

# PRACTICAL DECISION TOOLS FOR IMPROVED DECISION-MAKING IN COMPLEX, TIME-CONSTRAINED AND MULTI-TEAM ENVIRONMENTS

Annual project report 2014-2015

Chris Bearman<sup>1,5</sup>, Benjamin Brooks<sup>2,5</sup>, Christine Owen<sup>3,5</sup>, Steve Curnin<sup>2</sup>,  
Keith Fitzgerald<sup>4</sup>, Jared Grunwald<sup>1</sup> & Sophia Rainbird<sup>1</sup>

<sup>1</sup>Appleton Institute, CQUniversity

<sup>2</sup>University of Tasmania

<sup>3</sup>The Learning Organisation

<sup>4</sup>New South Wales State Emergency Service

<sup>5</sup>Bushfire and Natural Hazards CRC





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Cover: An Incident Management Team at work.

Photo: Christine Owen



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## EXECUTIVE SUMMARY

This annual report presents information about the Bushfire and Natural Hazard CRC funded project: Cognitive Decision Strategies, which is concerned with decision making, team monitoring and organisational performance in emergency management.

As the incidents associated with natural hazards increase in complexity, duration, and the number of agencies involved, there is likely to be an increased frequency of degraded operational situations, breakdowns within and between teams and the occurrence of errors. These problems will play out within the context of a decreasing tolerance in the community and their political representatives to emergency management coordination failure. The current project has three main research streams that aim to: Provide enhanced methods of making decisions in complex situations; develop methods to better monitor teams to detect breakdowns and disconnects that can impair operational performance; and to develop enhanced methods for agencies to evaluate and learn from their operational performance.

Towards this end the research team have visited 18 agencies in Australia and New Zealand to collect data and discuss the issues around decision making, team monitoring and to identify how agencies currently assess and learn from reviewing their organisational performance. The team has discussed the research and/or collected data with: chief officers, deputy chief officers, principle rural fire officers (NZ), state coordination personnel, regional coordination personnel, and incident management team personnel. These personnel represented urban fire brigades, rural fire agencies, land management agencies, state emergency services, council officers with responsibility for search and rescue, the Red Cross and the National Rural Fire Authority (New Zealand). In addition, we have conducted a number of research studies and observations, including: Literature reviews, semi-structured interviews with senior staff, observations of real-life and simulated events and an online survey.

This has provided the team with information about current practice in decision making, team monitoring and learning from evaluating organisational performance across Australia and New Zealand. Comparing current practice to the research literature provides opportunities to develop enhanced methods of developing decision making, monitoring teams and assessing organisational performance. For example, using skill-based training to enhance peripheral vision & memory in decision making, developing breakdown indicators that can indicate a malfunctioning team for team monitoring, and unpacking the values and challenged that enable and constrain learning from reviews of organisational performance. These strategies and methods will be investigated, developed and evaluated through close consultation with end-users in the next stages of the project.



## END USER STATEMENT

**Keith Fitzgerald**, *New South Wales State Emergency Service*

I am pleased to be asked to provide an end user statement for this project. Overall, I am convinced that the research project and its three intertwined streams, offer to the emergency management community, the opportunity to better serve their communities, through improved decision making in complex situations. The three streams of research can be viewed as standalone, however there are obvious synergies between the three and these interrelationships will become more apparent toward the latter phases of the research project. I would like to thank the research team for their work to date and for being responsive to the needs and input from the end users.

The decision making research stream offers clear opportunities in terms of viewing emergency management decision making as a framework rather than a set of decision tools in isolation, while the team performance monitoring stream and the notion of 'coping ugly' offers keen insights into disruptions to team functioning. The need to better improve our monitoring of team performance offers significant advantages in terms of optimising team performance and reducing the stress on individuals by better recognising how they are functioning. Finally, the organisational performance research stream provides insight into the modern emergency management environment where the better defining of successful operations and the need to better learn lessons across agencies and environments is becoming increasingly clear.

I have been impressed with the input from end users across all agencies and all hazards; ultimately I think we all see the benefits of this research at a national level. The next phase of the research will necessarily involve focusing the research effort within a smaller number of agencies, however the need for ongoing input from all end users is essential to the future benefits realisation. I look forward to the next phase of the research and encourage all end users to stay involved, finding time now to safeguard our future is difficult, but we need to stay the course. I look forward to your continued input as this project continues.



