory in Kolding. The model developed (Figure 1) follows a number of steps:

Our research looked at the experiences of people affected by disasters in Australia and New Zealand.[1] From on our findings, we identified 4 gaps in Andersen's model that we adapted our model to include (Figure 2). These were:

- Disaster affected people used comparisons to others impacted by the same event as part of their self-assessments.

Stages outlined by Anderson	Key points
STAGE 1 **Accomplishment of social category of affectedness**	'Outsiders' such as government, emergency services, aid organisations and the general public acknowledge the imapcts of the disaster. Impacted people can see that their 'affectedness' status is vaildated and reinforced by outsiders.
STAGE 2 **From agreement to disagreement**	The initial acknowledgment of 'outsiders' diminishes as time passes. 'Outsiders' have an expectation that those affected will change their behavior and recover quickly. Affected people may feel like they have to fight to have their ongoing impacts recognised. There is a misalignment between how 'outsiders' and those affected see the imapcts.
STAGE 3 **Comparison to people affected by different disasters**	Affected people are compared to people affected by other disasters. 'Outsiders' may downgrade the status of affectedness based on this comparison. Some affected people may agree with this downgrade, while others will see this as offensive and spend significant energy in maintaining recognition by outsiders.

Figure 1: Andersen's (2013) model of hierarchies of effectiveness.

Adjusted model of Hierarchies of Affectedness (modifications of Andersen's 2013 model)	Key points
STAGE 1 **Assessments of affectedness**	After a disaster there is a negotiated process to determine affectedness through different types of assessments: - self assessments by those who have been affected - assessments by others who have been through the same disaster - assessments by outsiders.
STAGE 2 **Validation and invalidation of self-assessments**	Disaster affected people may feel like their own self-assessments of how they have been impacted are validated or invalidated (or both) by others. This is a dynamic process and changes over time.
STAGE 3 **The role of hierarchies of affectedness**	Hierarchies of affectedness play different roles for those impacted by disasters. For some people, these comparisons may be a helpful, meaning making process. For others, these comparisons may be stressful and only helpful to self-justify why they need more support.

Figure 2: Adjusted model of hierarchies of affectedness (Brady, Gibbs & Harms 20211).

People used comparisons to others who experienced the same event as part of their self-assessments.

Image: Australian Red Cross

- The types of assessments that 'insiders' and 'outsiders' undertake are different in both their content but also their pace. The self-assessments that disaster affected people undertook tended to be more holistic and dynamic and included intangible impacts and secondary stressors, while outsiders tended to focus on the tangible impacts.
- Disaster affected people could experience both validation and invalidation of their experiences simultaneously.
- Disaster affected people used the role of these hierarchies differently. For some people, they were a helpful sense-making tool at a time where other social comparison markers were no longer available. However, for others these comparisons were a source of anger and injustice.

That research also showed that participants used hierarchies of affectedness to orientate themselves at a time of dramatic upheaval. For some participants, comparing themselves to others was helpful. They used their observations in a constructive way to reframe their experience. Conversely, for participants who felt like their experience had been diminished by others, hierarchies of affectedness served to demonstrate how bad their experiences had been. They used the comparisons to others affected by the same event to self-justifying why they needed more support.

Understanding hierarchies of affectedness

Understanding hierarchies of affectedness is important because they have practical implications for people and their recovery. Hierarchies of affectedness can help us understand how resource allocation after a disaster can be influenced. They can also help us understand the perceptions some disaster affected people have about the help they have received. It can be common for individuals and communities to feel they have been forgotten and their experiences are unacknowledged by governments, agencies and the public. When people feel like they have been badly affected but their concerns have gone unnoticed, or worse, have been diminished, it's natural for divisions to arise, frustration to grow and a sense of injustice to follow. These divisions can reduce the benefits that community connections after events can have. Experiencing and recovering from disasters is usually a stressful process and secondary stressors can make the experience harder.

Outsiders (such as governments, not-for-profit organisations and media organisations) need to understand that the processes they use to assess and determine levels of affectedness may:

- not be comprehensive
- diminish the experiences of people affected
- cause divisions within affected communities.

This is not to say that hierarchies won't need to be used to help make assessments about the types of support available, who is eligible and how resources are prioritised. But if organisations understand the role that decisions play in recovery, they can take steps to reduce their potential harm. Broad approaches to defining who is affected, community-led approaches to recovery, dynamic needs assessments and flexible support are ways that the potentially negative outcomes of hierarchies can be reduced and the potentially positive role of hierarchies can be amplified.

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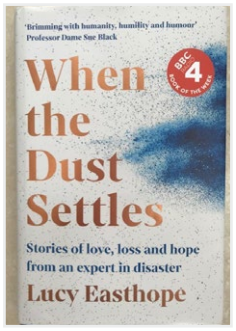
When the Dust Settles: Stories of love, loss and hope



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This autobiography and memoir covers the author's personal and professional experiences of emergency planning, response and recovery over more than 20 years. Lucy Easthope draws on her unique and varied roles in responding to events as wide-ranging as 9/11, the east Asian tsunami, the Iraq War, UK flooding, the Lac-Mégantic rail disaster, the Grenfell Tower fire and the COVID-19 pandemic.

The result is a fascinating and informative insight across all phases of disaster, from pandemic planning, disaster victim identification and mortality management, through to aftermath decision-making around, for example, personal effects and community engagement and into longer-term recovery journeys. For this reason, it is educational for anyone involved in emergency and disaster management, whatever their role, and offers the chance to see bigger pictures beyond the professional silos and situational awareness we sometimes inhabit.

The book has attracted interest and worthy praise among wider audiences too. It featured as a Book of the Week on UK BBC Radio 4 and has achieved *Sunday Times* best seller status.

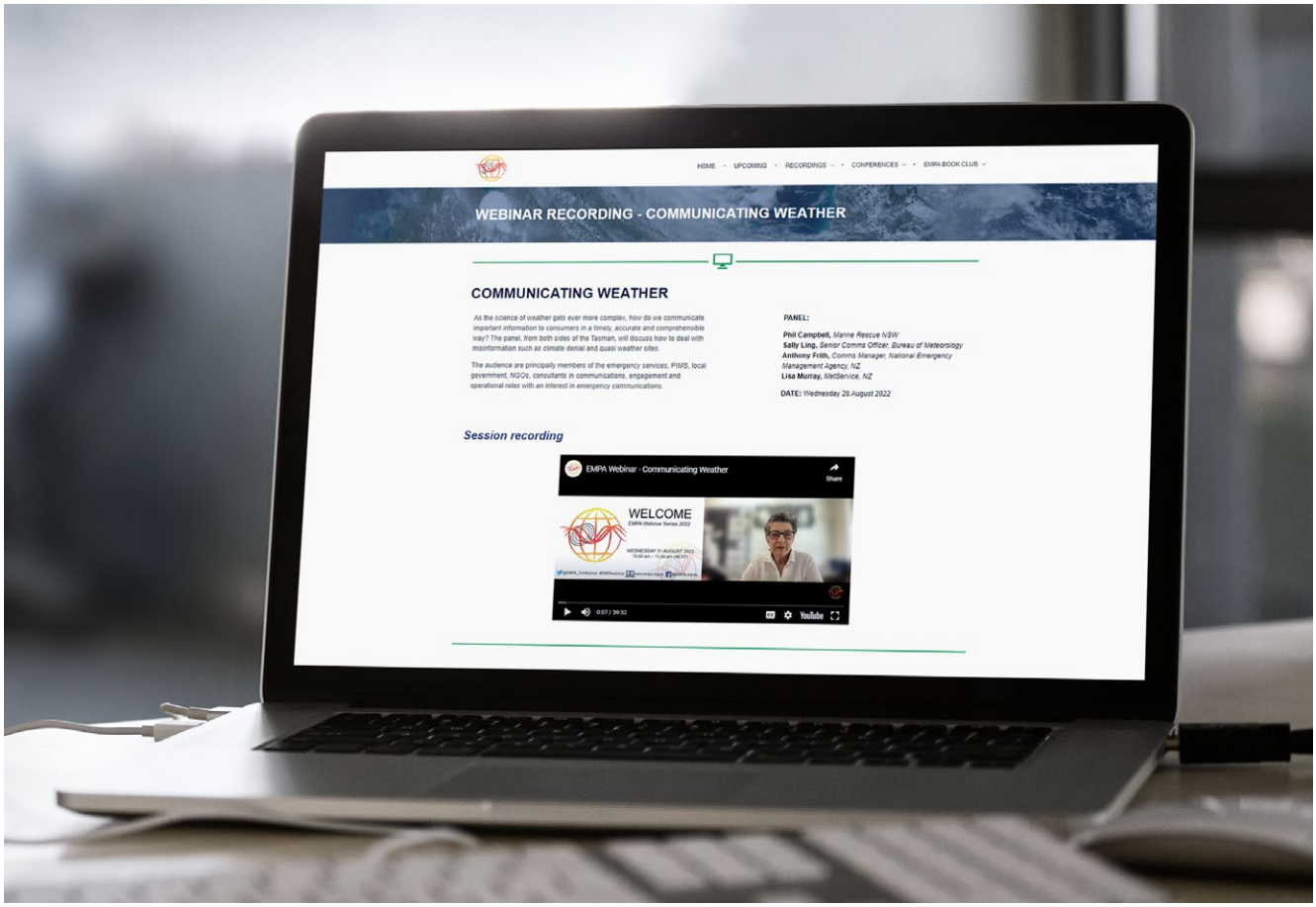
Its appeal is not only its light, readable style and its subject matter; themes of love, accounts of loss and details of disaster all appeal, but they rarely feature alongside each other in quite the way as they do in this book.

The weaving of the personal and professional is intriguing and holds the reader's attention throughout. Easthope's accounts of the bizarre reality and dissonant emotions of being in emergency response mode (like being on a mobile phone at a social gathering or whispering in the corner at a child's party) may chime with readers. If so, they may choose to share the book's stories with those close to them for it gives others in our lives a rare opportunity to see in, to understand this hidden world and its effects on people who operate in the emergency and disaster fields. The book highlights the rippling and leaking impact of disaster work on responders' families and friends. At the same time, a central theme is the importance of care and compassion for people directly affected since emergency management has consequences at some point for bereaved people, survivors and communities.

In a review for the *New Statesmen*, Dr Rowan Williams, former Archbishop of Canterbury, praised Easthope's revelations about how the way we recover from disaster goes to the heart of what it means to be human. Indeed, a common theme throughout the book is the author's ability to balance an honest presentation of the graphic realities of death and disaster with humanity, compassion, humour and hopefulness.

The experience of disaster is always deeply personal and dealing with multiple losses has enduring consequences. Easthope shares her family tapestries, hopes and dreams. It takes courage and humility to share one's personal and emotional experiences so openly in the way she does.

What may resonate, especially for seasoned emergency managers, is not the grim reality of dealing with collective tragedy—this, we sadly know—but the painful familiarity of political and administrative 'faff' revealed in this account and the immense frustration of learned lessons that a lifetime in disaster management highlights. Easthope maintains her sense of hope and humour while coping with multiple experiences of being personally and professionally marginalised on various grounds over the years—her youth, her self-effacement, her academic status, her passion and her gender. This book leads one to ask, especially in extreme moments, why some instincts feel less palatable than others and why we allow some voices to be louder than others.



Building an online resource for communicating emergency

EMPA hosts a continuing series of webinars on topics of interest to all emergency communicators. This year's clutch was varied and well-represented with excellent speakers from many sectors as well as from other countries.

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Measuring capability maturity for severe-to-catastrophic disasters

Andrew Gissing

Natural Hazards Research Australia

Abstract

Severe-to-catastrophic disasters pose unique challenges and are inevitable. Previous reviews have highlighted gaps in Australia's preparedness to manage severe-to-catastrophic disasters (Catastrophic Disasters Emergency Management Capability Working Group 2005).

Introduction

Capability is defined as the collective ability and power to deliver and sustain an effect within a specific context and timeframe. Capability consists of the elements of people, resources, governance, systems and processes (Department of Home Affairs 2018, p.7). Capacity is the key determinant of how long a capability can be sustained at a particular level of ability.

Severe-to-catastrophic disasters, by their nature, threaten to overwhelm the capability and capacity of jurisdictions requiring a nationwide, all-hazards, whole-of-community approach. It is not cost-effective to have a significant investment of resources that might only be employed in the most catastrophic events. However, the inevitability of such disasters means that it is important to consider the extent of capability gaps, where additional capacity might be sourced and how operating models may need to be adjusted.

The Royal Commission into National Natural Disaster Arrangements found that there was a need to take a national approach to capability planning across jurisdictions and that jurisdictions should have a structured process to regularly assess capability and capacity requirements (Binskin, Bennett & Macintosh 2020).

The *Australian Disaster Preparedness Framework*, developed by the Australian Government in conjunction with states and territories, supports a national effort to develop required capability to effectively prepare for and manage severe-to-catastrophic disasters. The framework identifies a suite of national capabilities essential to preparing for, responding to and recovering from these events. A key consideration highlighted in the framework is the need to identify the amount of capability required to ensure it can be sustained, including the identification of capability gaps (Department of Home Affairs 2018).

Some jurisdictions have existing capability frameworks that outline required capabilities and collective development pathways to ensure a multi-agency effort across prevention, preparedness, response and recovery. Efforts have also been made to understand capability maturity to identify and prioritise gaps.

Capability maturity assessment

The objective of a capability maturity assessment is to identify and prioritise capability gaps. Some jurisdictions have used a tool developed by the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC) called the Capability Maturity Assessment Tool to undertake these assessments (Gissing 2021). The tool uses a series of criteria to measure capability maturity based on input from subject-matter experts.

It provides insights into capability gaps across the capability elements of people, resources, governance, systems and processes for each defined capability. The output of the tool provides a ranking of capabilities by maturity score. Participants in the assessment have benefited from the sharing of information about capability maturity and identified gaps.

The assessment process is risk-based and involves evaluating capabilities against realistic severe-to-catastrophic disaster scenarios, which could include a single extreme event or could be a compounding disaster comprising multiple events that occur concurrently or in sequence. Future scenarios can be used to test the maturity of capability within the context of a warming climate and growing exposure to hazards.

The tool's criteria links to capability targets to provide a defined benchmark of the effect that a capability would be expected to deliver in the context of a severe-to-catastrophic disaster. Capability targets have been used in the United States as a fundamental method of measuring capability maturity, using the Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) processes (Department of Homeland Security 2018).

To enhance the application of the Capability Maturity Assessment Tool, research was undertaken by Natural Hazards Research Australia with the NSW emergency management sector to define capability targets for NSW. This included investigation of risk-based principles to guide the level of preparedness for the NSW emergency management sector, definition of targets and consideration of additional processes to measure capability maturity.

Risk-based principles to guide preparedness

In establishing capability targets, it is important to understand the level of risk that a jurisdiction wants to be prepared for. Working with emergency sector leaders, the following principles were suggested:

- **We partner with communities.** Emergency management is a shared partnership. Communities must be aware, connected and empowered. It is critical that community capability is mobilised to build resilience. We partner with communities and will take risks to explore new ways of working to maximise the effectiveness of how we work together.
- **Our work is focused on resilience.** Communities should have the capability and capacity to withstand, recover, adapt, strengthen and thrive. Some level of consequence from emergencies will be inevitable, although we strive to ensure these do not overwhelm communities.
- **We take a whole-of-community approach.** It is not cost-effective to maintain capabilities for severe-to-catastrophic emergencies. To maximise preparedness, we work in a proactive and seamless partnership with the Australian Government, other states and territories, local government, non-government organisations, businesses and industry, media and the community to support our capabilities and capacity.
- **We invest wisely**, ensuring that:
  - capability and risk management treatments are targeted and prioritised based upon the level of risk
  - investments are directed to capabilities that will best manage risk
  - capability and risk management treatments are cost-effective and do not pose downsides (externalities) that outweigh benefits
  - a base level of capability exists across the state that can be mobilised to respond to risks statewide and to support other states and territories
  - where possible, capabilities offer flexibility and adaptability.
- **We innovate to improve community safety outcomes.** We have a high appetite to innovate and take risks to explore new ways of working to improve outcomes with the community. We embrace a sector-wide approach to capability development, acknowledging that strength comes from working together and partnering with elected representatives.
- **Safety is our number one priority.** We work to ensure members of the emergency management sector are safe and healthy, both physically and mentally. We have zero appetite for serious work, health and safety harm.

Defining capability targets

The development of capability targets was informed by the FEMA THIRA methodology, risk-based capability principles and a series of workshops with capability subject-matter experts. Targets were developed to inform planning for severe-to-catastrophic disasters and are not intended to act as performance indicators. Each target was designed to assist in measuring the extent of capability available to respond to a severe-to-catastrophic disaster and hence provide an indication of preparedness.

