

IDENTIFYING LESSONS FROM EXERCISING AND TRAINING FOR STRATEGIC EMERGENCY MANAGEMENT DECISION-MAKING

Peer reviewed research proceedings from the Bushfire and Natural Hazards CRC & AFAC
conference
Sydney, 4 – 6 September 2017

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Version	Release history	Date
1.0	Initial release of document	04/09/2017



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Publisher:

Bushfire and Natural Hazards CRC

September 2017

Citation: Brooks, B., Curmin, S., Bearman, C. & Owen, C. (2017) Identifying lessons from exercising and training for strategic emergency management decision-making. In M. Rumsewicz (Ed.) *Research Forum 2017: proceedings from the Research Forum at the Bushfire and Natural Hazards CRC & AFAC Conference*. Melbourne: Bushfire and Natural Hazards CRC.

Cover: Country Fire Authority



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ABSTRACT

Decision-making is a skill that permeates every emergency event and every level of emergency and disaster management. The decision environment is often complex and uncertain, with challenging physiological contexts such as fatigue, and major consequence for poor decisions. This makes for a fertile ground for decision scholars, and significant opportunities to support the continual improvement of the management system. Emergency management organisations maintain, assess, and improve the quality of decisions in a number of ways. These include exercising teams in simulated emergency events and training focused on improving skills and knowledge.

We report on a series of training and exercising related studies that specifically examined this area. Study One included observation and surveying participants following multiple exercises in a range of end-user organisations. Study Two included detailed analysis of the set of decisions made by a commander during a Search and Rescue deployment to evaluate the core skills utilised. Study Three involved a training intervention – a one day decision-making course where participants were provided with both knowledge and tools to assist them in their decision-making.

Our results identify several consistent themes in terms of where participants perceive their organisations to be performing well, and several lessons are identified that can lead to improvements in decision-making.

Finally, we describe how the BNHCRC Research project 'Practical Decision-Tools for Improved Decision-making in Complex Situations' is building and testing cognitive decision tools based on these results.



INTRODUCTION

Decision-making is a skill that permeates every emergency event and every level of emergency and disaster management. The decision environment is often complex and uncertain, with challenging physiological contexts such as fatigue, and major consequence for poor decisions. This makes for a fertile ground for decision scholars, and significant opportunities to support the continual improvement of the management system.

Emergency management organisations maintain, assess, and improve the quality of decisions in a number of ways. These include exercising teams in simulated emergency events and training focused on improving skills and knowledge. In a previous evaluation of decision-making structures and processes within end-users of the Bushfire and Natural Hazards CRC project, a number of aspects of good decision-making knowledge and skills were evaluated. The process of evaluation included the review of organisational processes and semi-structured interviews with senior staff. Our focus was around the response to so-called 'Level 3' incidents. Participant organisations include a range of emergency response organisations, however were mostly Fire Agencies (both rural and urban) and State Emergency Services. The results identified a range of possible opportunities for improvement, as demonstrated in Table One.

Decision Concept	Coverage in Surveyed Aust/NZ Organisations
Decision-Styles: Awareness of and an ability to work across the spectrum from intuitive to classically rational decision approaches as the context requires them to.	<15%
Monitoring themselves and their teams for evidence of bias or decision errors. (Linked with decision-styles)	<15%
Sense-making: Recognition of the dynamic nature of the process, and the need to not just decide, but to make sense.	50%
Record Keeping: Balancing the need to record decisions for future reference with the effect recording has in creating bias in decision-making	<15%
Creating psychologically safe decision environments that build and maintain trust between teams.	50%

Table One: Evidence of Implementation of Decision Concepts (Adapted from Brooks et al, 2016).