## THE ELEVATOR PITCH

### “What is the Problem?”

There is increasing pressure on agencies from larger-scale natural hazards, financial constraints and declining volunteer numbers. As a consequence response and recovery is becoming more complex. These more complex operational situations exert pressure on people that may lead to an increased frequency of degraded situations, breakdowns in team coordination and the occurrence of errors. It is important then to develop strategies to help people cope in these more complex situations and to provide ways for people to more effectively monitor teams to detect errors and breakdowns. Post-event there is a need to develop more effective ways of reviewing organisational performance during a response so that lessons can be identified and learning leading to better capability in the future.

### “Why is it Important?”

As the complexity of operational situations increases it is necessary to develop enhanced ways for people to be able to function in such situations. If people are overwhelmed they are more prone to errors and breakdowns in coordination, which may ultimately impair task performance and degrade the operational response. Increasingly the response to large-scale emergencies is occurring in the context of decreasing tolerance in the community and political spheres to emergency management coordination failure.

### “How are we going to solve it?”

The objectives of the project are to develop practical ways to help people cope in complex situations and to better identify and recover from breakdowns and errors. Thus this project seeks to develop cognitive strategies that can be used to enhance strategic level decision making in complex situations. This will include constructing straightforward ways for strategic level managers to track the performance of teams they are responsible for to ensure the team is not operating at the edges of safety. In addition, we will develop a set of ways that agencies can better learn from their assessments of their own operational performance.



