Spanning boundaries to support effective multi-agency coordination in emergency management

Steven William Curnin

BMedSci (Hons) – University of Sheffield

MEmergMgt – Charles Sturt University

Submitted in fulfilment of the requirements

for the degree of Doctor of Philosophy

Faculty of Education

University of Tasmania

Australia

February 2015

Statements

Declaration of originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of the my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

Authority of Access

This thesis may be made available for loan and limited copying and communication in accordance with the *Copyright Act 1968*.

Statement of Ethical Conduct

The research associated with this thesis abides by the international and Australian codes on human research and was approved by the Tasmanian Social Sciences Human Research Ethics Committee (reference number: H0008810).

Published work contained in thesis

The publishers of the scientific research papers comprising appendices A, B, C, D and E hold the copyright for that content, and access to the material should be sought from the respective journals. The remaining non published content of the thesis may be made available for loan and limited copying and communication in accordance with the *Copyright Act 1968*. The statement of co-authorship for the aforementioned scientific research papers is located in Chapter 4.

Signed

Steven William Curnin

Abstract

Modern disasters are frequently beyond the management capability of any one organization and repeatedly necessitate an approach requiring multiple organizations such as those witnessed following the Indian Ocean tsunami in 2004 and the Haiti earthquake in 2010. An increased susceptibility of societies impacted by natural and man-made hazards consequently requires a coordinated response from public and private organizations in an effort to mitigate the risk to the affected communities. Failure to enact an adequate response to manage the consequences of disastrous events has the potential to create widespread death and injury to an already vulnerable global population.

This doctoral thesis by publication draws attention to the specialist workers involved in emergency management arrangements, commonly called liaison officers, from organizations involved in multi-agency coordination efforts. Liaison officers are required to span organizational boundaries to provide linkages between organizations engaged in emergency management events. Consequently, they are deemed fundamental to the success of any multi-agency coordination approach. However, the work of liaison officers is problematic as they are invariably confronted by a myriad of social, organizational and technological complexities. The unique nature of multi-agency coordination in emergency management is generally highlighted by coordination failure and continues to be inadequately addressed in practice and in research.

The principal aim of the research was to explore the work of liaison officers involved in multi-agency arrangements and suggest a framework for improving multi-agency coordination in emergency management. The research was thus embedded in human factors drawing on theories that also provided a contextual understanding of dynamic socio-cultural

environments. In so doing the research explicitly drew upon the methodology of core-task analysis which is a conceptual modelling approach for the analysis of empirical qualitative data that is typically suited to high reliability environments.

The qualitative data used in this research was collected from a series of individual interviews, observational studies and focus group interviews conducted with liaison officers from public and private organizations across three Australian states. The findings are presented in five scientific research papers. Three of the papers have been published in internationally recognized peer-reviewed journals. The final two papers have been submitted for publication and are currently under review.

The contributions of this research have enhanced knowledge development and provided insights that can be utilised in evidence-based practice in emergency management. The theoretical contribution provided an insight into the work of liaison officers in the context of emergency management arrangements. The methodological contribution permitted the application of core-task analysis to the domain of emergency management where it had not previously been applied. Finally, facets of this research have recently been implemented by industry into operational doctrine and organizational learning processes.

Preface

Given the developmental nature of *thesis by publication* in Australia I would like to first elaborate and provide a more detailed explanation on the structure of this thesis.

In the University of Tasmania's policy statement regarding *Thesis by Publication* it states that *"as a guideline, when the majority of a thesis is to be comprised of published papers, anywhere between three to eight papers bracketed between an introduction (that lays a coherent foundation to the research) and a conclusion (that draws the findings together and provides a clear statement concerning the findings) could be considered acceptable"*.

However, in this thesis by publication I have included a separate literature review chapter and a separate methodology chapter as these were requirements for a graduate certificate in research that was part of my doctoral studies. Although these are facets commonly associated with the more traditional format of a thesis (Mullins & Kiley, 2002) it allowed me to comprehensively articulate the literature review and methodology aspects of the research that are sometimes difficult to convey in a published paper due to the imposed word limitations. This is in contrast to the format of some thesis by publications that amalgamate these two areas into a *Framing* chapter. Therefore the reader may encounter some repetitiveness regarding these particular chapters when reading the literature reviews and methodology sections located in the five research papers.