Targets were developed for each core capability identified in the NSW Capability Development Framework (NSW Government 2020). Planning and preparedness-related targets were informed by existing emergency management policy objectives, while response and recovery targets attempted to comprise 3 components:

- An impact, which represents the size of the capability requirement.
- A critical task, which represents a specific action that is required to achieve a capability target.
- A timeframe metric, which represents the timeframe in which the action needs to be performed.

An example is illustrated in Figure 1.

The process of developing the capability targets consisted of:

- developing realistic severe-to-catastrophic disaster scenarios consistent with the State Level Emergency Risk Assessment to provide information relevant to the definition of the targets (e.g. a major tsunami hitting the Wollongong area resulting in structural collapses and mass injuries and fatalities)
- stakeholder consultation to establish capability narratives, describing a critical task representing a specific action that is required to achieve the capability and to define the impact and timeframe or policy measures consistent with the chosen disaster scenario.
- testing and validation of capability targets with subject-matter experts.

As an outcome of the process, some suggested capability target examples included:

- **Organisational Resilience –** all government departments, agencies and key partners have business continuity plans. Plans are tested and reviewed annually.

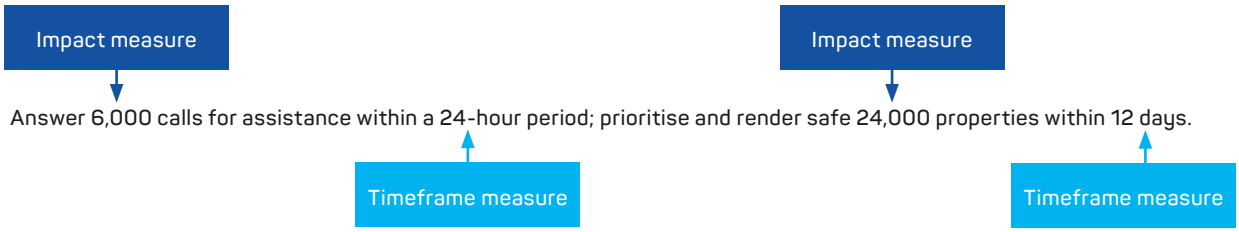

Figure 1: Capability target format sample.

- **Operations Management and Coordination –** within 6 hours of a potential or actual incident, establish and maintain a state-wide Level 3 integrated and coordinated incident control structure, and maintain operations for 6 months in support of an emergency.
- **Evacuation Support –** within 12 hours of a major incident, evacuation facilities are ready to receive 25,000 people and their companion animals (5,000 animals). Sustain capability for 2 weeks.
- **Mass Care –** within 12 hours of an incident, triage 2,000 injured people and commence treatment and transfer to appropriate facilities.

Capability measurement

To investigate methods to complement the Capability Maturity Assessment Tool, 2 methods were tested. Both methods quantitatively measured the gap between what exists and what is required in capability and capacity. These were:

1. **Desktop exercise scenario –** where agencies accountable for a given capability were provided with a scenario and small-to-medium enterprises allocated the people and resources required to achieve the capability target. This exercise assumed that resource allocation would not be constrained by existing capacities. The facilitator recorded the number of people and resources that were said to be required for different roles so that they could be compared with the number of people and resources that would be available given current sector capacity.
2. **Quantitative assumptions-based analysis –** where agencies identified the effect that could be achieved by people and resources specific to a capability. An example is the number of requests for assistance that a storm damage team could complete in a 12-hour shift. These assumptions were used to estimate the people and resources required to meet the capability target, and could then be compared to people and resources that would be available given current sector capacity.

The research identified numerous challenges associated with quantitatively measuring the number of people and resources that would be required to meet capability targets:

- Not all capability elements can be measured quantitatively, for example, governance, systems and processes.
- Assumptions based on subject-matter expert opinion used in the measurement process meant that there was uncertainty in estimates. There was a lack of historical data regarding the number of people and resources required to respond to severe-to-catastrophic disasters to inform or validate estimates. Given the lack of experience in managing severe-to-catastrophic disasters, subject-matter experts may assume a greater efficiency in resource allocations than may occur in reality.

To improve the accuracy of capability maturity assessments, agencies should collect data on the number and type of people and resources required across the timeframe of major incidents to which capabilities relate to. Ultimately, real-world events are the best measure of capability maturity.

A holistic approach

The outcomes of the research provide the basis for a series of principles to guide future capability maturity assessments. Capability maturity assessments should:

- focus on collective capability maturity, not just the capability maturity of an individual organisation
- explore all capability elements of people, resources, governance, systems and processes
- involve a variety of diverse organisations in the delivery of the capability, including all levels of government (local, state and federal), businesses and non-government organisations
- be collaborative and promote sharing of information between organisations about capability
- be supported by data where possible
- enable temporal comparison of capability maturity
- be informed by capability targets to provide a baseline to measure against
- be designed to suit the expertise and resourcing available within a jurisdiction to undertake it
- be regularly reviewed and validated
- be linked to planning and capability enhancement initiatives.

Given the need for Australia to adopt a nationwide approach to capability, as articulated in the Australian Disaster Preparedness Framework, it is important that a consistent approach to

capability maturity assessment be utilised in the future, suited to the Australian context.

Such an approach could be supported by the overall model illustrated in Figure 2, comprising the following elements:

1. **Risk –** all capability maturity analyses should be based on likely severe-to-catastrophic disaster risk scenarios that each jurisdiction faces. The risk-based capability principles can assist to identify the extent of risk that capability should be retained for.
2. **Capability targets –** based on the risk profile of the jurisdiction, targets should be established across each core capability that provide planning benchmarks and represent the desired effect that capabilities aim to deliver.
3. **Capability maturity analysis –** using the targets, a capability maturity analysis should be performed using collective capabilities in a manner that promotes information sharing between agencies involved. The Capability Maturity Assessment Tool can be used to complete this phase.
4. **Validation and review –** the results of the capability analysis should be regularly validated and reviewed. Validation can be performed using data from real-world incidents. Exercises and modelling can assist with validation but should be supported by data and subject-matter expertise. The capability maturity analysis should be updated based upon validation and review activities on an annual basis.
5. **Emergency planning and investment decision-making –** the results of capability maturity analysis should inform emergency planning and capability investment decisions.

Figure 2: Capability Maturity Assessment Model.

The BNHCRC Capability Maturity Assessment Tool can be accessed at www.bnhcrc.com.au/capability-maturity-assessment-tool.

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Beyond a hazard-centric approach to disaster risk assessment: a Tasmanian scenario-based approach

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Abstract

The Tasmanian Disaster Risk Assessment (TASDRA) 2022 reviews and extends previous risk assessments for the state to identify and better understand disaster risks or sudden stressors that may affect Tasmania. The TASDRA project involved 350 stakeholders across the state in 12 workshops. Participants examined potential disaster risks and identified treatment options to reduce those risks and increase disaster resilience across hazards through considering the systemic nature of risk. This paper includes some practical implications and suggestions to collaboratively examine risk. The sharing of such assessments helps to inform risk assessments across jurisdictions in Australia.

Introduction

The TASDRA project aimed to establish a better understanding of the disaster risks that Tasmania is exposed to and what kinds of disaster events communities must expect. The Tasmanian Government has significant roles to reduce risks and protect communities and needs to work closely with other governments, private sector organisations and communities to reduce risks.

The TASDRA was a partnership project between the State Emergency Service and the University of Tasmania. It involved consultations with subject-matter experts who provided modelling of identified scenarios and workshops where attendees examined plausible worst-case scenarios and potential treatment options.

The project covered:

- identifying ways to prevent a disaster from happening
- 'stress testing' current emergency arrangements for known hazards
- identifying potential disaster risk reduction (DRR) measures.

During the project, participants considered how risk is assessed in accordance with international and Australian practice (Department of Home Affairs 2018; United Nations 2015, 2019). This is an area of current and rapid change.

Changes to assessing risk

In line with international and Australian approaches to reducing risk, risk was viewed as an intersection of hazard, exposure and vulnerability (O'Connell *et al.* 2018, 2020). Traditionally, risk assessment has emphasised the hazard then focused on exposures to that hazard through considering the consequences. Disaster resilience and DRR are about reducing hazards, exposures and vulnerabilities. DRR is about increasing the capability and capacity to reduce exposure to hazards. Figure 1 shows how risk is the combination of hazard, the exposure to that hazard and the extent to which people are vulnerable in the face of that hazard when exposed.

The 2022 assessment extended the 2016 Tasmanian State Natural Disaster Risk Assessment (White *et al.* 2016) to cover additional hazards, exposures and vulnerabilities beyond those previously included, which were 'natural' hazards of bushfire, flood and geological events. Figure 2 shows the types of disasters included in the 2022 assessment including disasters associated with earth systems, geology and extreme weather risks such as tsunami, bushfire, smoke and heatwave, complex severe storms, coastal storm surge with consequent flooding and landslide. Events such as storms may also produce cascading hazards, for example, dam failure and oil spills. The assessment also included disasters associated with biological

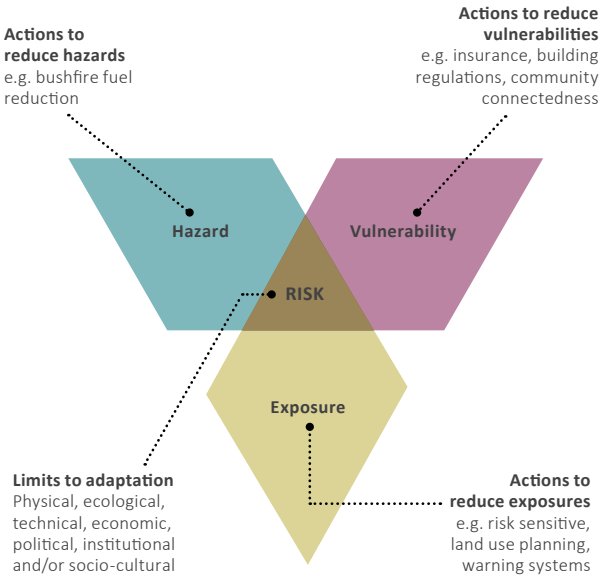

Figure 1: Risk as the intersection of hazard, exposure and vulnerability.

Source: Adapted from www.undrr.org/publication/ecosystem-based-disaster-risk-reduction-implementing-nature-based-solutions-0 p 16.

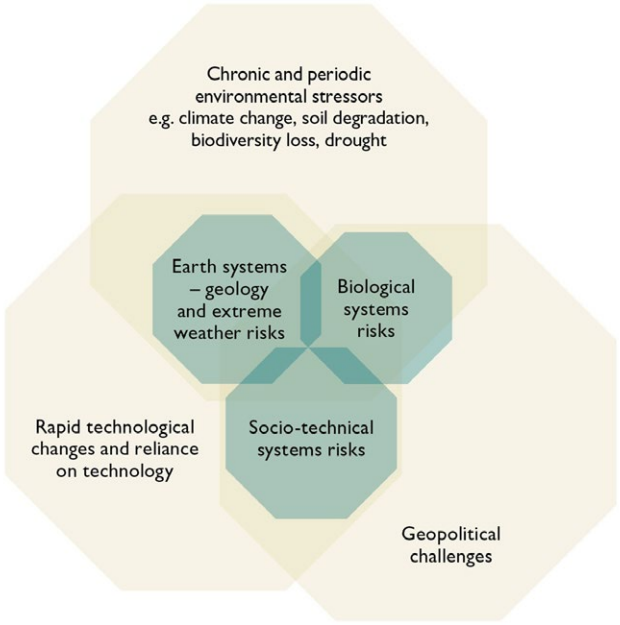

Figure 2: Risks examined in the Tasmanian Disaster Risk Assessment.

systems involving pathogens related to pandemics/epidemics and biosecurity threats, some of which may be caused or exacerbated by other factors.

The assessment also included major accidents or outages or technical systems that underpin modern society such as transport (maritime and road), internet and communications technology (cyber-security) and building safety (structural collapse).

TASDRA is broadly in line with the National Emergency Risk Assessment Guidelines (NERAG) (AIDR 2020). However, NERAG is not specifically designed for society-wide assessments such as TASDRA. Being hazard focused, NERAG does not explicitly address the systemic nature of risk, nor fully explore vulnerabilities. Some aspects raised in the assessment fitted well within existing NERAG categories but others did not, for example, animal welfare does not fit neatly into the existing categories. The NERAG includes the principle that the guidelines should be 'customised' such that the 'framework and process are appropriate to the societal needs, the context and risk profile' (AIDR 2020), so this principle was adopted.

The 5 NERAG categories of consequence helped to structure the assessment and combine the input from stakeholders. However, a few of the labels were adjusted and, in some cases, added to those consequences. Table 1 lists the categories used in what we have called 'NERAG+'. The 2 explicit changes in NERAG+ were the use of 'community and culture' instead of 'social setting' and the term 'core functions' in lieu of 'public administration'. The term 'core functions' was considered inclusive of the essential functions, critical infrastructure and services communities rely on. Some of these are private sector entities. NERAG+ includes 'lifeline' utilities, for example, power, water, telecommunications, transport and supply chains, hospitals and primary healthcare facilities, emergency services, core government services, childcare and educational institutions.

The approach to assessing risk

The TASDRA project involved and collated information from many areas of expertise and perspective. The project centred around a series of scenario workshops to explore risks and measures to reduce those risks. TASDRA is predominantly a qualitative assessment but drew on mapping and other quantitative data where possible.

The scenarios were 'credible but critical' descriptions of specific events at a particular time and location (Norwegian Directorate for Civil Protection 2019). To develop the scenarios, we drew on subject-matter expertise from the relevant hazard management authority or agency (e.g. Bureau of Meteorology, Mineral Resources Tasmania) as well as expertise from the University of Tasmania. The scenarios were 'critical but credible'. Historic events were referenced and made slightly more intense.

Each scenario provided a story to explore the associated exposures and vulnerabilities and consider how to mitigate the event happening and its consequences. The scenarios started with one or more interlinked hazards. The scenario 'stress tested' current arrangements to identify ways to reduce risks and to improve preparedness. While none of the scenarios are likely to happen exactly as described, they provide good examples of probable events.

The scenario assessment workshops involved 25–65 subject-matter experts and stakeholders from:

- relevant Tasmanian Government agencies
- local government
- Australian Government agencies such as the Bureau of Meteorology
- critical Infrastructure and service providers
- private sector and industry groups
- not-for-profit organisations.

Each workshop commenced with a scenario overview followed by work by participants in small groups to map out consequences from their many perspectives. Initially, participants focused on the

Table 1: Categories used in TASDRA based and adapted from NERAG.

Categories	Consequences
People's health, safety and wellbeing	Deaths, injuries or illnesses. People missing, Indirect/long term health/wellbeing consequences.
Community and culture changed from 'social setting'	Community displacement or isolation loss of connectedness; Loss of culturally significant objects, or the interruption of cultural events as a direct consequence of the hazard. Increased stresses in everyday life. Disruption of education and other activities.
Economic	Economic activity and/or asset monetary value loss/economic impact on important industries Indirect economic consequences, for example, due to reputational damage, loss of intellectual assets.
Environment	Loss of ecosystems or species, loss of environmental values of interest. Indirect consequences, for example, soil erosion due to vegetation loss.
Core functions changed from 'public administration'	Decreased capacity of governing bodies and utilities to deliver core functions.

Table 2: Workshops conducted based on hazard-based scenarios.

Scenario	Hazards included
Earth systems - geology and extreme weather	
East Coast Tsunami	Tsunami
'Black January'	Bushfire, heatwave, extended bushfire smoke exposure, with one workshop focusing on bushfire, the other on heatwave and smoke exposure using the same scenario
East Coast Low	Severe storm, flash flooding, riverine flooding, debris flow, landslide, dam failure, coastal storm surge/inundation, rockfall
Biological systems	
Respiratory pandemic Pandemic influenza Novel coronavirus	Pandemic extended from influenza to respiratory generally
Biosecurity incursions	
Foot and mouth disease Avian influenza Mediterranean fruit fly Shellfish biotoxin Didemnum vexillum ('sea vomit')	A range of biosecurity threats covering animal disease, pest incursions in land and marine environments effecting industry and natural values
Socio-technical systems	
Major maritime incident in a port	Transport accident - maritime
Major traffic incident	Mass casualty traffic event, hazardous materials
Building collapse	Structural failure
Statewide cyber outage	Focusing on disruption events

event impacts for specific locations, sectors of the community, types of individuals or specific types of threats (pandemic and biosecurity). Participants mapped the impacts for a scenario using different colours related to each of the 5 NERAG+ consequence categories. These discussions became the basis of a narrative describing the consequences in the TASDRA reports. This narrative replaces the NERAG's formal risk statements often used in risk assessment. We particularly wanted to explore how risks and consequences linked together, like ripples in a pond, to cause cascading and compounding consequences, including further risks. The narrative approach helped to explore the inter-connected nature of disaster risk. Ripple-effect mapping is an established methodology used in community development and evaluation (see Washburn *et al.* 2020).