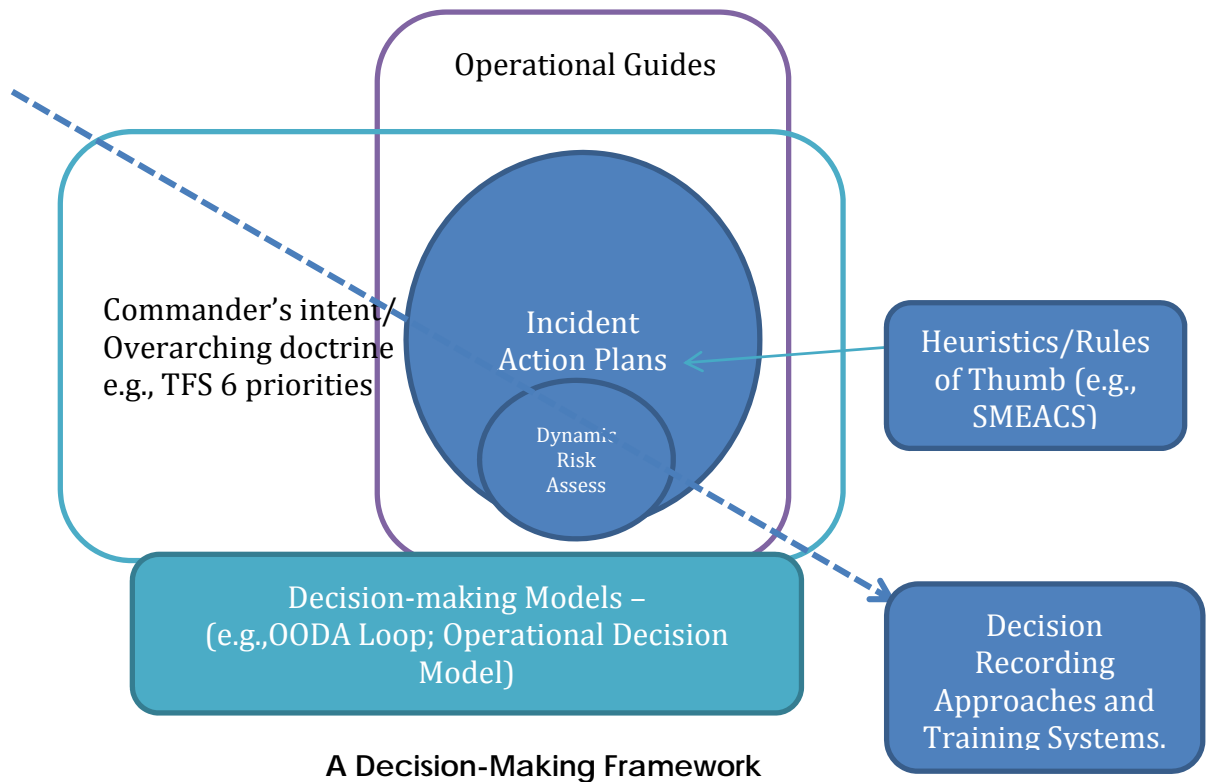


## INTRODUCTION & PROJECT BACKGROUND

Evidence from inquiries into major disasters, as well as government-based policy research suggests that incidents associated with natural hazards are increasing in complexity, duration, and require involvement of an increasing number of agencies (cf. Owen, Bearman, Brooks, Chapman, Paton, & Hossain, 2013). At the same time financial constraints from government, declining volunteer numbers, an aging workforce and workforce restructuring are presenting agencies with significant challenges. Together these factors have the potential to compromise the effectiveness of an agency's capacity to respond to emergencies. As a consequence during response efforts, there is likely to be an increased frequency of degraded situations, breakdowns within and between teams and the occurrence of errors. These problems will play out within the context of a decreasing tolerance in the community and their political representatives to emergency management coordination failure. The current project has three main research streams that aim to: Provide enhanced methods of making decisions in complex situations; develop methods to better monitor teams to detect breakdowns and disconnects that can impair operational performance; and to develop enhanced methods for agencies to evaluate and learn from their operational performance.

Decision making in emergency management can be challenging and stressful due to the dynamism, complexity, uncertainty and temporality that occurs in this environment (Brehmer, 1987; Danielsson & Ohlsson, 1999). This context in which decision makers operate in emergency management is not unique and is comparable to other safety critical high consequence environments such as the military and health industry (Baker, Day, & Salas, 2006; Wildman, Fiore, Burke, & Salas, 2011). Decision makers in these three types of environments often use mental shortcuts or heuristics, to aid in the decision making process (Aberdeen, Thiébaux, & Zhang, 2004; Croskerry, 2002; Mishra, Allen, & Pearman, 2013). Decision making in emergency management is a practical problem that can rapidly intensify when a situation quickly deteriorates as witnessed in the 2009 Australian Black Saturday Bushfires.

It is important to recognise that the system for managing decisions is much larger than just a decision-making tool – such as a rule of thumb, a decision-model or an aide memoir. The doctrine, policies, procedures and other organisational systems that wrap around the decision-maker all influence, and are therefore all part of the decision-making process. The diagram below attempts to identify these components and interpret at a very coarse level the relationship between them. It suggests that a group of elements impinge on decision-making at the IMT level – broader doctrine, operational guides, IAP processes, risk assessments and heuristics. Everything is underpinned by the decision-making model and the recording approach cuts through all of this to influence outcomes



Emergencies are managed by a complex network of teams (Schaafstal, Johnston & Oser, 2001). As operational teams engage in their tasks and deal with performance disruptions they can be said to move around a notional space of safe and unsafe operations (Rasmussen, 1997). If the operation is particularly difficult or there are unresolved disruptions to performance the team can move out of the zone of safe operations, firstly into the zone of coping ugly and then into the unsafe zone where incidents and accidents are more likely to occur (Brooks, 2014). Figure 1 depicts this notional safety space.





Figure 1. Notional space of safe and unsafe operations (from Brooks, 2014)

One of the important roles of regional and state level emergency managers is to monitor teams that are operating at their level as well as below them in the structure of the organisation to determine how they are performing. This provides an important safety and quality assurance function for agencies that operate in inherently risky environments. This monitoring allows the emergency manager to ensure that the team is functioning effectively and to detect disconnects and breakdowns in the team that can lead to impaired operational performance. However, there is currently limited guidance on how this should be done in emergency management.