As I was awarded a scholarship from the Australian Bushfire Cooperative Research Centre and thus aligned to one of their projects titled *Organizing for Effective Incident Management*, the research in this thesis will be explored from an Australian perspective.

Acknowledgments

Research is seldom performed in isolation and this is true for this thesis which is a testament to outstanding team work. My thanks go to all the liaison officers that participated in the study as without your participation there would be no thesis. I had the opportunity to work with numerous people involved in emergency management arrangements in multiple emergency operations centres and without your support and your ability to *grease the wheels* this project would not have run as smoothly as it did. In particular, a special thanks to all the liaison officers who participated in the observational studies conducted during actual catastrophic bushfire events. Your role is already challenging in this situation without having me following you around asking you questions, your patience was greatly appreciated.

To my primary supervisor Dr. Christine Owen, many thanks for your understanding regarding my obsession with time management and constant bombardment to turn papers around in a week so this thesis actually *was* by publication. I would also like to thank my co-supervisor Professor Douglas Paton for providing valuable feedback whenever I dumped chapters or papers for revision on his desk.

I would also like to extend a special thanks to my good friends Tanya Robb and Mark Wieser. Thanks Tan for proof reading this thesis in record time and to Mark for his honesty in not wanting to proof read the thesis as I am certain it would have bored you stupid.

To my parents and the outlaws who witnessed their son, son-in-law and father of their grandchildren quit a well-paid career to embark yet again on a low paid academic venture, your understanding is treasured.

I would like to say a super big daddy thanks to my two little ginger ninjas, Emily and Lewis, who never whinged when I worked away and always turned this into a positive and a great opportunity to request presents from the airport.

Last, but certainly not least, a special thanks to my very understanding wife Emma. Your support for this thesis and ultimately your unconditional encouragement in my quest for new challenges over the last 11 years is nothing short of amazing. I'm in constant surprise that you put up with me and therefore I would like to dedicate this thesis to you. I know you will put it to good use as a door wedge or some other practical application. Thank you!

Table of contents

Chapter 5
Conclusions

Appendices

List of tables

List of figures

Chapter 1
Context

Contents

1.1 Introduction

In this chapter I will outline the purpose and importance of this thesis by publication. Firstly I will present a brief overview of the research problem highlighting the significance of the topic under investigation. In the next section I will explain the global research question, methodological approach and three particular research questions framing this thesis. A guide to the thesis will be then be offered providing details how it is composed and finally a brief conclusion will be given.

1.2 Research problem

Globally, both natural and man-made disasters such as the World Trade Centre attacks in 2001, European heat wave in 2003, Indian Ocean earthquake and tsunami in 2004, Hurricane Katrina in 2005, Haiti earthquake in 2010 and the Fukishima nuclear incident in 2011 give prominence to the susceptibility and vulnerability of society to suddenly-occurring events. These disastrous events have a great impact upon society that is becoming increasingly urbanised and thus reliant on the interconnectivity of the communities where we live. The interconnected nature of modern society is dependent upon the effective functioning of critical infrastructure to provide public services, maintain a quality of life and encourage economic growth (Boin & McConnell, 2007). There is an expectation in industrialised societies that essential critical infrastructure services will still be available during extreme catastrophic conditions despite their vulnerability to disasters (de Bruijne & van Eeten, 2007; Marti & Hollman, 2008). Societal dependence on critical infrastructure is highlighted during disasters when significant damage to these assets and subsequent period of disruption deprives citizens of basic services often for considerable periods of time (Gheorghe, Masera, de Vries, Weijnen, & Kroger, 2007). Hurricane Katrina caused untold damage to critical infrastructures depriving its citizens of basic services with an estimated rebuilding cost exceeding $200 billion and the reconstruction of the physical environment and urban infrastructure estimated to take 8 to11 years (Fritzon, Ljungkvist, Boin, & Rhinard, 2007; Kates, Colten, Laska, & Leatherman, 2006; Leavitt, 2006; Simpson & Lasley, 2010). Consequently, organizations involved in emergency management arrangements require a coordinated approach to mitigate the damage during the disaster if possible and facilitate recovery from events that have the potential to create widespread death and injury, with loss of utilities, infrastructure and services.