Workshop participants discussed what success and failure might look like, reviewed controls already in place and identified potential new measures to reduce risk. Notes from the workshop formed the basis for the core of the TASDRA report that was refined, reviewed through further consultation with others (expert reference group and subject-matter experts). Where possible, research or other evidence to support claims made in workshops was included. Project participants could review the workshop notes and writeups and contribute further to the draft assessments before the full report was finalised.

Developing a 3-dimensional view of risk

By exploring the interconnectedness of cascading and compounding events, their consequences, exposures and related vulnerabilities and capabilities, this assessment developed a 3-dimensional view of risk. This picture helps to understand the risks that can occur in the systems that support, sustain and help communities identify ways to reduce their risks. Table 3 summarises the ways in which the three-dimensional view of risk was developed, connecting the hazard to its consequences and exposures and identifying vulnerabilities including systemic barriers, capabilities and enablers.

Insights

The following insights and practical implications have come from the project and when completing the assessment.

Challenges with NERAG

The main issue with NERAG is that it is hazard-centric. Extracting the hazard assessments in line with NERAG was challenging. For example, the east coast low scenario included 6 cascading hazards. However, often hazards lead to cascading and compounding secondary hazards and consequence. The scenarios discussed in the workshops reflected this. For example, the bushfire scenario explored consequences associated with heatwave and smoke. Participants assessed that an increased number of deaths and injuries would be due to heatwave and smoke hazards rather than the bushfire.

Assessing likelihood and consequences

We assessed likelihood and consequences of both the scenario in its entirety and the specific hazards it covered. For example, the 'Black January' scenario assessment included likelihood and consequence assessments for a significant bushfire event during a heatwave, plus the individual hazards that may occur without the bushfire event, for example, a heatwave without a bushfire. Including smoke as a separate hazard acknowledges bushfire smoke can cause significant risks well away from the fire front that can often be overlooked.

Assessing the scenario and the hazards it included in line with NERAG was an uneasy fit. This is because NERAG does not adequately assess varying levels of exposure and vulnerability. Focusing on hazards and their consequences (or exposures) only provides a 2-dimensional view of risk which is thus more limited. This is an area for future consideration. A 3-dimensional view of risk – that is, one that better considers how systemic vulnerabilities can increase exposures to many hazards. If we can reduce these systemic vulnerabilities then we can reduce risk across many hazards, including those not yet envisaged.

Table 3: Developing a 3-dimensional view of risk.

1. Hazards	2. Consequences and exposures (structured by values)	3. Vulnerabilities (systemic barriers) capabilities and enablers
Explored through scenarios of: · tsunami · bushfire/heatwave/smoke exposure · storm, coastal storm surge, flood, landslide/rockfall, dam failure, oil spill · pandemic · biosecurity · transport/HAZMAT · structural collapse · cyber-threats.	people's health, safety and wellbeing · economic · environment · core functions · community and culture	· placement of communities, infrastructure and assets · access and supply of essential information, goods and services · risk ownership and transfer · working together · community and individual vulnerability and capacities.
Based on evidence/scientific data driven where possible, observations, historical records.	Based on structured categorisation, expert judgement, insights through workshops.	Based on observations, qualitative analysis and systems thinking building on 1 and 2.

As an example, systemic vulnerabilities include land-use planning, more clarity around risk ownership and transfer, governance and community awareness of risk and engagement. This means the TASDRA assessment is in line with emerging international approaches to assessing risk, such as the Global Risk Assessment Framework (UNDRR 2020). Considering systemic vulnerabilities helps to explore complex 'wicked' issues that cause problems in similar ways across hazards and supports a cross-hazard approach to reducing risk and disaster resilience. A 2-dimensional approach reinforces a hazard-by-hazard approach to reducing risk by focusing on hazards and exposures to those hazards, so preventing a cross-hazard approach that disaster resilience requires.

In this respect the paper advances previous understanding by drawing out the 3-dimensional view of risk including hazard, exposure and vulnerability.

Effective stakeholder engagement

No one sector has all the answers to reducing risk and responsibility often lies between organisations and individuals. This meant any assessment needs to have wide stakeholder involvement. Risk assessment workshops were designed to be interesting and encouraged participation. In line with the Tasmanian Disaster Resilience Strategy 2020–2025, understanding and reducing disaster risk is everybody's business and needs to be incorporated into all levels of government, business, and not-for-profit sectors as well as community groups (Tasmanian Government 2019). So to understand, identify and mitigate risk, the process needs to be engaging to be effective. Encouraging workshop participants to be active in the structured groupwork using credible but critical scenarios was a key method to gather rich insights and perspectives.

Participants working in small diverse (i.e. different stakeholder) groups enriched the process and, in some cases, potential issues were resolved at the workshops due to this collaboration.

Being proactive

Proactively managing risk is not only about managing an emergency event and being prepared. In line with the *Sendai Framework for Disaster Risk Reduction 2015-2030* (UNDRR 2015), the scenarios used in the workshops helped participants to imagine potential mitigation measures to avoid hazard events occurring or, at least, reduce the consequences.

Identifying measures to reduce risks across hazards

The scenarios were based on hazards as a starting point. Importantly, mapping out how risks and consequences cascade and compound helped identify systemic vulnerabilities. The interlinked series of scenarios that had a wide range of hazards helped to identify ways to reduce risk relevant to many types of hazards. Many of the issues raised during the workshops were common across the hazards and exposures. These were issues such as land-use planning, supply chain security and cross-agency and sector governance and collaboration. More complex issues were considered and some hard questions were raised. We referred to the Profiling Australia's Vulnerability: the interconnected causes and cascading effects of systemic disaster risk (Department of Home Affairs 2018) to consider vulnerabilities as well as other work to help structure this part of the assessment focusing on systemic vulnerabilities.

Practical implications

TASDRA can inform and enable DRR directly and indirectly, particularly in areas that span multiple hazards. Thinking through a range of scenarios helps to identify vulnerabilities that can help with unanticipated other risks. One of the purposes of TASDRA was to help imagine what disaster scenarios could look like without needing lived experience.

At the state level, TASDRA created a register of proposed measures that can reduce risk, replacing the more formal risk treatment plan that NERAG advocates. This recognises that decision-making about investing in risk reduction generally involves different stakeholders and processes than formal assessments for state-level assessments. The register tracks how measures to reduce risk are being pursued through a range of initiatives, for example, through the implementation of recommendations from the Royal Commission into National Natural Disaster Arrangements (Australian Government 2021) or through existing or new state government programs. For example, Tasmania's SES Storm and Flood Ready program implements state and national recommendations relating to community resilience. TASDRA also supports planned risk assessments on climate change and other risks that may affect Tasmania.

Local government risk assessors can use the TASDRA to review how consequences might apply in their communities. SES Tasmania has a planned project to support councils assess their risks and leverage off the TASDRA assessment, in line with evolving national guidelines. NERAG is currently being reviewed nationally.

A growing collection of documented and shared scenarios from disasters and their consequences can inform risk assessments across jurisdictions as some scenarios are applicable to other parts of Australia. For example, an east coast tsunami would likely impact on coastal Victoria and NSW in similar ways to Tasmania. Effective risk assessment leverages off previous assessments and relies on sharing information.

TASDRA is a resource for service providers to help them consider how they would support their clients to be resilient in the context of other support provided to their clients. This project did not include public information guidance but can assist to develop such material. Guidance should prioritise the needs of community sectors, rather than the 'push' drivers of initiatives such as TASDRA. That is, guidance should be client-community centric and developed in a cohesive manner rather than be the final stage of multiple assessments or other projects.

Existing guidance relates more to the specific hazard and often duplicates information. Emergency management has, traditionally, been planned around hazards and has resulted in duplication and disconnection of issues that are similar across hazards. Information for communities at risk from multiple hazards can lack coherence. TASDRA supports the development of cross-hazard guidance and communications products that explain issues that span hazards. The combined TASDRA scenarios support a

cross-hazard approach, practical cross-sector engagement and integrated DRR that can better use resources.

Conclusion

Reducing hazards and exposures is important, however, they are only a first step. There are vulnerabilities that drive risk in Tasmania across all or most disaster scenarios, including those not examined through TASDRA 2022. If these individual and systemic vulnerabilities can be reduced, Tasmania will be better placed to deal with and recover from a disaster event. The 5 areas of systemic vulnerability include:

- continuity of supply and access to information and services
- placement and quality of buildings and other assets
- risk ownership and transfer
- governance and collaboration
- individual and community capability.

These themes build the work by the Australian Government and recognises that many of the issues facing Tasmania are similar to other Australian states and territories. Addressing vulnerabilities can significantly reduce disaster risks, however, they are often 'wicked' problems that are complex and difficult to address and generally involve cross-agency and cross-sector collaborative efforts. Addressing these issues involves iterative, adaptive and collaborative learning. It involves multiple streams of decisions and actions coming together and related areas of policy and effort focused on climate change, sustainable development and economic growth as well as community health and wellbeing.

TASDRA 2022 contributes to these streams of decisions by providing a rich and cohesive picture of disaster risk. The use of scenarios and the exploring of associated exposures and consequences uncovers potential measures that build on existing risk controls and measures. By reducing the risks and planning for these events, all parties can reduce risks and take actions to be prepared for disaster events that are yet to be envisioned.

The final TASDRA report contains details that are relevant to groups of users, so it is important to view its content in context. A common, and one of the greatest risks, is to not acknowledge or to oversimplify complexity. Oversimplified assessments usually produce simplistic solutions. Disaster risk is complex and so is its reduction. It involves many parties working cohesively, recognising that reducing risks is an iterative learning process, gradually chipping away at 'wicked' problems that create or sustain disaster risks.

The TASDRA 2022 report is available at www.ses.tas.gov.au/about/risk-management/tasdra-2022/.

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Abstract

The accepted detrimental effects of climate change and the anticipated increased frequency of cascading disasters means there is a pressing requirement to equip search and rescue teams with the capability to perform effective and complex risk assessments. This paper investigates risk-based decision-making expertise in the aftermath of the 2011 earthquake and tsunami in Japan. It compares the actual decisions made by an Urban Search and Rescue (USAR) commander, with the decisions that a cohort of people working within search and rescue made, when provided with the same decision context using 3 vignettes. Variations in the results are explored in terms of the complexity of the risk decision and the type of expertise required. The findings indicate that as the risk becomes more complex, the percentage of answers that were the same as the USAR commander (that we deem as 'correct' as they did not result in any adverse outcomes for the USAR team) decreased. Training entities need to provide decision-makers with the necessary human capabilities so they can perform the complex risk assessments required to make decisions in low-probability yet high-consequence disasters.

USAR decision-making: the role of hazard-specific expertise and risk assessment

Peer reviewed

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Introduction

The aftermath of a large-scale earthquake requires the deployment of Urban Search and Rescue (USAR) teams. These teams have to perform risk assessments to inform decision-making. These assessments are invariably based on the experience and expertise of individuals. This paper examines how USAR professionals use their expertise to perform risk-based decision-making using a series of vignettes. The vignettes are brief descriptions based on the actual decisions made by an Australian USAR commander deployed to Japan in the aftermath of the earthquake, tsunami and resultant Fukushima Daiichi nuclear disaster in 2011. Previous research identified that expertise in radiation protection and nuclear safety was used by the Australian USAR commander when making numerous decisions in what was an uncommonly complex and dynamic disaster environment (Curnin *et al.* 2020).

Due to the high-risk environments that USAR teams operate in, the management of risks is an essential skill. Risk assessments have to be properly interpreted and the key aspects of risk, uncertainty and knowledge, encompassed in the decision-making process (Aven 2016). However, conventional models of decision-making that argue for time-consuming and analytical processes can be unsuitable due to the time-sensitive nature of the decisions that must be made (Klein, Calderwood & Clinton-Cirocco 1988). Uncertainty of the situation, a lack of specific knowledge about the risk and temporal constraints, which are often encountered in high-consequence yet low-probability decision-making environments, can occur when an expert encounters a situation outside of their pattern repertoire. This can lead to delayed or deferred decisions (Curnin *et al.* 2020). In this context, judgements and decisions must be made rapidly, leaving little or no time for reflection (Hurteau *et al.* 2020) and can often depend on an individual's levels of expertise.

Prior experience and deliberate practice can play a critical role in risk assessment and decision-making in uncertain and dynamic environments, such as those created by disasters where experts are often called on to provide their knowledge to assess risk (Ahluwalia *et al.* 2021). In time-pressured

Due to the high-risk environments that USAR teams operate in, the management of risks is an essential skill.

Image: Assistant Commissioner Robert McNeil (retired)

situations, experts can use their accumulated knowledge and develop mental models to assist in making faster and accurate risk assessments. However, research has identified that when experts are presented with a domain-specific task outside of their previous experience, their performance is similar to that of a novice (Mumford *et al.* 2010). This phenomenon is known as domain-specificity and provides a useful tool for researchers to identify the differences in performance between novices and experts, as both can be presented with domain-specific tasks (Ericsson & Lehmann 1996) and differentiated based on their results in these tasks (Ericsson, Hoffman & Kozbelt 2018). Experience therefore plays an integral role in achieving expertise in a specific activity and the evaluation of individuals based on domain-specific tasks is an appropriate method to distinguish levels of expertise. This study explored this issue in the context of USAR decision-making.

Methods

The Critical Decision Method was used to elicit aspects of the Australian USAR commander's expertise following the 2011 Fukushima Daiichi nuclear disaster. This approach allowed for the use of a series of cognitive probes so the commander was able to reflect on his own strategies and the basis for their decision (Curnin *et al.* 2020). The commander was interviewed 2 times after the initial Critical Decision Method to clarify his decision-making rationales. All 4 of his team members were also interviewed between the second and third interviews to gather information, build a deeper understanding of the decisions and verify that the decision itself was considered 'correct' at the time. Ethics approval was received from the University of Tasmania Human Research Ethics Committee [Approval Code: H0008810].

Survey

A decision-making survey was created that drew on 3 of the decisions that the Australian USAR commander made during the deployment. The survey was designed to measure the effect of experience on decision-making ability. The 3 decisions made by the Australian USAR commander were translated into vignettes to provide context for those taking part in the survey. The 3 decisions were summarised as:

- the dust mask challenge
- the concrete bunker relocation
- the exit strategy.

These decisions were chosen due to the varying complexity required to manage the associated risks. The survey was tested with non-practitioners prior to being used in this study and took 15 minutes to complete. Participants began the survey by self-selecting the appropriate amount of experience they had in each of the 4 demographic categories of:

- number of years working in search and rescue
- current role in search and rescue
- number of operational SAR deployments completed (not exercises)
- number of SAR exercises or incidents experienced that involved a nuclear radiation scenario.

After completing the demographic information, participants were instructed how to answer each scenario. The survey consisted of 3 items. Each item started with a description of the scenario followed by 2 or 3 options. The participant's responses were assessed as 'correct' if they were the same as the actual decision made by the Australian USAR commander in the Fukushima deployment and 'incorrect' if they selected any of the alternate options.

Participants

There were 56 participants who attended the Australian Conference on Disaster Management, which had a stream that focused on SAR. The participants were divided into 2 groups based on their levels of experience in each of the 4 demographic categories (see Table 1). There were no exclusion or inclusion criteria other than participants being fluent in English.

Table 1: Demographic information of the survey participants

Demographic	Group
Number of years working in SAR (experience in years)	Group 1: 0–10 years (*N* = 28)
	Group 2: 11+ years (*N* = 27)
Current role in SAR	Group 1: Research and support / administration (*N* = 17)
	Group 2: Operational team member and commander (*N* = 37)
Number of completed operational SAR deployments (not exercises)	Group 1: 0–4 deployments (*N* = 23)
	Group 2: 5+ deployments (*N* = 32)
Number of SAR exercises or incidents experienced that involved a nuclear radiation scenario	Group 1: 0–4 (*N* = 5)
	Group 2: 5+ (*N* = 1)

Data analysis

The raw counts for each group were tabulated and converted to percentages of correct and incorrect answers for each of the 3 scenarios. Additionally, Group 2 in the 'Number of SAR exercises or incidents experienced that involved a nuclear radiations' scenario category was removed due to a lack of respondents ($N = 1$) in comparison to Group 1. However, data was useful to establish that there was not a bias of expertise with respect to the sample.

A chi-squared test of independence was conducted to examine the relationship between experience and the ability to correctly respond to the scenarios provided in the survey. The raw numbers of correct and incorrect responses were tallied for Group 1 (Low Experience) and Group 2 (High Experience) for 3 of the 4 demographic categories of (1) Years of experience in SAR, (2) Role in SAR an (3) Number of deployments. The 'Number of SAR exercises or incidents experienced that involved a nuclear radiations' scenario was again excluded due to the disparity between the number of respondents in the 2 categories of experience. Finally, all of the data was combined regardless of the level of expertise and a chi-squared test was conducted to determine if the proportion of correct to incorrect results was significantly different across the scenarios irrespective of 'expertise' as characterised by the demographic variables.