Several key concepts will re-appear throughout the paper in the different studies and are therefore discussed in the conclusion to the paper. These are briefly defined below:



- Sense-Making – is a collaborative process in which people identify meaning within their experiences. It is qualitatively different from decision-making in that it does not necessarily have a discrete start and end point. Further, sense-making identifies how a range of factors – both distant (e.g., our previous experiences) and close (the information at our disposal) combine to create our ‘sense’ of the current situation. It is often used to characterise the building of shared awareness in ambiguous or uncertain situations and therefore particularly appropriate for emergency management incidents.
- Decision Styles – different styles of decision-making include creative, procedural (following rules), heuristic (quick rules of thumb), the classical evaluation of a range of alternatives for their utility and intuition. These styles vary with the degree to which they require conscious evaluation, however all have value in certain decision contexts.
- Meta-cognition – can be described as our ‘thinking about our thinking’ or the awareness and understanding of our own thinking processes. In this scenario meta-cognition relates both the the decision styles and the other elements that influence the quality of the decision –such as bias.
- Cognitive Bias – is an artefact of human cognition that systematically leads to a particular way of deciding, which is quite often incorrect if viewed from a ‘rational’ decision-making perspective. For example, cognition is typically ‘anchored’ from early information or intelligence, even if the subsequent information changes.
- Psychological Safety – is a state of the environment of a team where everyone within the team is comfortable to speak-up about issues or information that could be considered discrepant or divergent from the dominant understanding. It therefore counters particular biases (such as ‘group-think’ or the tendency to side with the majority view), and creates an appropriate environment to explore and catch errors.

Following the evaluation identified in Table One, we triangulated these results with further research. This paper reports on the preliminary data associated with these efforts, and subsequent research utilisation products. Study One included observation and surveying participants following multiple exercises in a range of end-user organisations. These end users included a Fire Agency, a Critical Infrastructure organisation and a private oil and gas company. The exercises were complex enough to require the establishment of a team above what would typically be considered an Incident Management Team – and was therefore focused on strategic-level decision-making. Scenarios varied depending on the organisation and hazard type, but were all what would be considered a ‘Level 3’ incident. Study Two included detailed analysis of the set of decisions made by a commander during a Search and Rescue deployment to evaluate the core skills utilised. Study Three involved a training intervention – a one day decision-making course where participants were provided with both knowledge and tools to assist them in their decision-making.

BACKGROUND

STUDY ONE

A survey was developed to assess decision-making in a series of crisis management exercises. The statements in the survey were based on the decision-making indicator in the Australian Government's Organisational Resilience Good Business Guide. We used this model as its development was research-driven and identified all the significant components of resilience at a broad level. The various components of resilience are shown in Figure 1. The survey comprised of twenty-one decision-making statements grouped into seven themes. These statements significantly extended the initial decision-making elements identified in the Good Business Guide based on our review of the decision-making literature.



Figure 1: The Components of Resilience (Attorney Generals Department, 2016).

Decision-making Theme	Score*
Sense-making	83
Structural support for adaptive decision-making	80
Clarity in decision-making processes	75
Encouraging employees to engage in decision-making	71
Management of bias	81
Record keeping	69
Managing stakeholder expectations	79

*Preliminary data n=32; Score = combination of two scores – a 5 point likert scaled response and a measure of inter-rater reliability across the data, multiplied to create a score out of 100.

Table Two: Results of Decision-Making Survey following Crisis and Emergency Management Exercises



The preliminary results for two exercises are shown in Table Two. These results demonstrated that the participants considered their exercise teams (be they an IMT or Crisis Management Team) had built solid structures in order to be flexible and adaptive in their decision-making; were effective in making sense of the emerging situations and consistently managed bias in their decisions.

Opportunities for improvement included creating psychologically safe places for employees to speak up, and improved record-keeping of decisions. Participants also rated issues associated with the clarity of the decision processes – such as documenting alternative options and info/events that might change decisions; exploration of future scenarios as slightly lower. This suggests that Options Analysis remains an area of significant improvement in significant incidents.

STUDY TWO

Using the Critical Decision Method, a Search and Rescue (SAR) Commander was interviewed about the decisions made during an international SAR deployment. “A critical decision method is described for modelling (sic) tasks in naturalistic environments characterized by high time pressure, high information content, and changing conditions. The method is a variant of a J.C. Flanagan's (1954) critical incident technique extended to include probes that elicit aspects of expertise such as the basis for making perceptual discriminations, conceptual discriminations, typicality judgments, and critical cues” (Klein et al., 1989, p.462).