Disastrous events whose scale, complexity and duration, often transcend the management capability of any one organization (Meyerson, Weick, & Kramer, 1996). require organizations to transition from independent entities and assemble into temporary supra-organizations to address the problems in situations where there is little time to plan for this (Janssen, Lee, Bharosa, & Cresswell, 2010). Organizations "routine" expertise evolves to encompass a multi-agency management capability in which routine and emergency actions need to be combined and applied appropriately depending on the demands of the situation. This multi-agency approach occurring within the structures of the temporary supra-organization requires a coordinated response. However, despite its importance, the concept of multi-agency coordination in emergency management and associated challenges are ambiguous and warrant further investigation. The ambiguity means that despite improvements, a lack of timeliness compounded by the inappropriate delivery of resources often results in no services, as experienced during Hurricane Katrina. This is still an important concern today and therefore as a society we need to better understand how this can be improved.

Consequently, a crucial aspect of the response environment involves how these diverse organizations can be integrated to create a more holistic response. It is necessary to understand how the representatives of the multiple organizations involved in the emergency management arrangements operate. These personnel have to manage their operations in the back drop of all the complexities inherent in disastrous events using their existing means while operating in real time conditions and often with poor information. In emergency management, the people who represent the organizations involved in the multi-agency coordination efforts are habitually called liaison officers (Helsloot, 2005; Perry, 2003; Wolbers & Boersma, 2013). In order to analyse the work of liaison officers and how multi-agency coordination works I needed to find a theoretical model suited to this undertaking.

In this research I will adopt an approach grounded in human factors and ergonomics and draw upon a core-task analysis methodological framework to guide the project. This methodology is a conceptual modelling approach for analysis of empirical qualitative data for defining the constraints that a particular domain puts on the actors working in it. I acknowledge that the research could have used other methods such as cognitive task analysis approaches. However, due to the open ended and dynamic system of the research setting, where the external environment and subsequent interaction with the workers is decisive, I had to choose a framework that was suitable for this complex and uncertain environment. In addition, I will also be using the concepts of situation awareness and boundary spanning as mechanisms to investigate the problems of liaison officers working in multi-agency coordination arrangements. Further details of these constructs can be located in Chapter 2 and further explanation on the core-task analysis methodological approach is provided in Chapter 3. The following sections will contextualise the terms of emergency management, multi-agency coordination and liaison officers that were briefly referred to previously.

1.2.1 Emergency management

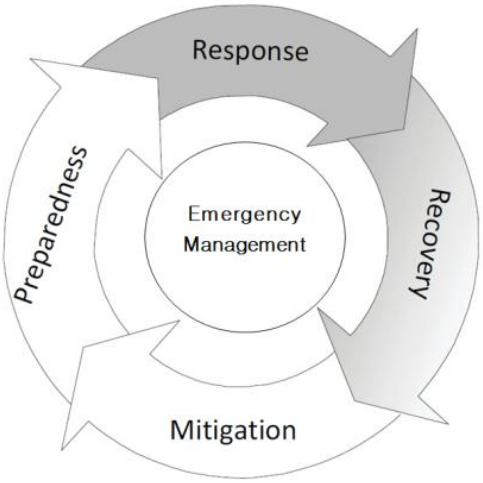
The definition of emergency management is extremely broad and unlike other, more structured disciplines, it has expanded and contracted in response to disastrous events (Haddow, Bullock, & Coppola, 2011). In the literature the term emergency management is interchangeably used with the term disaster management and also crisis management (Boin, 2004; Comfort, Waugh, & Cigler, 2012; Quarantelli, 1997; Zimmerman, 1985). An uncomplicated definition of emergency management is that it is a discipline that deals with risk and risk avoidance (Haddow et al., 2011). However, risk also represents the possible occurrence of a harmful event that has some known likelihood of happening over time (Comfort, 2005). Ultimately, in a complex social world it would be impossible for any

government to avoid all possible consequences (which represent a component of risk) in the kind of natural hazard events that can become disasters (Wildavsky, 1988).

Consequently, in this thesis I will adopt a definition by Emergency Management Australia (1998). They state that emergency management is a range of measures to manage risks to communities and the environment. It is also the organization and management of resources for dealing with all aspects of emergencies including the plans, structures and arrangements which are established to bring together the normal endeavours of government, voluntary and private organizations in a comprehensive and coordinated way to deal with the whole spectrum of emergency needs (Commonwealth of Australia, 1998).