The purpose of the organisational performance stream of the research is to investigate the question: how do organisations systematically review and evaluate their past performance and how do they monitor any changes based on insights that have been learned? Part of the challenge is that, there is no one size fits all when it comes to evaluating organisational performance in emergency management (Boin and't Hart, 2010). Moreover while it is well established that learning lessons from disasters and crises is becoming increasingly important (Borell & Eriksson, 2008; Brower, Jeong, & Dilling, 2009), recording, storing and sharing lessons identified, does not necessarily infer that anything has in fact or will subsequently be learned (Rostis, 2007; Deverell & Hansén, 2009). Typically performance is judged post-hoc and through public inquiry or in the media which does not necessarily have the intention of improving the effectiveness of emergency management systems (Elliott & McGuinness 2002; Owen, Bosomworth & Curnin, 2014).



## WHAT THE PROJECT HAS BEEN UP TO

Over the last eighteen months, the team members have visited 18 agencies in Australia and New Zealand to collect data and discuss the issues around decision making, team monitoring and organisational performance. Most (but not all) of these agencies are participants in the Bushfire & Natural Hazards CRC research project. The team has discussed the research and/or collected data with: chief officers, deputy chief officers, principle rural fire officers (NZ), state coordination personnel, regional coordination personnel, and incident management team personnel. These personnel represented urban fire brigades, rural fire agencies, land management agencies, state emergency services, council officers with responsibility for search and rescue, the Red Cross and the National Rural Fire Authority (New Zealand). In addition, our research team have conducted a number of research studies and observations over the past year. These have included engagement in:

- Literature reviews of the published literature on decision making, team monitoring and organisational performance.
- Semi-structured interviews with Level 3 incident controllers and senior staff from 18 agencies across Australia and New Zealand
- Desktop simulation/semi-structured interviews with Regional Controllers
- Focus group with multi-agency personnel in Tasmania
- Survey of senior staff from 36 agencies in all states of Australia
- Observation of G20 operation (Queensland)
- Observation of the 2015 Sydney Storm Event (New South Wales)
- Observation of Planned Burns (South Australia)
- Observation of the simulation "Operation Headache" (Queensland)
- Observation of the 2014 seasonal preparedness simulation (Tasmania)
- Staff Ride in Tasmania

The information obtained from these research studies and observations forms the basis of four reports. One report provides an overview of the research, with the supplementary reports providing more details about each of the three research streams. These reports are available from the Bushfire & Natural Hazards CRC. A short overview of the key findings and opportunities from each research stream follows:

### Decision Making

A number of issues have emerged from the investigations conducted in this phase of the research. These issues are associated with an interpretation of EM decision-making as a framework rather than considering decision tools in isolation.

- Opportunities appear to exist to support improvement in Agency decision-making within the 'framework' – this might be through the improvement of decision recording approaches (e.g., recognising the influence of bias, the limits of human cognition, the need to adapt to different styles of decision-making), adapting or implementing decision models, developing heuristics, or supporting changes in doctrine/policies/procedures.



- A lack of role clarity at strategic levels is a confounding issue in developing these improvements.
- The development of any tool is likely to need to be supported by training systems that build strategic knowledge and skills about decision-making.
- Decision-making is supported by physiological functions such as peripheral vision, memory and creativity. A growing area of research has established that the association between cognition and brain plasticity - changes in neural pathways and synapses due to changes in behaviour, environment, neural processes, thinking and emotions. Many of these functions can be improved with skill-based training and the most complete decision-making improvements are likely to come through the pairing of cognitive strategies and brain plasticity training modules.

### Team Monitoring

The research literature on team performance monitoring in other high risk industries suggests a number of methods that can be used to monitor teams, such as: monitoring team outputs, mapping team information flow, inspecting linguistic correlates, examining team-based behavioural markers, and assessing individual team members. Each of the approaches to team performance monitoring has different strengths and weaknesses. Of these methods, perhaps the weakest approach is to simply monitor the output of teams. This approach does not consider team processes and will not necessarily detect problems in team performance. Given the strengths and weaknesses of the different approaches it is best practice to use a number of different methods in combination. There has as yet been little or no translation of these methods into the emergency management domain.

Comparing the data on what emergency managers do to the literature on team performance monitoring shows that there are a number of opportunities to enhance how emergency managers monitor team performance and to develop more formal processes. For example, in addition to monitoring information flow, a more comprehensive list of things to look out for could be developed and used together with a set of behavioural markers of breakdowns and effective team performance. Such initiatives need to be developed together with industry partners to provide a set of approaches that are specific to emergency management, can be used by people who are not co-located with the team and can be used to monitor multiple teams. The exploration of these opportunities and challenges forms the basis for detailed discussions with our industry partners, which is the next stage of the project.

