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PROPOSED TOOLS FOR MONITORING TEAMS IN EMERGENCY MANAGEMENT

Interim report on emergency management breakdown aide memoire and team behaviour markers

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EXECUTIVE SUMMARY

As part of their role in managing emergencies regional and state level emergency managers (SEMs) monitor the activities of operational teams below them in the agency to ensure that those teams are functioning safely and effectively. Teams operating in complex dynamic environments are likely to experience disruptions to their teamwork (particularly in the early phases of an emergency). If these disruptions are not managed effectively they will cause the team to move out of conceptualised safe spaces of operation, firstly into the "zone of coping ugly" then into an area where incidents and accidents become more likely to occur.

The question then is how SEMs can best manage teams to ensure that they are functioning effectively. There are a number of methods for examining the performance of teams that have been presented in the literature on teamwork. However, none of these have been used in an emergency management context. Two of these methods have been selected as initially warranting further consideration and will be modified and trialled in the initial phases of the evaluation stage of the project. These methods are: The Emergency Management Breakdown Aide Memoire (EMBAM) and a Teamwork Behavioural Markers tool based on the work of Wilson et al. (2007).

The Emergency Management Breakdown Aide Memoir (EMBAM) is a guide to assist the identification of teamwork breakdowns across the various organisational levels by listing indicators of breakdowns. This includes categories, such as: missing information, conflicting expectations, inconsistent information, intuition, familiarity, and networks. The Team Behavioural Markers tool is based on a set of behavioural markers of teamwork developed by Wilson et al. (2007). It is designed so a person can scan the list and think about the items to ensure that aspects of good team performance are being followed and if not, to be able to identify what is going wrong.

In the next stages of the project the research team and a small group of end-users (selected from a wider set of end-users involved with the project) will iteratively develop and test the two team monitoring tools that have initially been identified as warranting further consideration. In this way, enhanced methods for monitoring teams can be developed that can be used for the early detection of problems that if unresolved, can lead to impaired operational performance.

INTRODUCTION

Emergency management can be characterised as a hierarchy of teams who need to coordinate effectively to successfully manage an emergency. Within the structure of an operational response, key personnel have responsibility for ensuring that the operation is safe and effective. Typically these personnel operate at strategic emergency management levels (i.e regional and state levels). Regional and state management teams function at what Chen et al. (2008) has described as the many-second coordination level, compared to the mini-second coordination level of incident management teams. As part of their role in managing emergencies then strategic level emergency managers (SEMs) monitor the activities of teams below them in the operational response to ensure that those teams are functioning safely and effectively.

One way to conceptualise the way that teams function is through the notion of a safety space (Brooks, 2014; Rasmussen, 1997)(see Figure 1). A safety space describes a notional area of performance, within which a team can operate safely. Beyond the safety space is an area that Brooks (2014) described as the "zone of coping ugly" where the team is able to function for a limited amount of time at the limits of that team's ability. Beyond the zone of coping ugly is an area of degraded performance where incidents and accidents are likely to occur. As teams managing an emergency deal with the complex dynamic situations the emergency creates they will move around and sometimes out of the safety space. It is important then for regional and state level emergency managers to be able to locate where each of the teams they are responsible for is operating with respect to the safety space. Strategic level emergency managers must be able to identify where teams are and move teams that are close to or beyond the boundaries back to safer spaces of operation. At present there is little guidance within agencies on how best to do this.