Emergency management can be described as a lifecycle that incorporates four basic phases. The four phases are closely related to each other and include *mitigation*, *preparedness*, *response* and *recovery* (McEntire, 2012). Figure 1.1 illustrates the four phases in emergency management.

Figure 1.1 Lifecycle of emergency management



The *mitigation* phase which can also be termed the prevention phase refers to actions taken in the pre-emergency event setting to identify risks, reduce the risks and thus limit the

negative effects identified that may impact the community. The *preparedness* phase denotes the actions taken prior to the event that enable the emergency management organizations and the potentially affected communities to be able to respond adequately when impacted. The preparedness phase also allows organizations to select and provide appropriate training for liaison officers who may be expected to fulfil the role. The *response* phase can be described as a stage where liaison functions are deployed. This is when an emergency event could not be adequately mitigated to reduce the impact to the community and subsequently the emergency management organizations trigger their response efforts in an effort to minimize damage to the impacted community. The final phase of *recovery* involves attempts to return to routine community processes. Liaison officers are pivotal in the *recovery* phase which can involve decisions and actions relative to rebuilding homes, replacing property, resuming employment, restoring businesses, and permanently repairing and rebuilding infrastructure. Therefore as the *recovery* phase has such long-lasting effects and usually high costs, the participants (including liaison officers) in the process are numerous and include all levels of government, the business community, political leadership, community activists, and individuals from the community (Haddow et al., 2011).

While recognizing the importance of every phase in the lifecycle of emergency management, the focus in this thesis is the *preparedness* and *response* phases. These phases typify where liaison officer's involved in emergency management processes are most likely to work within multi-agency coordination arrangements in the chosen research domain. During the response phase of a disaster, multi-agency coordination can occur simultaneously at several hierarchical levels within organizations to address operational, tactical and strategic demands (Paton & Owen, 2013). Liaison officers can be expected to work at any of these three levels. Australian emergency management arrangements follow similar concepts used in other countries such as the National Incident Management System (Walsh, Christen,

Christen , Lord, & Miller, 2011) used in the United States of America and the gold–silver–bronze command structure (Pearce & Fortune, 2006) adopted in the United Kingdom. In Australia the operational level typically occurs locally and is activated at the onset of an incident. Tactical arrangements take place at a regional level and are often invoked for multiple incidents within the same locality. Strategic arrangements ensue at a state level and adopt a multi-agency coordination approach offering strategic direction to the emergency events.

1.2.2 Multi-agency coordination

Coordination in emergency management is the way in which different organizations or parts of the same organization work or act together in order to achieve a common objective (International Organization for Standardization, 2011). Multi-agency coordination in emergency management can include membership of many tens of public and private organizations who never or very rarely interact together, and certainly never do so in the high risk and high stress emergency response context. These organizations with differing social histories and areas of expertise have a role in disaster response because the demands of the situation require their expertise. Nevertheless, if a disaster brings together diverse organizations that act in an autonomous manner, the consequence will be frequent confusion and conflict regarding objectives, and with problems establishing lead and subordinate organizational roles. This is because organizations act based upon their particular requirements and not the collective management of complex multi-faceted needs. There is a public expectation that these organizations will coordinate their efforts synergistically in a disaster in an effort to manage the consequence of risk to the affected community.

Modern society is reliant on the effective functioning of critical infrastructures such as energy, water, communications and transport to provide and maintain a quality of life (Boin & McConnell, 2007). The degree to which a hazard event becomes a disaster (or not) is

influenced by the severity of disruption to critical infrastructure and how quickly it can be restored. Organizations can never be fully in control of their business environment and consequently engage in business continuity management practices. This can often be defined as an internal process that identifies potential impacts that threaten an organization and provides a framework for building resilience and the capability for an effective response that safeguards the interests of its key partners, reputation, brand and value creating activities (Smith, 2003). This can differ to crisis response issues that require a holistic and coordinated approach engaging multiple organizations (that regularly have competing objectives) to achieve a common goal.