Results

Tables 2 and 3 summarise the results. Table 2 presents the raw numbers and percentage of correct and incorrect answers by demographic variables. Table 3 identifies the results of the chi-squared tests of independence between groups 1 and 2 for the 3 scenarios.

The results demonstrate no significant difference in the proportion of correct to incorrect answers across the variables. When all the data are viewed as one dataset, there is a significant result. A chi-square test of independence was performed to examine the relationship between the scenario and the correctness of the decisions made by participants. The result was significant, χ^2 (2, N = 164) = 26.8, $p < 0.00001$ and the ratio of correct to incorrect decisions for the scenarios are significantly different to each other.

Table 2: Raw numbers and percentage of correct and incorrect answers by demographic variables.

Variables	Groups	Scenario 1		Scenario 2		Scenario 3	
		Count (% Correct)	Count (% Incorrect)	Count (% Correct)	Count (% Incorrect)	Count (% Correct)	Count (% Incorrect)
Number of years working in SAR (experience in years)	Group 1: 0–10 years N = 28	24 (86)	4 (14)	20 (71)	8(29)	10 (36)	18 (64)
	Group 2: 11+ years N = 27	24 (89)	3 (10)	16 (59)	11 (41)	12 (44)	15 (56)
Current role in search and rescue	Group 1: Research and support/admin N = 17	15 (88)	2 (12)	10 (59)	7 (41)	9 (53)	8 (47)
	Group 2: Operational team member and commander N = 37	32 (87)	5 (14)	25 (68)	12 (32)	13 (35)	24 (65)
Number of completed operational search and rescue deployments (not exercises)	Group 1: 0–4 deployments N = 23	20 (87)	3 (13)	16 (70)	7 (30)	10 (44)	13 (57)
	Group 2: 5+ deployments N = 32	28 (88)	4 (13)	20 (63)	12 (38)	12 (38)	20 (63)
Groups combined		48 (87)	7 (13)	36 (66)	19 (35)	22 (40)	33 (60)

Table 3: Chi-square results for scenarios by demographic variables.

Variables	Scenario 1		Scenario 2		Scenario 3	
	p	χ^2	p	χ^2	p	χ^2
Number of years working in Search and rescue (experience in years)	0.723	0.124	0.342	0.900	0.508	0.436
Current role in search and rescue	0.850	0.031	0.532	0.390	0.216	1.529
Number of completed operational SAR deployments (not exercises)	0.952	0.003	0.586	0.295	0.655	0.199

Discussion

At face value, the results appear counter-intuitive. Differentiation of participants based on measures of SAR experience or expertise yielded no significant difference in correctness of outcome. Further analysis demonstrated a significant difference in correct answers based on the scenarios. This led to an examination of how the scenarios varied and to look for a rationale regarding answers that were incorrect or inconsistent with the decisions made by the USAR commander.

Simple risk assessment and control

Scenario 1 was the dust mask challenge and it had the highest percentage of correct answers. The participants were presented with the following scenario:

> *The USAR team has to drive through the Fukushima exclusion zone and the plume modelling has identified that there was caesium in the plume (caesium is a metal that may be stable/nonradioactive or unstable/radioactive). You have previously been assured by experts that the dust masks the team were issued with prior to deployment would capture and prevent larger particles from penetrating through the membrane. The team's equipment was also informing you that the radiation levels were just above normal.*

Scenario 1 possible answers:

- A - Immediately instruct the team to don their dust masks.
- B - Given that levels are almost normal and the associated down-side risk of creating concern in your team you do not instruct the team to don their masks.

The option chosen by the commander was to immediately instruct the team to don their dust masks (Option A).

Alternative option B was designed as a plausible outcome for a novice decision-maker. This option did not account for the fact that personnel within a USAR team are familiar with the use of personal protective equipment and unlikely to be overly concerned by an increase in risk while operating within this environment. The simple explanation of the correct decision from a risk-based perspective is that the commander identified an increase in risk and added a control they believed would mitigate this increase. The control was easily applied and reasonable in the circumstances. This answer was the most logical to choose and the easiest to comprehend.

Integrating intuition and risk management

Scenario 2 was the concrete bunker relocation. The participants had to respond to conflicting assessments of risk. The participants were presented with the following scenario:

> *Late one evening you are informed by a nuclear radiation detection expert in Australia that you need to find a concrete bunker and relocate the team to the new location. You are not aware of any changes in the last 12 hours due to sudden weather variations or other factors that would necessitate increased caution. You do not have the level of expertise as the nuclear radiation detection expert that has made this request, however, your intuition suggests that this is not correct.*

Scenario 2 possible answers:

- A - Direct the team to move to the concrete bunker as it immediately manages the radiological risk.
- B - Trust your understanding of the current situation, your judgement that the information you received is incorrect and do not immediately locate the team to a concrete bunker.
- C - Make no decision – seek a second opinion on the radiological hazard.

The option chosen by the USAR commander was to make no decision and seek a second opinion on the radiological hazard (Option C). In their decision, the commander sought to manage the conflict between their intuition and an expert opinion by seeking an alternative opinion and evaluating all sources of risk-based information. They determined that their intuition was correct through further analysis of the risk, concluding that the control option advised by the first expert was not justified. We can align this result with research in the health sector where intuition is an essential tool for people working in critical-care areas. Practitioners in these areas draw on their analytical skills and intuition when assessing risks and making decisions that require a high level of precision (Cork 2014).

The alternative options were specifically designed to appear plausible to a moderately experienced USAR decision-maker. Option A required the decision-maker to ignore, or at least downplay, their intuition. Option B required participants to trust their intuition and not seek further sources of information. It was expected that a more experienced practitioner would recognise their intuition had value but that it should not be the sole basis for a decision. We anticipated they would be aware of the logistical challenge of finding a concrete bunker in the devastation of the tsunami, earthquake and radiological event. It would have meant placing the objectives of the team on hold. There also would have been consequences for other international teams in the vicinity.

While research increasingly demonstrates the value of intuition (Cork 2014), it is more powerful and valid when sense-checked with rational analysis. In this study, the error in decision-making for the 2 'wrong' answers can be attributed to either authority bias (from the first expert) or a failure of meta-cognition (thinking about one's thinking) when trusting intuition without further analysis.

Pair-wise comparison of multiple risks and control options to determine the best solution

Scenario 3 was the exit strategy and was the most complex of the scenarios. This scenario elicited the least correct responses from the participants. The participants were presented with the following scenario:

Fukushima was the first event where internationally deployed teams had to manage risks of aftershocks as well as, equipment to manage hypothermia.

Image: Assistant Commissioner Robert McNeil (retired)

You have to arrange for the team to travel to the final destination airport where the team will fly back to Australia. Which option do you choose?

Scenario 3 possible answers:

- A - Take the team to a nearby airport so that you can be flown by military aircraft to the final destination airport where the team will fly back to Australia. This means the team will not have to travel back through the exclusion zone of the Fukushima reactor again. However, it is possible that the team will face significant delays at the nearby airport as the military operating the aircraft are committed to providing mercy flights to the Japanese community. This would expose the team to staying in a location that is at increased risk of further earthquakes where the team would again have to stay in tents in subzero temperatures, however, radiological risks would be avoided.
- B - Take the team by bus and drive to the final destination airport where the team will fly back to Australia. This means the team will need to travel through the exclusion zone of the Fukushima reactor gain. The drive to the final destination airport would be long but the team would be warm in the bus. Delays at the nearby airport would be avoided. During recent travel near the Fukushima reactor site the team monitored only slight readings for radioactive exposure.

The USAR commander chose option B. During the interviews, the commander reflected that they drew on their previous experience to perform this risk assessment. They clarified a situation that the military responders could not provide a time when they would be transported and, with their expertise over the previous 10 days, they knew that the team could be at risk of earthquakes and hypothermia if they followed that decision. The commander considered option A, which was to travel by bus through the exclusion zone, and weighed up the risks. Based on their previous experience and knowledge, they determined that the risk was low. The commander rejected option A of staying at the airport after exploring other options. This demonstrated an alignment to the Recognition-Primed Decision model.

Option A was designed as a plausible decision for an experienced decision-maker without radiological hazard-specific expertise. We expected that the selection of this alternative could be triggered by the avoidance of the radiological hazard. We considered that people triggered by the radiological hazard and choosing this option would discount the risks associated with the cold temperatures and earthquake aftershocks.

Although USAR teams have been deployed internationally and have had to manage the risks of aftershocks and are deployed with the appropriate equipment to manage hypothermia, Fukushima was the first event where teams had to manage these risks in tandem with radiation risk. The fact that many of the participants did not possess domain-specific expertise in radiation hazards could infer that the protection of risk from radiation was uncontrollable as it was an unknown. Perko (2014) suggests that those who lack expertise in radiation risks are more likely to have higher risk perception for radiological risks, such as nuclear waste. In contrast, those who have expertise

and experience in radiation risks are more likely to have a lower risk perception of radiological risks (Perko 2014). Scenarios such as Fukushima pose challenges for current risk models used in emergency management, such as the Dynamic Risk Assessment Model, as, in complex disasters, several risks are often controlled simultaneously. In these situations, and in the scenarios provided in the survey, a person's cognitive biases may alter the perception they have of the risks inherent to a particular decision (Adam & Dempsey 2020).

The future of risk assessments

As the risk becomes more complex, people performing the risk assessments require a combination of higher-order reasoning skills, such as inductive and deductive reasoning. However, due to the rarity of deployments such as occurred in Fukushima, USAR teams must rely on exercising that simulates extreme yet plausible scenarios to practice and enhance their risk-based decision-making. Those responsible for preparing USAR teams need to conduct training exercises that provide the necessary human capabilities to perform the risk assessments required to make decisions in these rare circumstances.

Conclusion

Low-probability yet high-consequence disasters require USAR teams, and particularly their leaders, to conduct risk-based decision-making. This paper proposed that, in risk-based decision-making, as the risk increases in complexity the critical thinking skills of the people performing the risk assessment need to improve so they can determine the level of risk and link it to their proposed actions. This requires decision-makers to have skills such as the ability to combine intuition with rational analysis, to manage cognitive biases and to use metacognitive skills when performing risk assessments. Further research may establish other aspects of critical thinking that are relevant to complex risk assessment. Practically, due to the rarity of deployments to disasters such as Fukushima, those responsible for preparing USAR teams must provide personnel with the necessary and realistic training environment so they can experience risk-based decision-making for potential complex disasters. Collecting detailed accounts of decision-making after an event and translating them into learning materials for exercising is a viable option.

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Abstract

The COVID-19 pandemic brought attention to scarce clinical resource allocation via secondary population-based triage (S-PBT) throughout the international healthcare community. Experiences overseas highlighted the importance of coordinated and consistent approaches to allocating resources when facing overwhelming demand, particularly for critical care. Noting the importance of consistency and the system of devolved governance deployed in Australia, this study aimed to identify and analyse sources of high-level policy that affect Australia's health system preparedness for the operationalisation of S-PBT. Of the 39 documents reviewed, 17 contained potential references to S-PBT. There was a lack of clear recommendations and guidance to inform S-PBT operationalisation and, where provided, advice conflicted between documents. Many jurisdictions did not detail how S-PBT would be operationalised and failed to delineate stakeholder responsibilities. These results are important as they reveal a lack of high-level jurisdictional policy preparedness for coordinated and consistent S-PBT operationalisation. These results offer insights and opportunities for enhanced disaster preparedness as clinicians, policymakers and academics critically reflect on pandemic responses. The results show a need for enhanced preparedness around the management of overwhelming demand and clinical resource management in Australia.

Australian high-level public policy preparedness for population-based triage during the pandemic

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Introduction

For many countries, the COVID-19 pandemic generated significant surges in demand for in-patient and critical care and health systems faced collapse. Traditionally, health resources are allocated to patients in an order determined by clinical acuity. However, pandemics create such significant demand that traditional triage models cannot drive scarce resource allocation decisions, especially if resource allocation will result in patients being denied care on the basis of availability (Burkle 2002, 2006).

In such circumstances, population-based triage (PBT) becomes necessary. There are 2 tiers of PBT in pandemic settings or bioagent events: primary population-based triage (P-PBT) and secondary population-based triage (S-PBT) (Burkle 2002, 2006). P-PBT sorts the population according to infection status to prevent further transmission or contamination and S-PBT sorts the population according to the clinical condition of individuals, their context within the population and health resource availability (Burkle 2002, 2006; Bielajs *et al.* 2008; Burkle & Burkle 2005). S-PBT thereby overcomes the limitations of traditional triage as it prioritises the patients most likely to benefit from available resources and may guide withdrawing resources after a 'trial-of-therapy' has failed (Burkle 2006; Bielajs *et al.* 2008; Burkle & Burkle 2005; Christian *et al.* 2006a; Christian *et al.* 2006b; Powel, Christ & Birkhead 2008).

S-PBT has not been implemented and recorded on a scale earning significant global attention prior to the COVID-19 pandemic, but the construct of PBT itself is not new. Early work identifying and exploring the construct emerged 2 decades prior to the COVID-19 pandemic (Burkle 2002, 2006), yet no proposed S-PBT protocol has been adequately validated or demonstrated to improve health resource allocation and overall mortality (Christian *et al.* 2009, Christian *et al.* 2011, Kanter 2015, Guest *et al.* 2009, Cheung *et al.* 2012). This carries significant weight due to the ethical, emotional, clinical and professional implications associated

with S-PBT decisions. Regardless, the pandemic drove S-PBT into operationalisation for the first time on a large-scale and with significant visibility; a reality first experienced in the pandemic by the Italian health system (Faggioni, Gonzalez-Melado & De Pietro 2021).

Australia recorded 28,631 confirmed COVID-19 cases in 2020. Of this, 72% occurred in Victoria, demonstrating that Australia evaded case numbers seen elsewhere during the early pandemic (National Notifiable Diseases Surveillance System 2021, State of Victoria Department of Health and Human Services 2021). In the same period, there were 20 million cases in the United States of America, 10 million cases in India, 7 million cases in Brazil, nearly 3 million cases in the United Kingdom and 2 million cases in Italy (World Health Organization 2022). Although S-PBT did not become necessary during Australia's early experiences of the pandemic, it is critical to consider Australia's policy preparedness as the threat from COVID-19 and other emerging infectious diseases remains.

High-level and even seemingly non-clinical policy is relevant in applications of S-PBT due to the structure of disaster and healthcare governance in Australia. Hospitals are not independent enterprises and do not operate with complete autonomy as in other countries or health systems. The Australian Government and respective state and territory governments share ultimate responsibility and provide the overall framework for healthcare delivery within respective jurisdictions (Australian Institute of Health and Welfare 2018). Between individual hospitals and services, variations in care and service delivery are accepted if they comply with regulations and standards determined by local health networks as well as government (Australian Institute of Health and Welfare 2018). Although resource allocation at the level of individual patients is often considered a clinical decision made by clinicians, the health system structure in Australia means processes such as S-PBT are heavily influenced by policy arising from government.

A previous review of pandemic plans available in Australia in 2009 identified significant variability across jurisdictions that could undermine effective pandemic responses (Itzwerth, Moa & MacIntyre 2018). The review identified that existing policies showed significant variations and gaps that were considered detrimental in pandemic responses. Since that review, many documents have been updated and, critically, this previous study did not consider S-PBT preparedness. Australia's current policy preparedness for S-PBT during pandemics has therefore not been critically reviewed in the literature. The objective of this research is to identify and examine government and medical professional body sources of policy that would inform S-PBT operationalisation within Australia's health systems, reflecting the overall approach to health system governance and disaster preparedness.

Methods

Qualitative document analysis was conducted according to the 5 stages described by Altheide and Schneider (2013): define relevant documents, develop data collection protocol, code and organise data, analyse data and report findings.

Relevant documents were those published by the Australian Government or relevant professional body informing healthcare provision during pandemics. An initial review identified pandemic influenza, disaster and COVID-19 plans as primary sources of relevant policy. Key terms included 'pandemic', 'pandemic plan', 'influenza plan' and 'COVID-19 response'. These were used to search the website of each government body (Australian Government and each state and territory government), respective departments of health and professional medical bodies (College of Intensive Care Medicine, Australian and New Zealand Intensive Care Society, Australasian College of Emergency Medicine, Royal Australian College of Physicians, Royal Australian College of Surgeons). The search for relevant documents was conducted on 27 July 2021. Policies referenced within identified documents were also considered for review. Legislation and local (health service or hospital) policies were excluded.