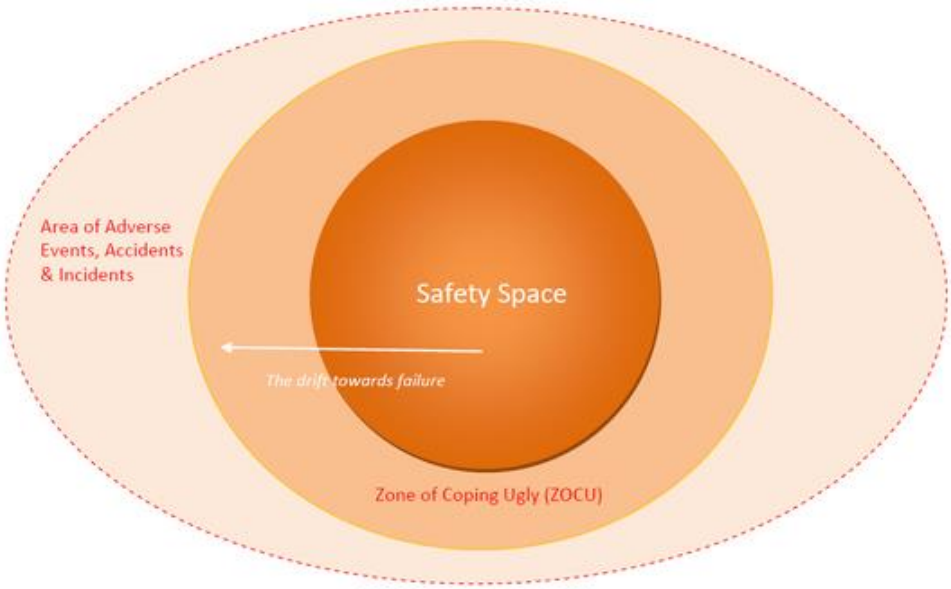

Figure 1. The Safety Space (from Brooks, 2014).

The literature on team performance monitoring in other domains offer a number of potential methods that can be adapted for use by strategic emergency managers (see Bearman et al 2015 for a review). These methods can be grouped into the following themes that describes their approach:

- Monitoring Team Outputs (e.g. Bearman et al., 2015)
- Mapping Team Information Flow (e.g. (Entin & Entin, 2001)
- Inspecting Linguistic Correlates (e.g. (Fischer, McDonnell, & Orasanu, 2007) Examining Team-Based Behavioural Markers (e.g. (Wilson, Salas, Priest, & Andrews, 2007)

Monitoring team outputs focuses on measuring the quality and timeliness of the outputs of a team (e.g. the incident action plans, requests for assistance). If the outputs of the team are confused, missing information, lack coherence or are late this might indicate that the team is not functioning effectively.

Mapping team information flow examines the quantity, directionality, timing and type of communication that occurs within and between the team (Entin and Entin, 2001). If team members are neglecting or excessively preferring one or more team members in their interactions this might indicate a problem in the team.

Linguistic correlates are the non-mission oriented components of team communication (such as: positive/negative affect, acknowledgements, disagreements, etc). Negative interaction in the team may indicate a problem in team functioning.

Team-based behavioural markers are designed to assess teams on a range of markers of good team performance. Teams can be examined against these markers to determine if they are performing effectively.

These methods of examining team performance have been used to differing extents in other domains and each has its strengths and limitations (Bearman et al, 2015). However, none of these methods have been systematically used in emergency management and none have been examined in the context of people who supervise, but are not a functional part of that team. The next stage of the project will examine team monitoring instruments from these approaches to determine their effectiveness in emergency management.

INSTRUMENTS

In the first round of research conducted in the next phase of the project two team monitoring instruments have been chosen for further evaluation based on discussions with end-users. There is currently little or no information about the effectiveness of each of the approaches in the context of emergency management, which is a gap that the current project seeks to fill. However, it seems reasonable to assume that the methods have particular characteristics, which are considered below. These assumptions will be tested in the project.

The team-based behavioural markers approach is based on extensive research into the components of teams (Wilson et al., 2007). The other methods have received much less attention in the research literature and are therefore supported by less evidence. The team-based behavioural markers approach also potentially provides detailed information about the components of teams that may or may not be working effectively, since it focuses on behaviours that should be observed in effective teams. None of the other methods provide this level of detail. The other methods may indicate that a team is or is not functioning effectively but seem to provide only a partial reason for why this might be the case based on the component of teams that they are examining (such as negative affect or information flow patterns around the team). A team monitoring instrument (TBM) was therefore developed for use in emergency management based on the work of Wilson et al. (2007).

While the team-based behavioural markers approach provides detailed information about how the team is functioning it has the potential limitation that it may not always be possible for people to investigate the team to the level of detail provided by the team-based behavioural markers approach, particularly when the people monitoring are not co-located in the team and may themselves be overwhelmed by the emergency. Thus, it is useful to supplement the use of the team-based behavioural markers approach with an approach that can potentially be very quickly applied and fits into the ongoing pattern of activities that are conducted as part of emergency management. The EMBAM (Grunwald and Bearman, 2015) was chosen to meet this purpose.