The purpose of this study was to deepen our understanding of the challenges associated with strategic decision making during emergencies. Following the commander's interview we identified a set of 10 decisions that were made. We then interviewed four of team members also on the deployment. Subsequent to this we re-interviewed the commander. An example of a decision and the deepening of the analysis can be found below.

This analysis created several insights. Good strategic emergency management decision-making addresses a range of issues previously identified in this research project (Brooks et al., 2016).

- It requires team leaders to build psychologically safe environments where team members can speak up.
- It requires decision-makers to be aware of their own thinking (metacognition), particularly when they are moving between different decision-styles (e.g., from intuitive to more rational analyses).
- It requires they evaluate important decisions for the influence of possible bias or error.

This study also identified broader questions that need to be examined in order to improve decision-making competence in emergency management. Does an Incident Controller or SAR commander require hazard specific expertise in order to make effective decisions? The analysis of this SAR deployment suggests that hazard specific knowledge was important. This has implications for cross-jurisdictional deployments, for how we train emergency management personnel and for their trajectory of professionalization through these organisations.



Also, if deployments such as the one identified above occur infrequently, how do you build capacity and provide experience of these sorts of incidents/deployments to a broader group of professionals? For the research team the response to this question involved the use of this sort of analysis to support training interventions, and this was the focus of the final study.

Decision context – first interview	Info from 2nd interview	Info from Team interview
<p>In establishing the base of operations the team leader had numerous complex decisions to make due to locally identified risks. The risk of subsequent earthquakes was high with the country still experiencing up to 20 aftershocks per day that could result in further tsunamis. However there were other risks to be considered – hypothermia from the extreme cold and the radiological hazard from the Fukushima nuclear reactor. The team leader also needed to balance risk against the ability to meet the task</p>	<p>The team leader was highly rational in his approach to determining the level of risk. In this situation the team leader identified 4 high level risks: (1) tsunami; (2) earthquake; (3) cold; and (4) radiation (the latter was actually manageable due to strict regulation surrounding radiation). He was constantly reassessing the risks and confirming on a regular basis that the team could pull out in 4 hours if required. If the severity is held constant in this situation (i.e. the worst case scenario involves multiple fatalities in the team), the team leader was making judgements about probability of that outcome and ranking them in order of likelihood and ability to reduce likelihood through the teams actions</p>	<p>Team-member – Initially thought baseball field where BOO (Base of Operations) was going to be grass but only when they arrived they realised it was dirt. Addressed risks in that were away from the coast on elevated ground and not in close proximity of any tall buildings. Knew prior to arriving that the baseball field was large enough to accommodate team and had not previously been impacted by the tsunami. ID site through google maps etc. but importantly trust the locals.</p>

Table Three: SAR Commander Decision Process

STUDY THREE

This study involved a training intervention – a decision-making course where participants were trained to provide them with both knowledge and support skills that assist them in their decision-making. Participants were represented from all Australian jurisdictions, and had previously experience at an Incident Management Team level.

Figure 2 identifies the different modules included in the course. The two lower modules we considered the foundations of good decision-making. Unless psychologically safe environments are built, maintained and retrieved (when they go wrong) it is difficult to make good decisions. Team members will not speak up about divergent intelligence and the decision-making becomes susceptible to a range of individual biases such as availability (relying on most recent experience even if it differs from the current situation). Teams become susceptible to group-think. Managing pressure is also foundational because the inability to manage pressure tends to create either fibrillation errors (doing many things but none effectively) or fixation errors (focusing on one issue to the exclusion of other important issues). Finally there are a range of individual

cognitive biases (beyond just anchoring or availability) that also support effective decision-making. The skills around scenario planning and anticipatory thinking tend to build on the foundational skills of managing bias, error and safe psychological environments. We note that this approach is open to argument and will continue to be tested through further assessment of the training modules in the second half of 2017.