Two authors independently reviewed and coded each document. Preliminary codes were derived from theoretical principles identified or related concepts to reduce the likelihood of references to PBT being missed. Codes were refined, with consensus between reviewers, after an initial pass of documents to ensure abstract references were captured while reducing unnecessary coding and analysis of data. Codes included exposure screening and minimising exposure, patient cohorting, surge resource management, critical care rationing, critical care triage and jurisdictional responsibilities or delegations. Coded phrases were extracted into Microsoft Excel™ spreadsheets and grouped according to code or theme. Data analysis aimed to identify whether each document informed S-PBT, the degree to which documents directly informed practice and any relationships between data extracted between documents. After performing analysis independently, discussion between all reviewers occurred until unanimous agreement was achieved. Analysis was conducted over a period concluding in October 2021.

Results

This study will not directly replicate word-for-word extracts of documents. Rather, results are presented as a summary of relevant document sources, an analysis of the terminology used when documents refer to S-PBT and a critical appraisal of the guidance provided around S-PBT operationalisation.

Document sources

A total of 39 documents was reviewed of which 17 contained references to S-PBT (see Table 1). Of these 17 documents, 3 (18%) came from the Australian Government, 13 (76%) came from state or territory governments and 1 (6%) came from a professional medical society. Six of the 17 documents had a revision or publication date during the COVID-19 pandemic.

References to S-PBT were found in 4 documents from Western Australia (WA), 3 from New South Wales (NSW), 2 each from South Australia (SA) and Victoria and 1 each from Queensland and Tasmania. No references to S-PBT were identified in

1. At the time of publishing, COVID-19 case reporting and presentation had evolved and is no longer presented in the form of this dataset.

Table 1: Publicly available policy documents informing secondary population-based triage operationalisation in Australia.

Jurisdiction document title*	Description and summary
Australian Government	
Australian Health Management Plan for Pandemic Influenza (Australian Government Department of Health 2019)	Outlines national health response to pandemic influenza. 2nd version published 2019; 232 pages.
Australian Health Sector Emergency Response Plan for Novel Coronavirus (COVID-19) (Australian Government Department of Health 2020)	Outlines COVID-19 specific arrangements to supplement national arrangements for the communicable diseases. Published 2020; 56 pages.
Emergency Response Plan for Communicable Disease Incidents of National Significance (Australian Government Department of Health 2018)	Outlines national approach to communicable disease emergencies not covered by a disease-specific plan. Published 2016; 51 pages.
New South Wales	
Influenza Pandemic – Providing Critical Care (New South Wales Health 2010)	Outlines the provision of critical care during a pandemic influenza. Published 2010; 44 pages.
New South Wales Health Services Functional Area Supporting Plan (NSW HEALTHPLAN) (New South Wales Health 2014)	Outlines health emergency resource management. 4th version published 2014; 54 pages.
NSW Health Influenza Pandemic Plan (New South Wales Health 2016)	Outlines health preparedness and response for an influenza pandemic. Published 2016; 57 pages.
Queensland	
Queensland Health Pandemic Influenza Plan (Queensland Health 2018)	Outlines arrangements for responding to an influenza pandemic. 3rd version published 2018; 59 pages.
South Australia	
Pandemic Influenza Plan (South Australia Health 2018)	Outlines strategic response to pandemic influenza. 5th version published 2018; 48 pages.
SA Health Viral Respiratory Disease Pandemic Response Plan (South Australian Health 2020)	Outlines state health management plan for viral respiratory illness pandemics. 6th version published 2020; 52 pages.
Tasmania	
Tasmanian Health Action Plan for Pandemic Influenza 2016 (Tasmanian Government Department of Health and Human Services 2016)	Outlines state government approach to preparedness and response. 2nd version published 2016; 118 pages.
Victoria	
COVID-19 Pandemic plan for the Victorian Health Sector (State of Victoria Department of Health 2020)	Outlines health sector management plan for a pandemic. Published 2020; 32 pages.
Victorian health management plan for pandemic influenza (State of Victoria Department of Health 2014)	Outlines state health response to an influenza pandemic. Published 2014; 121 pages.
Western Australia	
Framework to guide decision making on the appropriateness of intensive care management during the COVID-19 pandemic (Government of Western Australia Department of Health 2020a)	Outlines advice to clinical decision-makers regarding allocation or denial of ICU care. Published 2020; 4 pages.
Infectious Disease Emergency Management Plan (Government of Western Australia Department of Health 2017)	Outlines management plan for general infectious disease emergencies. Published 2017; 24 pages.
State Health Emergency Response plan (Government of Western Australia Department of Health 2018)	Outlines state health emergency response. Published 2018; 35 pages.
Western Australian Government Pandemic Plan (Government of Western Australia Department of Health 2020b)	Outlines state whole-of-government response to a pandemic. 5th version published 2020; 41 pages.
Australian and New Zealand Intensive Care Society	
Guiding principles for complex decision-making during Pandemic COVID-19 (Australian and New Zealand Intensive Care Society 2020)	Outlines professional body recommendations for allocating scarce critical care resources due to COVID-19. Published 2020; 10 pages.

*Note: documents referenced in this table are included in the reference list.

documents from the Australian Capital Territory (ACT). No documents from the Northern Territory (NT) were found.

NSW, WA and the Australian and New Zealand Intensive Care Society (ANZICS) each produced a document that specifically addressed the provision and continuation of intensive care during a pandemic. All other references to S-PBT were identified within documents outlining the health response to an infectious disease pandemic, primarily an influenza pandemic.

Terminology

No documents directly used the term 'secondary population-based triage'. Data extracted from the documents primarily referred to triaging critical care, alternative or modified models of care and altered admission or discharge criteria or processes. References to triaging overwhelmingly related to standard triage or P-PBT and the identification and isolation of suspected or confirmed cases. Distinguishing whether a reference to triaging related to standard triage, P-PBT or S-PBT required critique of the context and the intended triage outcome.

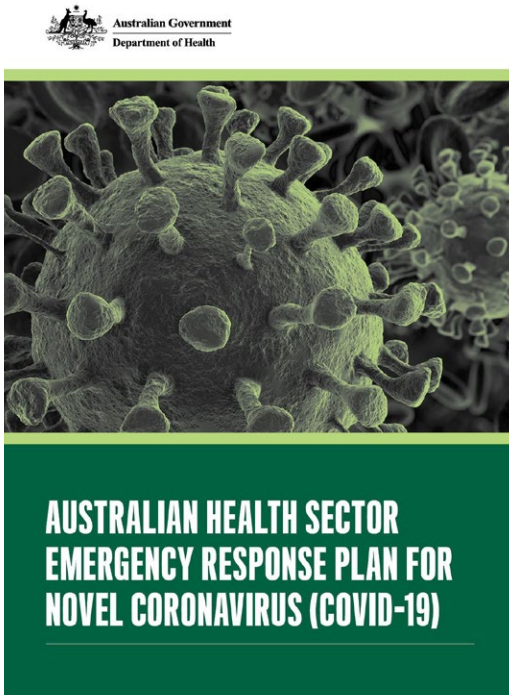
References to S-PBT were occasionally identified in documents discussing 'alternate models of care', but this required distinction between whether the intention was to avoid critical shortages (that is, related to increasing surge capacity) or allocate scarce resources. Similar distinctions were required when analysing data extracts that discussed modified or altered admission or discharge criteria or processes.

Practical guidance

The documents published by the Australian Government provided that, if required, triage algorithms and documents governing changes to standards or models of care would be developed in conjunction with state and territory governments that would remain responsible for implementation (Australian Government Department of Health 2019, Australian Government Department of Health 2020, Australian Government Department of Health 2018).

Each state and territory accepted this responsibility and outlined that pandemic health responses were to be overseen by the state or territory departments of health. Nearly all governments explicitly outlined a system of further devolved governance within their jurisdiction. State governments were to maintain strategic oversight within the department but defer operational responsibility to local authorities. In doing so, these state governments directed local health authorities to prepare policies and procedures to manage local surges in demand for in-patient and critical care services. The NSW, Tasmanian and Victorian governments explicitly stated that collaboration between the state government and local health jurisdictions would be relied on to achieve a consistent approach but maintained onward delegation.

Many of the state-level government documents acknowledged the potential requirement for S-PBT; however, there was significant variation in the quality and quantity of guidance around S-PBT operationalisation. In WA, in documents pre-dating the pandemic and in one Queensland Government

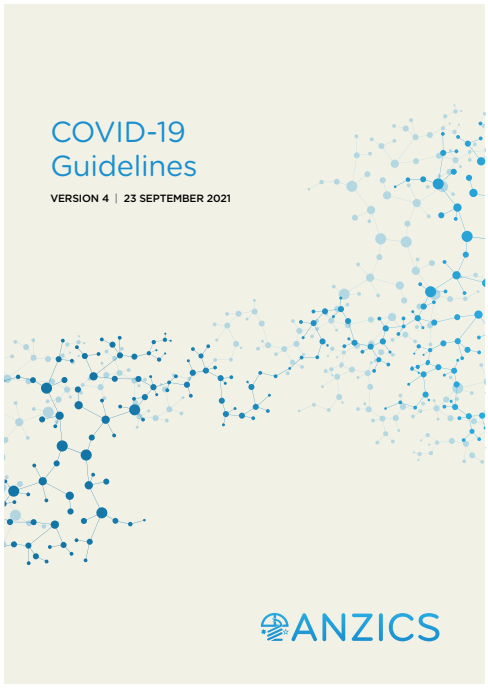


The Health Sector Emergency Response Plan to Novel Coronavirus guides Australia's health sector response to pandemics.

document, the potential for S-PBT was acknowledged but they provided no further guidance or relevant discussion (Queensland Health 2018, Government of Western Australia Department of Health 2017, Government of Western Australia Department of Health 2018). Tasmania reiterated ethical principles detailed in Australian Government documents but provided no further guidance (Tasmanian Government Department of Health and Human Services 2016). SA noted that guidance around service operationalisation delivery limitations and triage algorithms would be provided if required but did not discuss implementation (South Australia Health 2018, 2020). Finally, Victoria noted a reliance on the national development of a triage protocol (State of Victoria Department of Health 2020).

One document each from NSW, WA and ANZICS detailed practical considerations or recommendations for S-PBT operationalisation. The document from New South Wales Health (2010) endorsed 2 proposed protocols to guide S-PBT within the state. The document endorsed using a statewide protocol, outlined protocol administration (including who should be involved, the nature of acceptable decision-making tools), detailed documentation requirements and deferred providing medicolegal and professional protections to individual employers. Importantly, this document endorsed the use of illness severity quantification (ISQ) tools to inform decisions.

The document by Australian and New Zealand Intensive Care Society (2020), produced in response to the pandemic, outlined recommendations for the operationalisation of S-PBT. This document outlined policy and practical recommendations for S-PBT operationalisation, including the considerations that



The COVID-19 Guidelines are a valuable resource for critical-care healthcare workers preparing, training and delivering care for patients.

should and should not inform allocation decisions, how allocation determinations should be reached and who should be involved in allocating critical care resources. This document explicitly asserted that clinical prioritisation is best done by subjective assessments conducted by experienced intensivists rather than ISQ tools. Finally, the document outlined the importance of clinicians being protected from legal or professional consequences if practicing according to endorsed policies and calls for jurisdictional authorities to endorse such policies.

On review, the relevant document from WA served to reiterate and endorse the recommendations provided by the ANZICS document within the WA jurisdiction but provided no further instructions (Government of Western Australia Department of Health 2020a).

Discussion

In Australia, responsibility for disaster management lies with state and territory governments. The Australian Government does not have the statutory authority to direct states and territories in matters of disaster management and adopts an advisory and supportive role, if required (Australian Government Department of Health and Ageing 2011). Devolved governance within state and territory jurisdictions means that ultimate responsibility for operational aspects rests with jurisdictional health authorities or even individual hospitals. This approach has pertinent implications for S-PBT operationalisation.

Terminology used throughout selected documents was heterogeneous and often ambiguous, resulting in the reader relying on context to identify whether specific details informed S-PBT operationalisation. References to triage, models of care and rationing variably related to S-PBT. This could stem from a lack of clear conceptual and practical understanding of S-PBT and its operationalisation, which has remained mostly unchallenged prior to the pandemic. Inconsistencies in the language and terminology used in documents from both levels of government are likely fuelled by ambiguity and attempts to contextualise an unclear concept in jurisdiction-specific documents.

There is a significant lack of practical guidance within the identified documents that carries significant weight given the roles and responsibilities of the Australian Government and state and territory governments in disaster management. Only one state government provided a robust and descriptive plan for S-PBT operationalisation within its jurisdiction; however, the detailed approach adopted frameworks yet to be validated by empirical evidence and, in some instances, directly conflicts with guidelines provided by ANZICS as a body of clinical stakeholders.

The document produced by ANZICS provides many recommendations but, on its own, is not sufficient to enable S-PBT operationalisation. Importantly, this document serves to inform the allocation of intensive care resources only, which is only one, although a very prominent, application of S-PBT in a pandemic. Additionally, governments and health systems are not obliged to adopt these recommendations and adherence to these guidelines may expose clinicians to liability. Most documents do not address clinician protection and indemnification, while some defer this responsibility to employers. This leaves significant room for uncertainty and the potential for profoundly inconsistent protections within and between jurisdictions.

This analysis suggests that, as at the time of document collection, S-PBT operationalisation lacked central coordination and cross-jurisdictional consistency. This is evidenced by the overall absence of rigorous or comprehensive policy detailing the practical aspects of S-PBT. Additionally, documents failed to clearly delineate the responsibilities and inputs of the Australian and state governments and local health authorities.

Future revisions of pandemic plans in Australia should aim to address S-PBT operationalisation, adopt clear and consistent terminology, consider the evidence available to inform endorsed approaches, clarify the scope and permissible variability between operational plans and detail the source and limits of protections for clinicians.

Limitations

There are limitations to this study, including that only publicly available documents were identified and included. Additionally, decentralised responsibility for health responses means that documents most clearly outlining S-PBT operationalisation may have been at the local level and these were not included. However, there are significant findings in relation to consistent and coordinated policy preparedness. Finally, despite care in identifying potentially relevant documents, it cannot be guaranteed that relevant documents were not missed.

Conclusion

This review aimed to assess the policy preparedness to operationalise S-PBT in response to COVID-19 across Australia. Documents significantly lacked practical guidance and, where that did exist, there were often conflicts between documents. Many jurisdictions do not address S-PBT at all and that must be remedied. Documents that did address S-PBT should be revised and consider the evidence available to inform this critical facet of pandemic management. Document revisions should adopt standardised and consistent terminology when discussing S-PBT to reduce heterogeneity and ambiguity. Finally, policies should address protection and indemnity for clinicians who may be required to undertake S-PBT given the marked variation in protections detailed and a lack of clarity around where protection will come from.

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Quantifying the benefits of Australian emergency services training

Abstract

There is greater competition for funding within the public sector and, combined with the increasing scope of high-risk hazards that emergency services personnel are responsible for is placing greater economic pressure on emergency services worldwide. With this pressure comes additional requirements to justify expenditure and effort across operational and corporate contexts, including the training of career and volunteer personnel to the necessary level of contemporary multi-hazard expertise. Within this context, Australasian fire and emergency services must submit formalised cases for funding through state or Commonwealth treasury departments, in most cases competing with other government departments for limited funding. These are usually assessed based on public and political value and benefit. The investment in new, high-fidelity practical and simulated training environments, let alone a new training academy or college, is expensive and has the potential to be one of the largest capital projects emergency services can undertake. Justifying the cost of new training environments is complex due to the difficulty of translating the technicalities of specialised emergency response into corporate language and because of the lack of data and literature on which to draw guidance. This paper bridges this knowledge gap by building on existing models and research to propose an Emergency Services Training Financial Rationalisation Model (EST-FRM) for the funding of emergency services academies in Australia. The model has potential application wherever financial rationalisation of emergency services facilities is required.

Peer reviewed

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Introduction

In Australia, fire and emergency services are legislatively responsible within their respective jurisdictions for the prevention, preparation, response and recovery of high-risk hazards and disasters. In a country as large as Australia, this includes centralised fire and emergency services training facilities and headquarters supporting geographically diverse urban and regional operations and response. The annual financial cost of disasters to society is significant, currently costing the Australian economy $38 billion per year and this is expected to rise to $73 to $94 billion by 2060 (Deloitte Access Economics 2020). As these events become more complex and far-reaching due to increasing urbanisation and climate change, emergency management (the organisation, command, control and coordination of resources and responsibilities during a crisis) and the ability to make critical decisions with limited information in time poor environments is essential (Penney *et al.* 2022; Patterson *et al.* 2009; Nja & Rake 2009; Curnin, Brooks & Owen 2020; Launder & Perry 2014).

The failure of the decision-making process required in high-impact disasters produces the most severe consequences and can significantly lengthen and increase the socio-economic burden to society (Tuhkanen, Rosemarin & Han 2017). To mitigate the consequences of poor decisions, development of training that exposes emergency managers and responders to a wide range of high-risk scenarios coupled with the spectrum of decision-making processes common across the services that form multi-agency incident management teams is required (Penney *et al.* 2022, Launder & Perry 2014, Cohen-Hatton & Honey 2015).