The initial evaluation of the two instruments will provide a starting point from which the instruments can be refined and adjusted to meet the needs of the stakeholders. The instruments will be evaluated using the QUIS (Questionnaire for User Interface Satisfaction) tool (see Appendix) during the evaluation session, followed up by a semi-structured interview at the end of the evaluation session. This will provide information about the effectiveness, efficiency, and safety of the instruments.

Different uses of the instruments

Given the structure of emergency management and our focus on regional and state levels, there are three different potential applications of the teamwork monitoring instruments: the team supervisor, supporting personnel and the team.

- *Team supervisor*
  The team supervisor has one or more teams that are below them in the organisation and has responsibility for ensuring these teams are performing effectively. This person is not part of, or co-located with that team, but oversees their operation. The team supervisor may be a regional or state level coordinator. The teamwork monitoring instruments gives the team supervisor an indication of where the team is operating in the safety space, allowing early detection of teamwork issues so that they do not escalate and lead to impaired operational performance. This role is the primary focus of the research.

- *Supporting personnel*
  Supporting personnel are people who are present in the regional or state coordination centres but have no formal oversight of teams as part of their role. These people are typically in a support role, such as: support officers for state or regional coordinators, chaplains, liaison offers, mentors, etc. Supporting personnel understand the operation and can ask questions but are not directly involved in managing the emergency. The role of supporting personnel provides them with a perspective that potentially allows them to be able detect teamwork breakdowns.

- *Team*
  The teams themselves can utilise the team monitoring instruments. As emergency management teams frequently operate in complex time pressured situations they may not have insight into issues that are impacting on their operation. The use of team monitoring tools allows a team to detect such issues and either act to resolve them, or report them to the next level in the structure. The use of a team monitoring instrument provides the team with a conceptual framework and a language to discuss teamwork issues.

INSTRUMENT 1: EMERGENCY MANAGEMENT BREAKDOWNS AIDE MEMOIRE (EMBAM)

EMBAM was developed to help strategic level emergency managers better identify and resolve breakdowns. It is based on research with Australian regional coordinators and follows findings by Bearman et al (2015) that informational and operational sub-components of breakdowns in large-scale emergencies were frequently unresolved. EMBAM is essentially a guide to identify breakdowns across the various organisational levels by listing key indicators of breakdown. It includes the categories: Missing information, conflicting expectations, consistent information, intuition, familiarity, networks and feedback (See Figure 2).

EMBAM is designed to provide a quick and easy reference guide for aspects of breakdowns that occur predominantly in the observable products of the team (e.g. the incident action plans and requests for resources). EMBAM provides ways to both identify breakdowns and methods that can be used to resolve them, utilising the person's own knowledge and the networks they possess. Each indicator poses a question that can highlight a potential breakdown within the team. It also lists some strategies useful in resolving a breakdown should one be detected. These include resolving issues by delegating, resource provision, asserting authority, mentoring and replacing personnel. Each strategy includes a descriptor detailing how they might be implemented.

While the properties of EMBAM have yet to be evaluated in the emergency management domain it seems reasonable to assume (subject to further testing) that EMBAM would be quick and simple to use in an operational environment making it a useful health check for teams by people who are themselves operating in complex time pressured situations. However, EMBAM focuses on the output of teams, which means that it detects problems in the team after it has started to influence the team's performance. EMBAM also appears to be unable to detect problems that are being compensated for by the team. A team may have a breakdown that is affecting its performance but may not show up in the outputs of that team. To be able to detect early issues in teams and problems not yet influencing the team's output a measure of team process is required.

Emergency Management Breakdown Aide Memoire (EMBAM)

Purpose

This guide is proposed to help people recognise breakdowns within collocated and distributed teams, and provide some practical resolution strategies.

What are breakdowns?

A breakdown occurs when teams lose the ability to coordinate or communicate effectively. Breakdowns are caused by differences in understanding between teams. For example, not having a shared understanding across teams may lead to teams developing different operational plans, which in turn can lead to operational dysfunction. This guide aims to assist you in identifying breakdowns across the various organisational levels by listing key indicators of breakdown. It also lists some strategies you may find useful in resolving a breakdown should one be detected.

What to look for when identifying breakdowns...

1. **Missing Information:** How confident are you that you have the relevant information about the incident?
2. **Conflicting expectations:** Is the information consistent with what you would expect to be happening in that situation?
3. **Consistent Information:** Is the information you have consistent across all sources?
4. **Intuition:** Does your gut tell you something isn't right about the situation?
5. **Familiarity:** Is someone familiar to you not behaving in a manner you have come to expect of them?
6. **Networks**: Have you spoken about plans and problems with key personnel recently?
7. **Feedback**: Have you received confirmation that the tasks you delegated have been completed?