Figure 2: Modules of the Decision-Making Training Intervention

The training modules are described below – working from the bottom of Figure 2 upwards:

Managing Pressure - This module explores the various factors that create pressure on the decision-maker and identifies strategies that can be put in place to mitigate those pressures.

Managing Bias and Errors - This module starts with consideration of the key challenges to making decisions in EM environments such as uncertainty, time and resource constraints. The key sources of bias and error in decision-making are identified. The implication for how decisions are recorded is explored.

Psychological Safety - This module uses a simple 3-step strategy to improve the psychological safety of teams. The aim is to produce greater levels of engagement and allow team members to feel comfortable to speak up if they disagree or have divergent opinions, and underpins good decision-making.

Anticipatory Thinking, Situational Awareness, Worst and Most Likely Scenario Planning - This module examines concepts including situational awareness, mental models, sense-making and cognitive predictions (anticipatory thinking). It explores how these concepts are used to build and influence Common Operating Pictures, and to develop Options Analyses.

From the available literature a set of checklists (aides memoir) were developed that were linked to these concepts. The participants then engaged in an exercise that had been specifically designed with injects to test the concepts in the aide memoir, but embedded within a realistic emergency scenario. An example of an aide memoir is identified below:

AIDE MEMOIR: Situational Awareness:

PERCEPTION: Are you comfortable with the quality and quantity of intelligence you are receiving/producing? What are you missing?



COMPREHENSION: Are you transferring your analysis of the intelligence into SMEAC's or similar and contributing to building a Common Operating Picture?

PROJECTION: Are you planning for what is going to happen next shift, next 24 hours, next 48 hours or next 7 days?

Participants evaluated the usability of the checklist following an exercise. The exercise was a major oil spill event. To do this they used the Quality In Use Scoring Scale, or QIUSS. Quality in use is a usability measure of the degree to which a product enables specified users to accomplish specified goals with effectiveness, productivity, safety and satisfaction. The quality in use scoring scale used here is made by Brian Sherwood Jones, Process Contracting Limited, v1.0 17 March 2008. It is used under a creative commons licence. The full tool can be found in Appendix 1. The results of the assessment for the aide memoir for situational awareness are identified in Table Four below. The range for all criteria was between 2-4 on each scale (i.e. no participant ranked the aide memoir a '1' or a '5'). These results are both encouraging – given the median descriptor across the four criteria, but also indicate the possibility for improvement.

Criteria	Median Descriptor	Average and SD
Effective	Functional – You can get a good outcome. It enables you to perform your tasks. 75% chose this descriptor or better.	Ave = 2.80 SD = 0.5
Safe	Dependable – It provides good protection and you would feel safe if you used it again. 71% chose this descriptor or better.	Ave = 2.83 SD = 0.6
Efficient	Helpful – It is efficient and tuned to your needs. 71% chose this descriptor or better.	Ave = 2.83 SD = 0.6
Satisfying	User friendly – You are happy to use it and use it out of choice. 83% chose this descriptor or better.	Ave = 2.80 SD = 0.4

Average scores from 27 surveys, ratings between zero and 5 as per QIUSS, see Appendix 1 for details.

Table Four: Quality in Use Scoring Scale Results



CONCLUSION

This body of research has followed a process called 'User-Centred Design'. Typically this design process begins with establishing the context of use. This required the researchers to visit end-user agencies and collect documentary and interview data to understand the nature of strategic decision making at that point in time. This identified opportunities for improvement, but also built our awareness of the context of use for any tools we might develop. Following this we conducted three studies:

1. Surveys of participants in emergency management and crisis management exercises, asking them to evaluate their decision-making. This data demonstrated opportunities for improvement in the involvement of employees in decision-making, record keeping and the clarity of decision processes.
2. We assessed the decisions of a SAR commander for one international deployment using the Critical Decision Method – we then interviewed 4 of his team members, and re-interviewed the commander. Our aim was to provide a deep contextual understanding of the decision-making. This work identified to us the value of building psychologically safe environments, managing changes in decision styles and controlling for cognitive bias and error.
3. Finally we conducted a training intervention. We created training modules on key decision-making issues and paired them with an aide-memoir. We then exercised participants with injects that directly tested the particular decision concepts and asked them to identify the value of an aide memoir that supports that decision concept. Using an aide memoir from one part of the training intervention we identified that 75% of participants found it to be at least functional, dependable, helpful, and user friendly. This also indicates that 25% of participants did not ascribe the same level of usability to the aide memoir. This identifies an opportunity to continually improve the product.