### Organisational Performance

The focus in this stream is on examining the tools agencies are developing to conduct post-hoc analyses of incidents and following a season of events to identify lessons that can be learned for continuous agency-wide organisational improvement.

An environmental scan was undertaken with end-user agencies to ascertain what strategies they currently have in place to assess performance following an



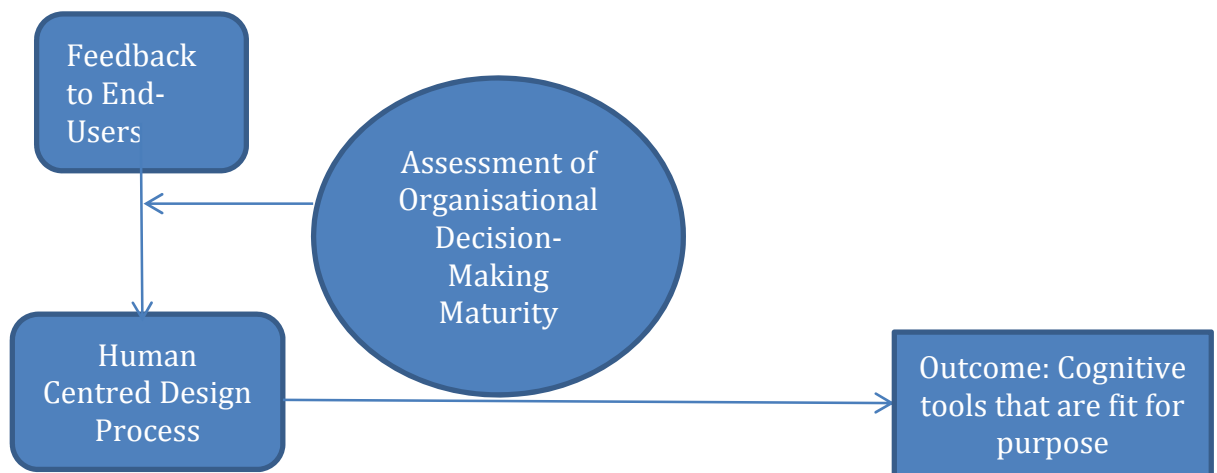
incident, or season of events. This revealed that there is considerable activity occurring in agencies to capture lessons that may be learned from after action reviews and post incident review. Nearly all agencies, for example, are developing their own localised processes to evaluate performance and to learn including

- Developing processes and strategies to systematically review data and insights collected from other forms of monitoring, including real-time performance monitoring.
- Appointing personnel to be responsible for analysing patterns in after action reviews and seasonal debriefs to ensure that actions taken to redress problems as well as that there is alignment between organisational policies, procedures and training.
- Establishing lessons learned databases and lessons management systems.

However challenges remain. The ways in which agencies are evaluating previous incidents, or periods of activity is highly variable. In addition it appears that there is high variability in the training provided to personnel to conduct these evaluations of performance. There appears to be limited systematic sharing of learning from evaluations across the sector. This is in part is a cultural issue because agencies are not keen on airing their problems with others. In addition, there are structural impediments to sharing reviews and evaluation of performance across the sector. These include agencies using different terminologies and limited shared language with which to aid collective understanding.

## NEXT STAGES OF RESEARCH PROJECT

The next stage of the project is to continue to develop the strategies and methods that will form the basis of the outcomes from the project. To do this we recommend using a human-centred design process and an assessment of end-user organisation's decision framework maturity to appropriately tailor tools to organisations. Embedded within the design process will be the testing protocol to assess validity and reliability of the tool.



### *Human Centred Design (HCD)*

The basic premise of Human Centred Design (HCD) is that systems are designed to suit the characteristics of intended users and the tasks they perform, rather than requiring users to adapt to a system. Usability Testing (UT) is a key component of HCD and uses methods that rely on including users, or user-based design principles, to test the ability of systems to support user needs. UT helps to identify potential problems and solutions during design and development stages by using an iterative approach to testing.