How you might resolve breakdowns...

1. **Delegate:** Find someone who is close to the breakdown or has the most appropriate skills and have them resolve the issue. Remember to receive confirmation.
2. **Resource:** Breakdowns can be caused by missing resources. Find out what is missing, or what will assist the other teams, and get it to them.
3. **Mentor:** A subtle form of resolution, mentoring allows you to suggest alternatives, opinions and strategies without stepping on people's toes.
4. **Assert:** If you've tried more subtle strategies and they haven't worked you can use your authority to resolve the problem.
5. **Replace:** If breakdowns are occurring because of disruptive personalities in the management team, or even things like fatigue, you can stand them down or give them alternate duties.

Lastly, ensure those under your command understand what a breakdown is and to report it to you.

Please note, these are preliminary tools that are currently under development by the Bushfire and Natural Hazards CRC research team led by Dr Chris Bearman.

INSTRUMENT 2: TEAM BEHAVIOURAL MARKERS

The Team Behavioural Markers (TBM) tool is based on research by Wilson et al. (2007) and is designed to detect teamwork breakdowns military operations. The TBM tool focuses on situational awareness and decision-making capabilities and was developed from the teamwork literature to identify a theoretical basis for an error classification taxonomy. The taxonomy was further developed to incorporate behavioural markers 'that can affect shared cognition in teams'. Three areas of team processes (communication, coordination and cooperation) are used to cover a range of 'teamwork competencies' (i.e. knowledge, skills and attitudes).

The TBM tool used in this research is adapted from Wilson et al. (2007). TBM closely examines the behavioural markers of teamwork breakdowns, converting these markers into a list of questions that can be explored in real world situations. For example, closed-loop communication is a behavioural marker of good team work (Bowers, Jentsch, Salas, & Braun, 1998), so questions about the adequacy of closed-loop communication could uncover a breakdown. TBM is designed to be used as a checklist for breakdowns. It is designed so a person can scan the list and think about the items to ensure that aspects of good team performance are being followed and if not, to be able to identify what is going wrong.

Like EMBAM the properties of TBM have not yet been evaluated in the emergency management domain. However it seems reasonable to assume (subject to testing) that TBM provides a detailed consideration of teamwork processes that can potentially detect early problems in teamwork and problems that are not yet influencing the output of the team. TBM also seems to be useful in following up on team performance if a problem in team functioning has been detected using other methods, such as EMBAM. The likely disadvantages of EMBAM are that it is quite detailed, long and may be difficult for someone to use by someone who is under stress and time pressure. These are empirical questions and will be examined in the testing phase of the tool.

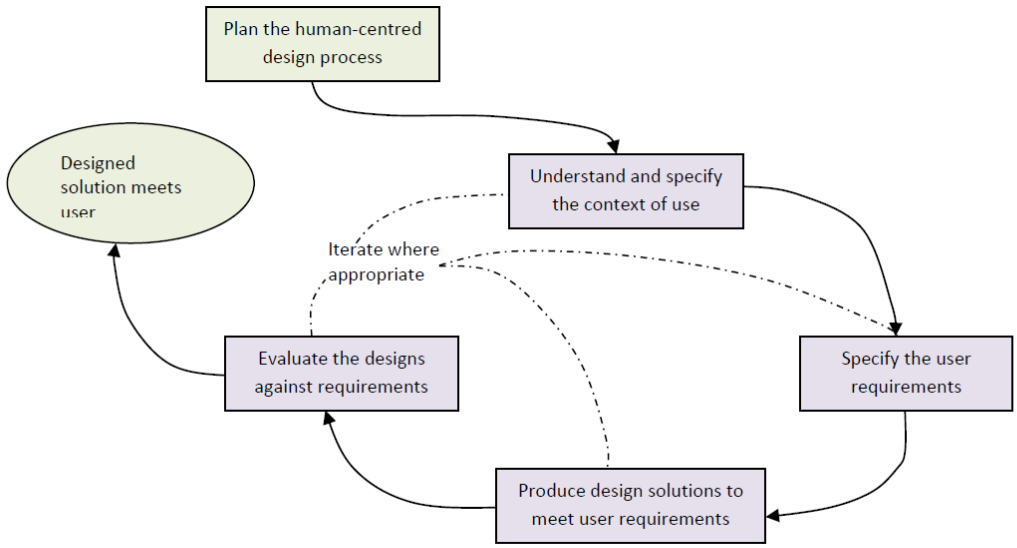

Figure 1 – Interdependence of human centred design activities (ISO 9241-210:2010(E) p.11)