By understanding the tendency of humans to default to heuristics (simple strategies used to approximate or estimate the best outcome from a decision when time or processing capability is limited), training can be designed and applied to ensure the most high-risk decisions (those with highest affect that provide no discretionary time to research the best course of action) can be addressed in the most effective way. To achieve this, hyper-realistic and immersive simulation

training environments combined with exposure to and practice of a range of decision-making models is required (Popper 2019, Patterson *et al.* 2009). Hyper-realistic training environments are defined as 'having a high degree of fidelity in the replication of battlefield conditions in a training environment, so participants willingly suspend disbelief that they become totally immersed and eventually stress inoculated in a way that can be measured physiologically' (Hoang *et al.* 2020, p.1].

While it is foreseeable that all emergency services personnel will have at least a base level of training capability, to achieve this level of high-fidelity realism within fire and emergency training facilities requires significant investment for all aspects of the project, regardless of jurisdiction. This is particularly the case in services that cater for incident response and emergency management of a comprehensive range of hazards. For example, the Civil Defence Academy in Singapore (which has reciprocal training relationships with fire services throughout Australia) was established at a cost of $96 million in 1999 (Singapore Civil Defence Force 2020), equating to approximately AUD $165 million in 2022. By comparison, the Victorian Emergency Management Training Centre, completed in 2014, required an investment of $109 million (Curtin 2017), equating to approximately AUD $121 million in 2022. The investment in new training environments, l*et alo*ne a new training academy, is one of the largest capital projects an emergency services organisation can undertake.

In Australia, most emergency services organisations including fire services and policing are responsible for the provision of the entirety of training required. Unlike professions including teaching or nursing or trades, there are limited options available to use private or external training providers. Also, different types of facilities and resources are required to address a broad range of training needs. For example, most of the fire and emergency services require training facilities that can facilitate 'hands on' technical and practical training including simulated urban environments, hot (live) fire simulation facilities, classrooms or lecture rooms and, increasingly, complex simulation suites for incident management training. Further, emerging risks and hazards including electric, hydrogen or fuel cell powered vehicles and battery storage systems may require the development of new types of training props or facilities.

Planning to meet the future training needs of emergency services over the lifetime of a facility is a specialised process. Justifying the cost of new training programs, technologies, an academy or a centralised facility supporting regional training through a hub-and-spoke model or similar, can be equally as difficult. This is due to the complexities of translating the technicalities of specialised emergency response into corporate language and because of the dearth of data and literature on which to draw guidance. The lack of existing data, coupled with the distinct differences between emergency services and other public services makes the use of traditional public-value assessment and cost-benefit analysis problematic.

This paper considers this knowledge gap by proposing a defendable cost-benefit analysis model for financial rationalisation of improvements in emergency services training that results in tangible improvements including safety, training programs, operational response and other community benefits. This model, termed the Emergency Services Training Financial Rationalisation Model (EST-FRM), builds on existing cost-benefit analysis methodologies as well as Swedish approaches (Jaldell 2004, 2017; Weinholt & Granberg 2015) to financially rationalise first responder initiatives. The model has potential application wherever financial rationalisation of emergency services training facilities is required, whether it be for entirely new facilities or for staged development and enhancement. Using a hypothetical case study for a new emergency management training facility, we demonstrate how the model can be applied as part of a comprehensive business or funding case.

Emergency Services Training Financial Rationalisation Model

When completing financial analysis of any major project or initiative, analysts consider the current state, in other words the baseline, against the proposed alternatives, modelled as economic changes that move society from the baseline towards a new state of equilibrium (National Center for Environmental Economics 2014). It provides quantitative guidance for decision-makers as to whether a project is worth the expense when it is not possible to perform market evaluations (Weinholt & Granberg 2015). A new training facility is typically a once-in-a-generation project where comparative market evaluations are not possible. The baseline is regarded as the current situation including any existing facilities. The new state of equilibrium is the new training facility. Adapted from Weinholt and Granberg (2015), this can be expressed as Equation 1. The primary improvement in the EST-FRM compared to existing methodologies is the inclusion of service utility (discussed in detail later), which facilitates the evidence-based calculation of the value of consumer benefits directly attributable to new, high-fidelity emergency management training centres.

Equation 1: $W_t = (B_t + EE_t + SU_t + PS_t)$

Where W (the annual nominal societal economic value) is expressed as the sum of recurrent annual nominal government budgets (B), external effects (EE), service utility (SU), and producer surplus (PS) over a time period (t). The start of the project, considered to be when capital outlay occurs, is represented by t = 0.

Benefits are represented by positive numbers and costs are represented as negative amounts. For example, an increase in ongoing maintenance costs would be a negative figure in the equation, while a reduction in operating costs is considered a benefit and would be represented as a positive figure. In infrastructure projects such as new emergency management training facilities, most costs are incurred soon after the project is approved and the benefits are realised over decades (Deans 2018). Where the scientific basis for a well-established discipline is sound, a relatively small uncertainty factor (UF), also known as a safety factor, may be suitable (Penney, Habibi & Cattani 2020). Consistent with the approach of the Rural Urban Interface Model (RUIM) (Penney, Habibi & Cattani 2020), an uncertainty factor

of 2 is initially applied to identified future benefits (i.e. those that aren't realised at the onset of the project) to account for the uncertainty of predictions.

As the benefits and costs realised in the future are worth less than those enjoyed in the present (Department of the Prime Minister and Cabinet 2020), a discount rate (D) to future benefits must be applied. This is achieved by calculating the net present value (NPV) of the project, using Equation 2.

Equation 2: $PV = \left(\sum_0^t \frac{W_t}{(1+D)^t} \right) - C_i$

Where (C_i) is the initial capital investment.

In Australia, the discount rate for capital infrastructure projects is 7%, with sensitivity analysis recommended at 3% and 10% where uncertainty is present (Department of the Prime Minister and Cabinet 2020). A positive Net Present Value (NPV) for the time period suggests an overall economic benefit for a new emergency management training facility. An NPV=0 represents the breakeven point for the project.

Government budgets (B) include the changes to recurrent operating costs of the proposed training facility including salaries, programs and maintenance. Positive values identify cost savings while negative values represent a financial cost to society.

Weinholt and Granberg (2015) suggest external effects (EE) may be assumed to equal zero as all individuals in society can be considered consumers of the responders produced by a new training academy. However, where the new training facility supports international emergency services capabilities, such as INSARAG Urban Search And Rescue teams that will be deployed for international disasters, benefit to international communities may be captured as an external effect.

Service utility (SU) is considered the improvement in emergency service performance attributable to the new facility and funded by the government expenditure. Historically, calculating these benefits and determining their attributability to a new facility has been problematic (Weinholt & Granberg 2015). The EST-FRM addresses this issue through the application of the Fire Brigade Intervention Model (Australasian Fire and Emergency Services Authorities Council 2020), the Rural Urban Interface Model (Penney, Habibi & Cattani 2020), research by Jaldell (2004, 2017) and Marks, He and Buckley (2018) as well as emergency services data.

Jaldell (2004) applied a risk-based linear model to calculate the dollar value per minute of damage caused by fires and other emergencies. Marks, He and Buckley (2018) reported the economic cost of business disruption and operational response in the context of false fire alarm response. The results have been contextualised for current Australian conditions and expanded to include response to other incident types. The FBIM enables the time taken to be calculated for firefighters to be alerted, respond and suppress fires, deal with hazardous materials incidents and conduct rescues in urbanised areas. The RUIM enables the same outputs to be calculated in the context of regional areas and the rural urban interface. Both the FBIM and RUIM incorporate percentiles into the calculations that allow for the varying levels of firefighter proficiency. It is incorporated into the EST-FRM to calculate existing and potential incident response timeframes once emergency responders have arrived at an incident.

In the context of emergency services, a new emergency management training facility that provides high-fidelity training may lead to improved operational practice, which in turn provides consumer benefits of higher survival rates and reduced damage costs (Tuhkanen, Rosemarin & Han 2017; Cohen-Hatton & Honey 2015; Hoang *et al.* 2020). This improvement is incorporated into the EST-FRM and allows annual nominal SU to be calculated, see Equation 3.

Equation 3:

$$SU = \frac{\sum}{U_F} [E1_L \Delta T(\emptyset + \beta + \alpha) + E1_p \Delta T(\phi + \beta + \alpha)) + E2_L \Delta T(\emptyset + \beta + \alpha) + E2_p \Delta T(\phi + \beta + \alpha)) + E..._L \Delta T(\emptyset + \beta + \alpha) + E..._p \Delta T(\phi + \beta + \alpha)) + ...]$$

Where U_F is the uncertainty factor applied to recurrent benefits; E_n is a discrete incident type, for example apartment fires, warehouse fires or traffic accidents; subscript *L* denotes incidents where property damage occurred and causalities were injured or killed; subscript *P* denotes incidents where property damage occurred without injuries or fatalities; Ø is the value of property and life damage in AUD 2020 per minute, contextualised from Jaldell (2004) and detailed in Table 1; ϕ is the dollar value of property damage only in AUD 2020 per minute, contextualised from Jaldell (2004) and detailed in Table 2; β is business disruption; α is the operational cost of fire service emergency response and ΔT is the difference in incident duration in minutes.

Using the values in Table 2 and supported by suitable fire service data (identifying the number of incidents involving casualties and those incidents resulting in property damage only) the statistical value of life and associated disability weightings (Department of the Prime Minister and Cabinet 2020), can be used to calculate both Ø and ϕ using equations 4 and 5. The duration of the incidents (i.e. how long it takes from arrival of responders to making the incident safe to handover to local jurisdictions including business owners and local governments) can be determined from either available data or suitable models including the FBIM and RUIM.

Equation 4: $\emptyset = \frac{\textit{Total value of property and life}}{\textit{Duration of incident}}$

Equation 5: $\phi = \frac{\textit{Total property damage value}}{\textit{Duration of incident}}$

The economic cost of both business disruption (β) and fire service operations (α) is sourced from research into fire service alarm calls (Marks, He & Buckley 2018). Fire service alarm calls with no actual fire present, where firefighters respond to a false alarm (burned toast, steam, construction, malfunction), result in significant disruption to workplaces as workers evacuate until firefighters confirm the false

alarm and either isolate or reinstate fire alarm systems. The economic cost of this business disruption per incident has been reported by Marks, He and Buckley (2018) as $1,825 in 2014, equivalent to $2,024 in 2020. The cost of associated fire service response was reported as $3,651 in 2014, equivalent to $4,048 in 2020.

Table 1: Damage in dollars per minute in AUD 2020 (adjusted from Jaldell 2004).

Incident type	Ø ($)	ϕ ($)
Structure fire (average)	6,201	5,455
Structure fire (detached house)	2,631	2,587
Structure fire (apartment buildings)	3,999	3,163
Structure fire (medical facilities and hotels)	2,417	1,979
Structure fire (shops, schools and restaurants)	24,746	21,923
Structure fire (agriculture and farm buildings)	9,503	9,226
Structure fire (chemical industry)	11,473	11,089
Structure fire (other industry and warehouses)	6,567	5,558
Bushfire - productive forest	527	527
Bushfire - other	219	219
Traffic accident (average)	3,851	-
Traffic accident (road traffic)	3,556	-
Traffic accident (trains)	23,129	-
Traffic accident (aircraft)	33,069	-
Traffic accident (ship/boat)	76	-
Hazardous materials	174	-
Water damage	49	-
Storm damage	11	-

Table 2: Property damage in dollars per incident in AUD 2020.

Incident type	$
Fire - residential[1]	36,480
Fire – other than residential[2]	57,513
Vehicle crash – fatal[3]	15,487
Vehicle crash – serious[3]	12,941
Vehicle crash – other[3]	12,770
Vehicle crash – average[3]	13,733

1. Adjusted from Commonwealth of Australia (2016)
2. Adjusted from Association of British Insurers (2009) cited in Commonwealth of Australia (2016)
3. Adjusted from Australian Transport Assessment and Planning (2020)

Economic costs of business disruption and service operations per minute is calculated using equations 6 and 7. While data pertaining to the business disruption due to storm, flood or road crash rescue response was not located during the development of this model, β may be calculated using available departmental or institutional data. The duration of the incident can be determined from either available data or the FBIM (as detailed in the case study). Using the example of a fire service alarm call (see Table 5) the calculated incident duration is 38 minutes, business disruption (β) is calculated at $53 per minute using Equation 6, and the cost of fire service operations (α) is $106 per minute calculated using Equation 7 (which can also be applied to other incident types in the absence of suitable data).

$$\text{Equation 6: } \beta = \frac{\textit{Cost of disruption}}{\textit{Duration of incident}}$$

$$\text{Equation 7: } \alpha = \frac{\textit{Cost of operational response}}{\textit{Duration of incident}}$$

The difference in incident duration (ΔT) in minutes is calculated using:

- available fire service data, or in the absence of this data, the FBIM
- mean incident task durations representing baseline responses and enhanced quality of response and/or a reduction in time for effective action to commence upon arrival as a result of enhanced high-fidelity training, represented by a reduction in task timeframes (excluding turn out and travel times). The reduction in task timeframes is representative of improved performance as a result of high-fidelity training (Tabassi, Ramli & Abu Bakar 2012; LaCerra *et al.* 2018; Sawyer *et al.* 2017) and is conservatively estimated at 5%.

Data for all incident types was not located. Some incidents, including road accidents, may be considered 'instantaneous' where the full extent of the physical damage to the asset occurs on impact. In these circumstances, enhanced response and rescue efficiency may not result in reduced financial damage but may reduce rates of mortality and morbidity. Accordingly, it may be appropriate for ϕ to be assigned a value of zero where this occurs, noting the reduction in these risks to the community (through more effective emergency service action) and the additional benefit of reductions in firefighter injuries and fatalities. The latter impose significant financial, morale and reputational costs on emergency services and any quantifiable reductions could be incorporated into the assessment.

Producer surplus (PS) is the difference between what the producer gets paid for a good or service and the variable cost of production (Hutchinson 2016). For the purposes of the financial analysis of a new emergency services training facility, there will be no difference between the salaries paid to the individual emergency services workers and corporate staff of the existing and proposed facilities, and any difference in salary costs associated with training programs will be captured when calculating operating costs (CO). In the context of emergency services, PS will, however, include increased volunteer responder rates whose service financially offsets the salary of paid responders. Providing suitable and beneficial training is a major factor in volunteer retention (McLennan *et al.* 2009; Birch A 2011; Kim, Kim & Yoo 2018) and it is reasonable to assume improvements in volunteer training will result in some improvement in volunteer retention. In the absence of data,

this retention rate must be assumed and justified by the project team. Producer surplus (PS) is calculated using Equation 8.

Equation 8: $PS = \frac{V_R \times S_S}{U_F}$

Where V_R is the number of volunteers retained as a result of improved training, S_S is the salary cost of the staff that would be required in lieu of the volunteers and U_F is the uncertainty factor applied to recurrent benefits.

Capital investment (Ci) is the initial, non-repeating capital costs and benefits of the project, represented by Equation 9.

Equation 9: $C_I = (C_P - C_R - S_P)$

Where C_P is the total capital cost of the new project including design and build, as well as any land purchase and rehabilitation; C_R is the rebuild costs that would be required to replace the end-of-life existing training facility and maintain the existing training delivery level and S_P is the proceeds of sale of the existing site and facility, land offset benefits and other economic benefits directly related to the release of the existing facility.

It should be noted the equations presented in this model are not exclusive to fire services, with the ability for police, paramedic or other emergency service incidents including marine rescue or land search to be substituted or added to the equation where required.

Case study

In order to demonstrate the suitability and application of the EST-FRM for inclusion in a business case for a new emergency services training centre, the following case study is presented for a facility in Newtown (a fictitious capital city). Due to the nature of the project, it is not possible to complete market valuations for guidance or comparison and the EST-FRM is applied. An uncertainty factor (UF) of 2 is applied and a discount rate (D) of 7% is used with sensitivity analysis of 3% and 10%.

A business case for a new training centre in Newtown is developed for a fire and emergency service that provides emergency response to fire, hazardous materials, rescue, storm and flooding. Details relevant to the model are:

- the existing facility is at end-of-life and would costs $60 million to replace like-for-like facilities without enhanced training, therefore CR is $60,000,000
- the initial cost estimates of a new training centre is $140 million and will have a life span of 40 years. Rather than being sold, the existing training facility will be demolished and rehabilitated at a cost of $8 million as part of a threatened ecological community environmental plan, therefore CP is $148,000,000 and t is 40 years
- the value of the threatened ecological community (once rehabilitated) was assessed to provide a financial offset of $7 million, therefore SP is $7,000,000
- the total capital investment (Ci) was calculated using Equation 9 as $81,000,000
- business analysts identified the future operations costs (salaries, goods, services and support) of the new facility to be $12 million, an increase from the current operating costs of $1 million due to changes to staff structure and the number of training courses required to run each year. Maintenance costs of the existing facility are $1.2 million per year while the new facility is forecast to have reduced annual maintenance costs of $800,000 per year, an annual savings of $400,000 per year (reduced to $200,000 once the uncertainty factor is considered). The change in budget (B) is -$800,000.
- no external effects have been identified, therefore EE is 0
- Newtown volunteer services have reported that inadequate training is a significant factor in the retention of volunteers. For the purposes of the case study, it is conservatively assumed that the improved training will result in the retention of 1% of the total number of volunteer responders within the service, equating to 20 personnel retained each year. The average annual salary of a frontline responder in full-time employment is $75,000. The uncertainty factor (UF) of 2 applies. Producer surplus (PS) is therefore calculated using Equation 3 as $750,000.