### *Organisational Maturity*

Emergency management organisations are required to manage and improve operations in an environment of fiscal austerity and increasing complexity. In similarly challenging environments, other high risk organisations have used Safety Maturity Models (SMM's) to track and improve operational performance. Reported SMM benefits include better management systems, improved coping with complexity, and better organisational learning. We also assert that safety maturity is itself likely to influence an agency's readiness to accept safety interventions/changes, given that these interventions (e.g., checklists, decision-models, training approaches) themselves vary in maturity/sophistication.

For this reason it is our intention to embed an assessment of system maturity in the HCD process focused specifically around the issue of decision-making in the human-centred design process. In order to develop this assessment, we will build a more sophisticated model of safety maturity specifically for emergency management organisations, and use this in the '*Concept Development/Context of Use*' and '*Planning & Analysis*' phases of the HCD process.



To facilitate the research conducted in the next stage of the project we will form a research development and testing group who will work closely with us to develop the specific strategies and methods in decision making, team monitoring and performance development. Members of this group will contribute to product development workshops, provide feedback on work-in-progress reports, and provide opportunities to test the developing products in simulated and real-life situations. This will allow us to develop specific strategies and methods that have an appropriate level of specificity and have been tested in realistic situations.





## PUBLICATIONS LIST

### Peer-Reviewed Conference Papers

Owen, C., Brooks, B., & Bearman, C. (2014). Challenges of Measuring Emergency Management Performance Under Adversity: The good, the bad the ugly. In Maddock, N. (Ed.). *Proceedings from the Bushfire and Natural Hazards CRC and AFAC 2014 Research Forum, Wellington, New Zealand*. Melbourne: Bushfire and Natural Hazards CRC

### Industry Reports

Bearman, C., Brooks, B., Owen, C., Curnin, S., Fitzgerald, K., Grunwald, J., & Rainbird, S. (2015). Decision making, team monitoring & organisational performance in emergency management: Overview and next steps. Melbourne, Victoria: Bushfire & Natural Hazards CRC.

Brooks, B. & Curnin, S. (2015). Decision making in emergency management. Melbourne, Victoria: Bushfire & Natural Hazards CRC.

Bearman, C. (2015). Team monitoring in emergency management. Melbourne, Victoria: Bushfire & Natural Hazards CRC.

Owen, C. (2015). Organisational performance in emergency management. Melbourne, Victoria: Bushfire & Natural Hazards CRC.

### Invited Talks, Conference Presentations & Webinars

Bearman, C. (2015). Decision making and team monitoring in emergency management. Talk to New South Wales State Emergency Service Regional Controllers Workshop 2015, Manly, New South Wales.

Owen, C., Bearman, C., Brooks, B.P., & Conway, G. (2014). Beyond the Incident. Research Driving Change Bushfire CRC Webinar Series.

### Submitted Manuscripts

Owen, C., Brooks, B.P., & Bearman, C. (2014). Values and complexities in assessing emergency management response effectiveness. Manuscript submitted to Journal of Crisis and Contingencies Management.

Grunwald, J. & Bearman, C. (2014). Identifying and Resolving Coordinated Decision Making Breakdowns at the Regional Coordination Level of Wildfire Management. Manuscript submitted to Safety Science.



## **CURRENT TEAM MEMBERS**

Dr Chris Bearman (CQUniversity) – Lead Researcher  
Dr Benjamin Brooks (University of Tasmania) - Researcher  
Dr Christine Owen (The Learning Organisation) – Researcher  
Mr Steve Curnin (University of Tasmania), Research Assistant  
Dr Sophia Rainbird (CQUniversity) – Research Assistant  
Mr Jared Grunwald (CQUniversity) – Research Assistant  
Keith Fitzgerald (NSW SES) – Lead End User  
Heather Stuart (NSW SES) – Lead End User  
Jeremy Smith (TFS) – End User  
John Santiago (Red Cross) – End User  
Alen Slijepcevic (CFA) – End User  
Mike Grant (NZ SRFA) – End User  
Andrew Lawson (CFS) – End User  
Mike Wouters (DEWNR) – End User  
Phil Robeson (NSW FRS) – End User  
Janet Richardson (QFRS) – End User  
Chris Irvine (TAS SES) – End User  
Mark Swiney (MFB) – End User  
David Launder (SA MFS) – End User



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