Figure 1. Team Behavioural Markers (adapted from Wilson et al., 2007)

Team Behavioural Markers (TBM) Checklist

Communication
Information exchange
Are team members seeking information from all available resources?
Are team members passing on information in a timely manner before being asked?
Are team members providing "big picture" situation updates?
Phraseology
Are team members communicating clearly and audibly with each other?
Are team members using proper terminology and communication procedures?
Are team members passing complete information to each other?
Closed-loop communication
Are team members acknowledging requests from others?
Are team members acknowledging receipt of information?
Are team members verifying that information sent was interpreted as intended?
Coordination
Knowledge requirements
Do team members have a common understanding of the mission, task, team,
Do team members share a clear and common purpose?
Mutual performance monitoring and back-up behaviours
Are team members recognising and correcting any mistakes made by others?
Are team members providing and requesting assistance from other team
Adaptability
Are team members compensating for others?
Are team members adjusting to meet situation demands?
Cooperation
Team orientation
Are team members collectively motivated, and are they showing an ability to
Are team members acknowledging and using inputs from other team
Collective efficacy and mutual trust
Do team members exhibit confidence in fellow team members?
Do team members exhibit trust in fellow team members?
Are team members following team objectives without opting for
Team cohesion
Are team members remaining united in pursuit of mission goals?
Are team members resolving any conflict effectively?

Please note, these are preliminary tools that are currently under development by the Bushfire & Natural Hazards CRC Research Team led by Dr Chris Bearman.

RESEARCH PROGRAM

The team monitoring tools will be evaluated in the next part of the project in conjunction with members of Research Development and Testing (RDT) Group. The RDT Group has members from both universities and emergency management agencies and will work together to develop and test the team monitoring tools in an iterative cycle of activity. The establishment of the RDT group is part of the process developed by the research team to develop human-centred tools that are tailored to humans performing complex tasks in operational environments.

The iterative cycle of development in conjunction with end-users of the tools is part of a human-centred design approach that has been adopted in the project. 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. Establishing such a design process can help ensure the usability of systems by addressing human elements and other technical issues.

Activities are carried out in a human centred design process and centre around understanding the context of use, specifying the user requirements, producing design solutions to meet user requirements and evaluating the designs against user requirements. At the beginning of the process the human-centred design process is conceptualised and planned and at the end of the process the designed solutions are deemed fit for use. Figure 4 presents this as a conceptual model.

The focus of the next stages of the project is to work closely with the RDT group to iteratively develop and test the two team monitoring tools that have been identified as warranting further consideration. In this way, we will seek to develop team monitoring tools that emergency managers can use to better monitor their teams so that problems in team functioning can be identified and rectified early, before they lead to impairments of operational performance.

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APPENDIX – QUIS-R (ADAPTED FROM JONES, 2008)

Effectiveness

5	Outstanding	You get outstanding outcomes under all circumstances
4	High performance	You can get a very good evaluation of performance under different circumstances
3	Functional	You can get a reasonable evaluation of performance. May be limited in some circumstances.
2	Does the job	Provides an ok evaluation of performance but nothing more than that. Limited to a few specific contexts.
1	Inadequate performance	It provides very little help with evaluating the task. This instrument gives a very poor result.

Efficiency

5	Minimal Effort	It helps you achieve your goal with the minimum of effort
4	Helpful	It is efficient, and mostly tailored to your needs.
3	Workmanlike	You can perform the task but it's a bit awkward to use.
2	Tedious	So long-winded that you can hardly get the task done. You waste a lot of time and effort with it.
1	Impossible	It takes so much time and effort that it prevents you from doing the task. Dysfunctional, and prevents you achieving any outcome.

Safety

5	Trusted	It provides very good protection against all potential threats
4	Dependable	It provides good protection from some potential threats.
3	Neutral	It has no impact on safety or security.
2	Risky	Using it puts you or someone else at risk, and it can only be used with considerable care.
1	Dangerous	It puts people in harm's way, or provides no protection whatsoever