For the purposes of the case study, the hypothetical Newtown 10-year incident data is detailed in Table 3, including the average annual number of incidents involving life, n(L), incidents involving property damage only, n(P) and incidents involving both life and property n(L+P). The values for Ø, ϕ, β and α are identified. To illustrate how the FBIM and RUIM can be used, relevant data was calculated using the FBIM and RUIM as identified in Table 3. Adopting a conservative approach, it is assumed all damage as a result of vehicle crashes occurs at the moment of impact and ϕ is assigned a value of zero for road crash rescue incidents. Applying the uncertainty factor (UF) of 2, unadjusted service utility (SU) using Equation 4, is also detailed in Table 3.

The annual nominal societal economic value (W) of the project is calculated using Equation 1 as $6,786,085.

In order to calculate NPV using the equations detailed previously, a spreadsheet is created to identify the distribution of annual nominal costs and benefits of the project. Table 4 details an extract of this spreadsheet, with societal economic value (W) and initial capital investment (Ci) shaded and in bold. As detailed in Table 4, following the initial capital outlays and external benefits, the annual components remain unchanged for the duration of the project timeframe. It should be noted that the majority of the project costs, including all capital costs, are incurred at the commencement of the project and are therefore unaffected by the discount factor (Weinholt & Granberg 2015).

The spreadsheet is then used to plot the NPV, including sensitivity analysis, for the lifespan of the project (Figure 1). The results demonstrate that applying a 7% discount factor, the NPV of societal economic benefit associated with the investment in a new high-fidelity emergency services training facility in Newtown is approximately $9.5 million over the lifetime of the proposed facility. The 'break even' point (being where the NPV=0) occurs after 27 years. Applying the sensitivity analysis of a 3% discount factor the NPV over the lifetime of the proposed facility is $75.8

Table 3: Case study incident data.

Incident type	ϕ	ϕ	α	β	n(L)	n(P)	n(L+P)	ΔT	Benefit ($)
Fire alarm - no fire	0	0	106	53	0.00	700	700.00	1.9[1]	211,470
Structure fire (detached house)	2,631	2,587	106	53	4	676	680.00	3.7[2]	6,908,944
Structure fire (apartment buildings)	3,999	3,163	106	53	3	52	55.00	3.7[2]	685,313
Structure fire (medical facilities and hotels)	2,417	1,979	106	53	0.50	13	13.50	5.5[3]	159,961
Structure fire (shops, schools and restaurants)	24,746	21,923	106	53	0.06	10	10.06	5.5[3]	1,222,702
Structure fire (agriculture and farm buildings)	9,503	9,226	106	53	0.20	4	4.20	5.5[3]	217,089
Structure fire (chemical industry)	11,473	11,089	106	53	0.30	7	7.30	5.5[3]	452,224
Structure fire (other industry and warehouses)	6,567	5,558	106	53	0.20	11	11.20	5.5[3]	353,259
Bushfire - productive forest	527	527	106	53	0.30	3	3.30	12[4]	27,852
Bushfire - other	219	219	106	53	0.02	230	230.02	12[4]	1,069,207
Traffic accident (road traffic)	3,851	0	106	53	70	180	250.00	5	1,546,600
Hazardous materials	174	174	106	53	0.05	80	80.05	6.8[5]	181,265
Water damage	49	49	106	53	0.01	230	230.01	5	239,210
Storm damage	11	11	106	53	0.02	437	437.02	4	297,174
Total *SU*									13,572,271
Total *SU* with U_F applied									6,786,135

Notes: For the purposes of the case study, incident data is sourced from a hypothetical Newtown incident statistics unless otherwise specified.

1. Calculated using FBIM for fire alarm response – see Appendix A, Table 5.
2. Calculated using FBIM for residential dwellings – see Appendix A, Table 6.
3. Calculated using FBIM for complex structures – see Appendix A, Table 7
4. Calculated using RUIM for rural urban interface fire response – see Appendix A, Table 8
5. Calculated using FBIM for hazardous materials incidents – see Appendix A, Table 9

Table 4: Nominal annual costs and benefits of the project in AUD.

Item	Year 0	Years 1–40
C_p (total capital cost)	-148,000,000	0
C_R (rebuild cost)	60,000,000	0
S_p (proceeds of sale)	7,000,000	0
C_i (initial capital investment)	-81,000,000	0
B (budgets)	0	-800,000
PS (producer surplus)	0	750,000
EE (external effect)	0	0
SU (service utility)	0	6,786,135
W (annual nominal societal economic value)	0	6,786,085

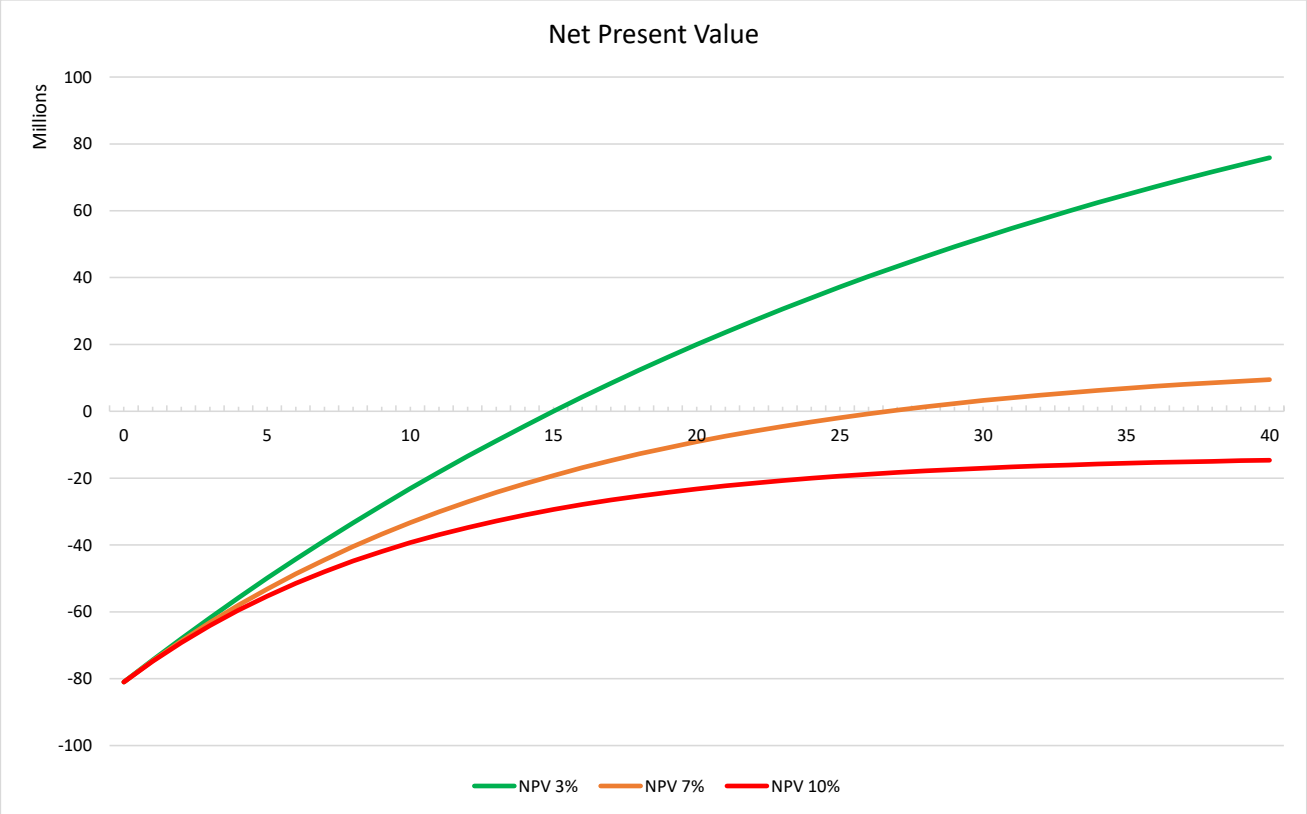

Figure 1: Net present value of the project over the 40 year lifespan.

million, while a 10% discount factor provides the NPV over the lifetime of the facility of -$14.6 million. Considering the application of the uncertainty factor to benefits only, the model therefore demonstrates that the investment in the Newtown training facility will not only likely to be economically justifiable but will provide a net economic benefit to the community.

Limitations

While every effort was made to make the EST-FRM robust, it has limitations:

1. As a manual process, it can be time consuming and complex, however, new training facilities represent significant capital expenditure and may be once-in-a-generation investments. It is therefore reasonable to expect detailed financial analysis to occur. This may be addressed through the development of spreadsheets or applications.
2. While much of the data, research and models supporting the EST-FRM have been previously published, they are limited to fire services of the eastern states of Australia and Sweden. This stated, it is a model that can be easily adapted to international jurisdictions using local data sets. The inclusion of larger datasets will also strengthen the model.
3. In the absence of suitable data, assumptions have been made at some stages of the model. To ensure the limitations of the model are fully comprehended, these assumptions should be clearly identified when the model is applied. Sensitivity analysis may also be beneficial in such instances to improve confidence in the outputs.
4. The EST-FRM assesses financial benefits for the defined items only. Other financial aspects and measures including social benefit may be worthwhile considering. For example, research by Kim, Kim and Yoo (2018) may be of benefit when attempting to quantify social benefit.

Conclusion

The EST-FRM builds on existing models and research to provide guidance regarding the economic costs and benefits of investment in emergency services high-fidelity training centres. Incorporation of financial and engineering safety factors to conservatively account for uncertainties enables guidance to be provided in an achievable manner. The model provides a detailed and flexible workflow that can be applied beyond firefighting to all emergency services and response contexts. As demonstrated in the case study, when used correctly by experienced and suitably qualified personnel, the EST-FRM has the potential to determine the financial viability of significant capital investments in emergency services.

Appendix

Table 5: Fire alarm response - public buildings, industrial and other calculated using FBIM (Australasian Fire and Emergency Services Authorities Council 2020).

Task description	Normal duration	Time saving
Time for initial determination of fire panel location		
Time to complete safety procedures		
Time to don safety equipment and gather tools		
Time to dismount fire appliance and don Breathing Apparatus (BA)	88.1	4.4
Time to remove necessary tools from appliance		
Hydrant equipment	32.5	1.6
Forced entry tools	25	1.3
High rise pack	13.5	0.7
Time to communicate with fire warden	90	4.5
Time for firefighter travel		
Horizontal travel time		
100m in turnout uniform, BA and equipment	140	7
Vertical travel time		
Stair travel time (10 stairs per floor, 5 floors, carrying 65mm hose)	35	1.8
Time for information gathering 5,000 to 10,000	60	3
Time taken to identify alarm location and cause, and to reinstate alarm system (assumed 30 min)	1,800	90
Total (seconds)	**2,284.1**	**114.2**
Total (minutes)	**38.1**	**1.9**

Table 6: Residential structure fire calculated using FBIM (Australasian Fire and Emergency Services Authorities Council 2020).

Task description	Normal duration	Time saving
Time for initial determination of fire location (smoke visible only, premises occupied)		
Time to set up water supply requirements (adequate flow and pressure)		
Remove, connect and charge hose from hydrant to appliance (65mm x 2 lengths)	120.8	6
Remove and connect hose from appliance to booster connections (1 length)	45.3	2.3
Forced Entry required		
Time to don safety equipment and gather tools		
Time to dismount fire appliance and don Breathing Apparatus	88.1	4.4
Time to conduct safety procedures		
Flush hydrant	32.8	1.6
Time to remove necessary tools from appliance		
Hydrant equipment	32.5	1.6
Forced entry tools	25	1.3
Time for firefighter travel		
Internal doors to be negotiated		
Door 1 - Outward opening, side hung fire door forcible entry	180	9
Door 2 - Outward opening, hollow core door	45	2.3
Door 3 - Outward opening, hollow core door	45	2.3
Horizontal travel time		
100m in turnout uniform, BA and equipment	140	7
Time taken connect and charge hoses to the fire (1x65mm and 1x38mm)	100.5	5
Time taken to extinguish fire (assumed 60 min)	3,600	180
Total (seconds)	**4,455**	**222.8**
Total (minutes)	**74.3**	**3.7**

Table 7: Complex structure fire response – public buildings, industrial and other calculated using FBIM (Australasian Fire and Emergency Services Authorities Council 2020).

Task description	Normal duration	Time saving
Time to set up water supply requirements (adequate flow and pressure)		
Remove, connect and charge hose from hydrant to appliance (65mm x 2 lengths)	120.8	6.0
Remove and connect hose from appliance to booster connections (1 length)	45.3	2.3
Forced Entry required		
Time to don safety equipment and gather tools		
Time to dismount fire appliance and don Breathing Apparatus	88.1	4.4
Time to conduct safety procedures		
Flush hydrant	32.8	1.6
Time to remove necessary tools from appliance		
Hydrant equipment	32.5	1.6
Forced entry tools	25	1.3
High rise pack	13.5	0.7
Time to force entry		
Door 1 - Roller security/steel door	220	11
No or insufficient fire brigade pre-planning documented		
Time resolved way finding: Multi-level, numerous enclosures	30	1.5
Time for firefighter travel		
Internal doors to be negotiated		
Door 1 - Outward opening, side hung fire door forcible entry	180	9
Door 2 - Outward opening, hollow core door	45	2.3
Door 3 - Outward opening, hollow core door	45	2.3
Horizontal travel time		
100m in turnout uniform, BA and equipment	140	7.0
Vertical travel time		
Stair travel time (10 stairs per floor, 5 floors, carrying 65mm hose)	35	1.8
Time for information gathering 5,000 to 10,000	60	3
Time taken connect and charge hoses to the fire (1x65mm and 1x38mm)	100.5	5
Time taken to extinguish fire (assumed 90 min)	5,400	270
Total (seconds)	**6,613.5**	**330.7**
Total (minutes)	**110.2**	**5.5**

Table 8: Bushfire response calculated using RUIM (Penney, Habibi & Cattani 2020).

Task description	Normal duration	Time saving
Incident Task		
Time for Officer in Charge to complete size up	2.3	0.1
Time taken to deploy hose lengths (1x65mm, 2x38mm)	1.7	0.1
Time taken for firefighters to seek shelter	2.5	0.1
Time taken to extinguish fire (assumed 4 hours)	240	12
Total (seconds)	**14,787**	**739.4**
Total (minutes)	**246.5**	**12.3**

Table 9: Hazardous materials response calculated using FBIM (Australasian Fire and Emergency Services Authorities Council 2020).

Task description	Normal duration	Time saving
Time for initial determination of fire location (no spill visible, premises occupied)		
Time to don safety equipment and gather necessary tools		
Time to dismount fire appliance and don Breathing Apparatus	88.1	4.4
Time to don hazardous incident suit	584.4	29.2
Time to conduct safety procedures		
Flush hydrant	32.8	1.6
Obtain hazardous materials information from communication centre	701	35.1
Decontamination unit set-up	764.9	38.2
Assemble miscellaneous safety equipment (first aid, staging, etc)	290.6	14.5
Time to remove necessary tools from appliance		
Hydrant equipment	32.5	1.6
Hazmat equipment (deemed equivalent to forced entry tools)	25	1.3
No / insufficient fire brigade pre-planning documented		
Time resolved way finding: Single storey, numerous enclosures and passages, floor area > 5,000 m^2	45	2.3
Time for firefighter travel		
Horizontal travel time		
100m in turnout uniform, BA and equipment	140	7.0
Time for information gathering 5,000 to 1,0000	60	3.0
Time taken to make Hazmat incident safe (assumed 90 minutes)	5,400	270
Total (seconds)	**8,164.3**	**408.2**
Total (minutes)	**136.1**	**6.8**

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Leadership emotion: how leaders influence employee wellbeing and performance in the disaster and emergency management context

Abstract

Leaders play a unique role in the disaster management context as they address the safety needs of communities and manage the complexities of the response and recovery task. Leaders who effectively navigate the challenges of leading in this unique context bring hope and positivity, uniting the efforts of community and government to address the needs of those seeking safety and support. Positive affect is one aspect of effective leadership that receives considerable attention in the academic literature but has, as yet, received little attention in the disaster and emergency management area. This paper draws on contemporary literature on the understanding of positive affect in leadership, bringing together the limited current literature in the area of leader affect in the emergency management context and identifying a significant gap. It calls for a research focus on positive affect in the unique context of disaster and emergency management and consideration of the implications for wellbeing and performance.