The results of this series of studies identify a consistent set of decision themes that can change the quality of strategic emergency management decision-making. If managed appropriately, these themes can support effective, efficient, safe and satisfying decision-making. The research is still in progress – and while we can confidently identify the decision challenges facing strategic decision-makers in emergency management, there is still a significant way to go before the research utilisation products are completed and implemented. Data will continue to be collected from exercises throughout 2017 to verify the preliminary results of Study 1, and the training materials will also continue to be trialled and improved during the same period.

This points to a design process which is user-centred and research driven. This process is iterative, which means the research team will consistently revisit the conclusions as data-sets increase in size, and iterate on the design of the research utilisation products. Through the use of these products it should be possible to improve strategic decision-makers knowledge and skills in decision-making, and therefore improve decision processes during Level 3 type emergencies.



The research has also highlighted important questions currently beyond the scope of the research but worthy of further examination. In particular our Study 2 of the SAR deployment indicated to us the value of hazard-specific knowledge to the decision-making process. In a world of cross-jurisdictional and cross-service deployments, this particular issue warrants further examination. We also note that other aspects of decision-making remain to be investigated. We are yet to fully understand the challenges and opportunities associated with the use of creativity and divergent thinking during emergencies, or whether new research associated with brain plasticity can be used to support improvements in the fundamentals of cognition (e.g., memory, attention, perception). All of this points to the need for further research in this important area of human performance.



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APPENDIX 1

Quality in Use Scoring Scale (QIUSS)

Effective

0	Useless	No useful functionality at all. Might as well not have it.
1	Inadequate performance	It provides very little help with performing a task. Even if you use all the features, you still get a very poor result.
2	Does the job	You can achieve adequate performance but nothing more than that.
3	Functional	You can get a good outcome. It enables you to perform your tasks.
4	High performance	You can achieve your goals completely. You get very good outcomes under all circumstances.
5	Transforms the task	You get outstanding results and can achieve exceptional performance. Even a regular user will award this score very rarely.

Safe

0	Dangerous	It puts people in harm's way, or provides no protection whatsoever .
1	Risky	Using it puts you or someone else at risk, and it can only be used with considerable care.
2	Neutral	It has no impact on safety or security.
3	Dependable	It provides good protection and you would feel safe if you used it again.
4	Trusted	It provides very good protection against all threats.
5	A real protector	It provides completely assured protection. Even a regular user will award this score very rarely.

Efficient

0	Impossible	It takes so much time and effort that it prevents you from doing the task. Dysfunctional, and prevents you achieving any outcome.
1	Tedious	So long-winded that you can hardly get the task done. You waste a lot of time and effort with it.
2	Workmanlike	You can perform the tasks without hindrance but it does not provide any real assistance.
3	Helpful	It is efficient, and tuned to your needs.
4	Slick	It really helps you achieve your goal with no effort at all.
5	Almost psychic	Anticipates what you want to do next. Even a regular user will award this score very rarely.

Satisfying

0	Horrible	You refuse to use it unless it is absolutely necessary.
1	Unpleasant	Unpleasant to use, and is only used with considerable resentment. A pain in the neck.
2	Bland	Using it is just something you do when necessary.. You are not involved or interested.
3	User friendly	You are happy to use it and you use it out of choice.
4	Joy to use	You get a kick out of using it. Using it provides real enjoyment.
5	A miracle of rare delight	Possibly the most enjoyable system you are ever likely to find. Even a regular user will award this score very rarely.