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Introduction

Leaders have a unique role in emergency and disaster management situations, navigating uncertain timeframes, dealing with high levels of community vulnerability and coordinating stakeholders (Lin, Kelemen & Kiyomiya 2017; Suhaimi, Marzuki & Mustaffa 2014). Leaders in these roles play a vital role in providing for people seeking safety, support and information (Mahmud, Mohammad & Abdullah 2020).

While managing the complexities of response and recovery tasks, the leader brings hope and positivity to foster a united effort among stakeholders (Mahmud, Mohammad & Abdullah 2020; Lin, Kelemen & Kiyomiya 2017). Effective leaders who navigate these unique challenges have a significant impact on outcomes for communities and on the wellbeing of staff, volunteers and community members (Chi, Chung & Tsai 2011). This effect is particularly relevant for emergency and disaster management personnel who often experience high job-related stress that can lead to short term and chronic health problems (Baek, Choi & Seepersad 2021; Thyer, Simpson & Nugteren 2018),high rates of burnout (Kalemoglu & Keskin 2006; Adriaenssens, Gucht & Maes 2015; Beldon & Garside 2022) and high job turnover (Das & Baruah 2013; Montminy, Russell & Holley 2021).

In navigating these challenges and supporting the wellbeing of staff, a leader's positive affect can have a significant influence on employees and volunteers. A leader's positive affect is conveyed through the leader's behaviours and through their verbal and nonverbal communication (Damen, Van Knippenberg & Van Knippenberg 2008; Pressman & Cohen 2005). Leaders who demonstrate positive affect inspire a positive vision of the future (Carleton, Barling & Trivisonno 2018) by taking a future-orientated perspective and influence others through a process of emotional transference, also

known as emotional contagion, where employees are more likely to demonstrate positive affect when positive affect is shown by the leader (Peñalver, Salanova & Martínez 2020; Mukherjee & Sreeja 2018). Leader's positive affect can also influence interactions between individuals by enhancing communication and facilitating the positive social interactions of groups (Damen, Van Knippenberg & Van Knippenberg 2008).

This paper draws on contemporary literature on positive affect in leadership and contributes to the understanding of leadership related to the influence of a leader on the wellbeing of others with the aim to reduce burnout and fatigue. This paper adds to the body of knowledge about the wellbeing of emergency management employees by drawing connections between positive affect and the role of leaders. It brings together some of the current research and identifies a gap in the research related to 2 emergency management contexts; the crisis and the everyday. The findings have practical application as leader's positive affect contributes to positive outcomes for employees.

Leadership

The role of the leader is complex in any context and, while considerable research has been done to advance the understanding of leadership (Megheirkouni & Mejheirkouni 2020, Kort 2008), a commonly agreed definition of leadership remains elusive (Kort 2008, Clarkson *et al.* 2020, Nawaz & Khan 2016). There are, however, some commonalities across various approaches (Summerfield, 2014). One is the understanding of leadership as a social relationship, whereby the leader influences the followers, often through an emotional or interactional process (Yan *et al.* 2021, Summerfield 2014, Kort 2008). It is also considered to be an enhancing role that improves the situation or environment, moving towards a desired goal (Summerfield 2014, Kort 2008). Leadership occurs within a context, with the leader's style, traits and skills being shaped by contextual factors (Summerfield 2014, Zaccaro & Horn 2003) and leaders working effectively to ensure that the combination of traits, skills and motivations that they apply to this unique context ensure the support and safety of others and the end of the suffering as quickly as possible (Mahmud, Mohammad & Abdullah 2020; Summerfield 2014). Thus, the leader uses their skills effectively, including interpersonal skills, to achieve the desired outcome and to generate positivity and hope (Waugh & Streib 2006; Mahmud, Mohammad & Abdullah 2020; Feldmann-Jensen *et al.* 2019).

Leaders within the emergency management and recovery context are vital to the success of their organisations and the achievement of desired outcomes (Maxfield & Russell 2017). Leaders must navigate complex challenges when working with employees and volunteers, as well as community members and volunteer groups to undertake a variety of vital services including response and recovery as well as mitigation and preparedness (Jensen & Kirkpatrick 2022: Alshayhan & Yusuf 2021, Lin, Kelemen & Kiyomiya 2017).

Positive affect

Limited studies have been conducted on leader positive affect in the specific context of emergency management and recovery. Positive affect has, however, been studied extensively in other contexts with positive affect being considered useful in the work environment most of the time (Ashkanasy, Humphrey & Huy 2017). 'Affect' is a broad concept that encapsulates terms such as emotions, feeling and mood (Wang *et al.* 2019, Clarkson *et al.* 2020). It is considered to be a positive affect if the general feeling, mood or emotion is good, positive or pleasant (Ashkanasy, Humphrey & Huy 2017; Harmon-Jones & Harmon-Jones 2021; Shiota *et al.* 2021). Positive affect is considered to be generally consistent with a high level of energy and concentration, reflecting engagement in a pleasurable way with the environment (Pressman & Cohen 2005; Carleton, Barling & Trivisonno 2018). Emotions and feelings like joy, excitement, contentment, amusement, calm, satisfaction, positiveness, cheerfulness, happiness, attentiveness, being interested and alert all fit within the broad category of positive affect (Pressman & Cohen 2005; Carleton, Barling & Trivisonno 2018). On the contrary. feelings of hostility, guilt and irritability are consistent with negative affect (Pressman & Cohen 2005).

Positive affect and leadership

In terms of leadership, individuals who demonstrate a positive affect are said to be more successful in many areas of life (Carleton, Barling & Trivisonno 2018) and attract followers (Maxfield & Russell 2017). One reason for this is that leaders who demonstrate positive affect demonstrate prosocial actions, verbal communication patterns and nonverbal patterns of behaviour including eye contact, body language and facial expressions that are associated with emotional support (Jia & Cheng 2021; Carleton, Barling & Trivisonno 2018). They also provide vital information to followers orientated towards the relationship (Damen, Van Knippenberg & Van Knippenberg 2008). Leaders who demonstrate positive affect are more likely to see events as positive and to draw on memories of positive events to share with others (Carleton, Barling & Trivisonno 2018) in addition to engaging in behaviours that create positive experiences (Carleton, Barling & Trivisonno 2018). This is in contrast to the demonstration of negative affect by leaders, which increases negative moods in others (Clarkson *et al.* 2020, Petitta & Jiang 2020), lower performance (Xie, Wilson & Sherron 2022; Carleton, Barling & Trivisonno 2018) and decreases morale (Xie, Wilson & Sherron 2022).

Another that positive experiences for followers is created is through emotional contagion (Mukherjee & Sreeja 2018, Yan *et al.* 2021, Wang *et al.* 2019). This process can occur at an unconscious or conscious level (Mukherjee & Sreeja 2018, Yan *et al.* 2021). Followers with leaders who demonstrate positive affect are more likely to demonstrate positive affect (Clarkson *et al.* 2020) and to be in a positive mood (Peñalver, Salanova & Martínez 2020, Mukherjee & Sreeja 2018). This can occur at the individual follower level or at the whole-group level and research suggests that positive affect also increases group cohesion in addition to positive affect among group members (Wang *et al.* 2019, Yan *et al.* 2021).

Research indicates that leaders who demonstrate positive affect are more successful in taking a future-orientated perspective and

in using emotion to inspire a positive vision of the future (Carleton, Barling & Trivisonno 2018). Positive affect can also generative creative solutions and flexibility in thinking (Yan *et al.* 2021), prosocial behaviour (Shiota *et al.* 2021) and greater citizenship behaviour (Wang *et al.* 2019; Xie, Wilson & Sherron 2022).

Overall, based on the literature, positive affect is seen to have a significant positive effect on followers including wellbeing and performance. In a study by Rackoff and Newman (2020a)), individuals who demonstrated lower positive affect were determined to have a higher risk for depression and anxiety when measured years later. Positive affect mitigates the stress (van Steenbergen *et al.* 2021, Folkman & Moskowitz 2000) including long-term, chronic stress that generates physiological responses in the brain and body (Folkman & Moskowitz 2000, van Steenbergen *et al.* 2021) and during stress events (van Steenbergen *et al.* 2021, Folkman & Moskowitz 2000). Research suggests that positive affect builds resilience through a hopeful and optimistic view of stressful events (Pillay 2020). This is of particular interest for those providing emergency and recovery response as stress is recognised as an ongoing problem with significant negative health implications (Thyer, Simpson & Nugteren 2018; Beldon & Garside 2022).

At the organisational level, positive affect demonstrated by leaders has a positive influence on employee engagement and performance. Leaders positive affect can improve the creativity and emotions of individuals and groups (Mukherjee & Sreeja 2018; Carleton, Barling & Trivisonno 2018) shaping social interactions and boosting an individual's belief in their role within the organisation and their ability to perform within the given context (Damen, Van Knippenberg & Van Knippenberg 2008; Carleton, Barling & Trivisonno 2018). Leaders who express positive emotions boost productivity (Carleton, Barling and Trivisonno 2018; Clarkson *et al.* 2020) through higher levels of employee engagement (Yan *et al.* 2021; Peñalver, Salanova & Martínez 2020) and a greater belief in the abilities of leaders and individuals (Carleton, Barling & Trivisonno 2018; Mukherjee & Sreeja 2018).

Positive affect, leadership and emergency services

Leaders in emergency and recovery contexts operate in 2 contexts (Brandebo 2020), one being an everyday context and the other a crisis context (Lin, Kelemen & Kiyomiya 2017; Suhaimi, Marzuki & Mustaffa 2014). A number of studies examined positive affect of employees in emergency services. For example, in 2021, a study was conducted on the emergency response to the COVID-19 pandemic and the construction of emergency hospitals in 2 areas of China (Wang *et al.* 2021). The study found a positive correlation between positive affect in individuals, such as pride and determination and citizenship behaviour, however, leadership affect was not addressed (Wang *et al.* 2021). Similarly, a study by Feng *et al.* (2022), included positive affect of emergency physicians as one factor that was directly associated with lower turnover intentions. In a conceptual paper by Reyes *et al.* (2020), the importance of leaders maintaining a positive affect during crisis situations was highlighted in order to convey optimism, openness and confidence. Some research has included alternative findings, such as Rosing *et al.* (2022) who determined that the presence of leadership humour can have a detrimental effect on communication in emergency situations, particularly in a firefighting context. Overall the research around leader positive affect and its influence on followers in the emergency services remains low.

Discussion

Given the prevalence of burnout (Kalemoglu & Keskin 2006; Adriaenssens, Gucht & Maes 2015; Beldon & Garside 2022), stress (Baek, Choi & Seepersad 2021; Thyer, Simpson & Nugteren 2018) and job turnover (Das & Baruah 2013; Montminy, Russell & Holley 2021) in emergency management organisations, opportunities for leaders to operate effectively within these organisations should not be overlooked. Given that the role that leaders play in emergency management and recovery occurs in 2 distinct contexts, that of the everyday and the other being the crisis context (Brandebo 2020), a key finding of this review is the lack of research to support an understanding of the impact of the leader's positive affect on followers in the unique contexts experienced by emergency management leaders (Rosing *et al.* 2022, Reyes *et al.* 2020). While extensive research has been conducted on positive affect (Ashkanasy, Humphrey & Huy 2017; Harmon-Jones & Harmon-Jones 2021; Shiota *et al.* 2021) in alternate contexts highlighting the significant impact a leader's positive affect has on followers (Carleton, Barling & Trivisonno 2018; Maxfield & Russell 2017; Jia & Cheng 2021) in the everyday context, limited research exists as to whether this applies in the unique crisis context also,

Conclusion

In navigating the challenge of leadership, leader's positive affect is shown to have a significant influence on the wellbeing of followers and the performance of organisations. The leader's role in the specific context of emergency management and recovery is unique and especially challenging as they address high levels of community vulnerability while managing their own organisation. This unique role that occurs across the 2 distinct contexts of the everyday and crisis (Brandebo 2020) provides a rich context for research, which has not as yet been addressed. While limited research exists in this area of positive affect in the emergency management context, the high rates of burnout and stress experienced within emergency management provides a compelling imperative for ongoing future research.

Positive affect is conveyed through the leader's patterns of behaviour and communication activities. This paper draws on the limited literature on positive affect in leadership in the emergency management context and highlights the extensive research available in alternate contexts. An opportunity exists to explore positive affect in the emergency management context with reference to the specific behaviours and communication employed by emergency management leaders to convey positive affect. An understanding of leader positive affect in emergency

management contexts of the crisis and the everyday remains elusive. Further research is needed to determine the influence of these behaviours, communication, employee wellbeing and performance. The need for further research is apparent.

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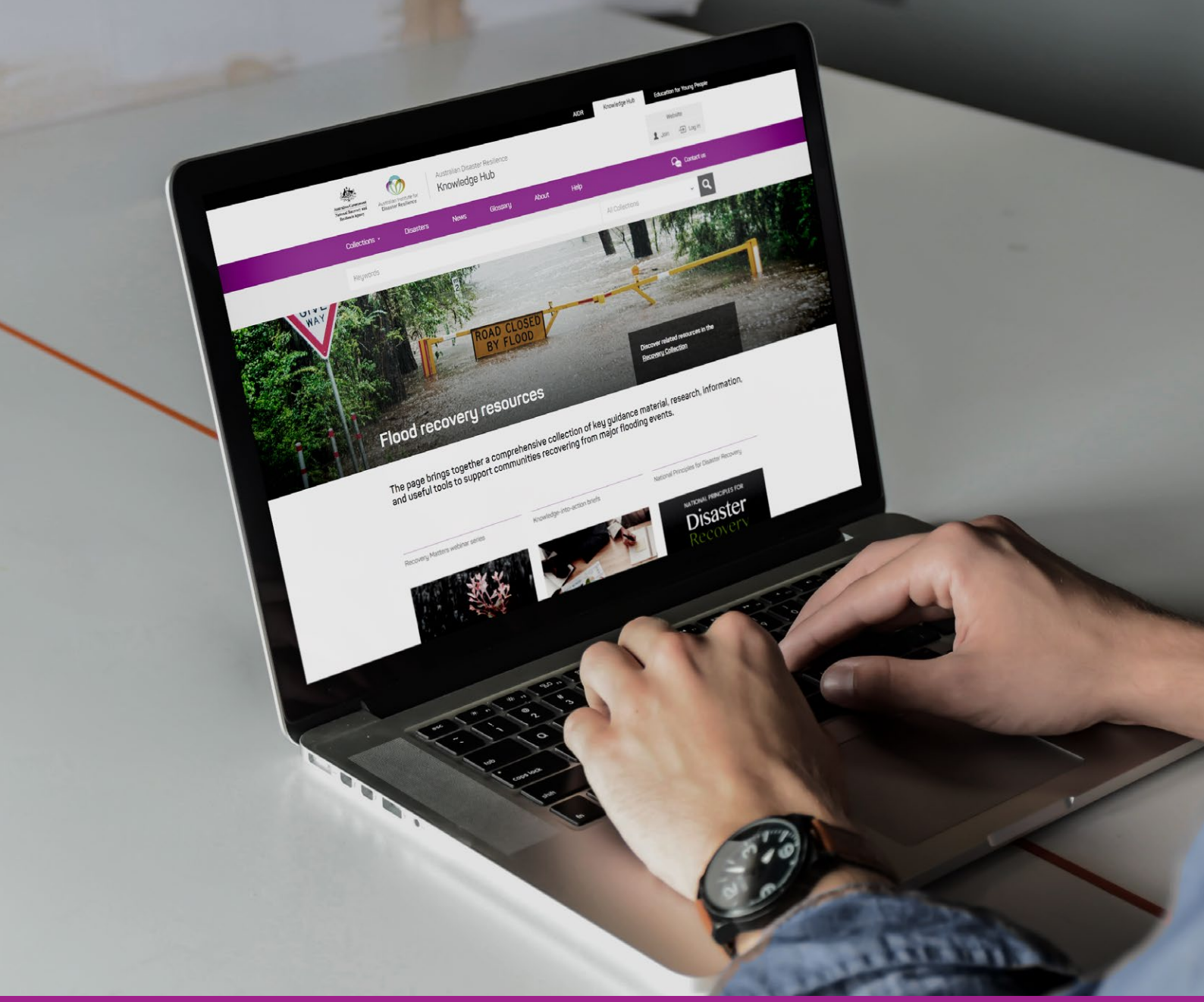
About the author

Katie McIntyre is a sessional academic and postgraduate research student at the University of the Sunshine Coast with qualifications in social science, business and education and Masters in business administration and education. Her research in leadership focuses on the effects leaders have on people's wellbeing, engagement and performance, particularly the concept of joyful leadership.



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