Frequently the importance of coordination in emergency management is emphasized by coordination failure (Comfort & Kapucu, 2006; Lutz & Lindell, 2008; Moynihan, 2007; Reid, 2006; Teague, McLeod, & Pascoe, 2010; Wise, 2006). In the literature it has been found that the temporal constraints can cause delays in accessing resources or assimilating information (Janssen et al., 2010; Mishra, Allen, & Pearman, 2011). In addition, communication between organizations and the community is challenging during a disaster as a result of dysfunctional systems due to critical infrastructure breakdowns (Aedo, Díaz, Carroll, Convertino, & Rosson, 2010; Comfort & Kapucu, 2006; Manoj & Baker, 2007; McEntire, 2002). This frequently results in a deterioration of quality information (Bharosa, Janssen, & Tan, 2011) that can be compounded by a lack of familiarity and incompatibility with the information systems used (Baber et al., 2007; Coates, Wilson, Hawe, & Crouch, 2011; Ley et al., 2012; Saoud, Mena, Dugdale, Pavard, & Ben, 2006) and differing organizational information requirements (Van de Walle & Turoff, 2008). Information sharing is a necessity to satisfy the information requirements of the organizations involved in the relief efforts in a struggle to inform their situation awareness which is often interpreted as the

ability to understand what is going on, which is required to aid multi-agency coordination (Curnin & Owen, 2013).

During the response phase of a disaster, multi-agency coordination can take place informally in temporary locations at the incident site or in a structured environment such as an established emergency operations centre. At a strategic level, temporary supra-organizations invariably assemble at a designated emergency operations centre. A deficiency in the situation awareness of multiple organizations at a strategic level emergency operations centre can affect decision making capability which can impact actions at the tactical and operational level (Paton & Owen, 2013). Therefore the activities of liaison officers at a strategic level are vitally important to the emergency response efforts. From an Australian perspective, the need to establish strategies to improve multi-agency coordination is gaining increasing attention. As one of the most bushfire[1] prone areas in the world, Australia has also been affected by recent catastrophic bushfires including the 2009 Black Saturday Victorian bushfires and 2013 Tasmanian bushfires. Both of the post-disaster inquiries as a result of these bushfires cited problems associated with a lack of coordination between organizations pointing toward the complications of multi-agency coordination (Tasmanian Government, 2013; Teague et al., 2010). Multi-agency coordination during disasters is still a problem in Australia today.

Effective multi-agency coordination requires a collective approach from public and private organizations that includes the emergency services (e.g. police, fire and ambulance services) and non-emergency organizations (e.g. military, non-government organizations, critical infrastructure agencies, land management agencies). These organizations have to span organizational boundaries to provide linkages between organizations that facilitate the required information sharing and cooperation (Harrald, 2006; Janssen et al., 2010).

[1] For the purpose of this thesis the Australian term of bushfire shall be used which is comparable to the term of forest fire in Europe and wildfire in North America.

1.2.2.1 Organizational boundaries

When multiple organizations come together in the event of a disaster they will encounter numerous boundaries. These often include the different administrative and technological boundaries amongst organizations. In addition are the cultural boundaries unique to particular types of organizations. Depending upon the extent of the disaster, geographical, jurisdictional and political boundaries may also be encountered. When working at the boundaries of organizations, liaison officers are often deemed to be practicing 'boundary spanning' activities. Boundary spanning is a useful tool to consider the work of liaison officers who need to operate at the boundaries of their organizations to facilitate and enable multi-agency coordination.

1.2.3 Liaison officers

Multi-agency coordination in emergency management and specifically the role of liaison officers is problematic due to a myriad of social, organizational and technological complexities (McMaster & Baber, 2012). Fundamental to the enactment and maintenance of the required linkages between organizations is the requirement for liaison officers to have credibility in their role in an effort to obtain adequate information to inform their situation awareness of the event (Salmon et al. 2011), engage in team decision-making (Salas, Rosen, Burke, & Nicholson, 2007), and effectively coordinate their activities so that decision making and coordinating activities may be effective.

Given the pivotal position of liaison officers within multi-agency coordination arrangements it would seem that their activities would be the focus of a good deal of attention in the international emergency management literature. Nevertheless, in this literature the concept of liaison officers working within emergency management arrangements is often in reference to the sharing and exchange of information between organizations, particularly within the notion of multi-agency coordination (Bharosa et al., 2011; Kapucu, 2006b).

However, the role of a liaison officer is far more than that of an information conduit. In addition, the overwhelming majority of research that describes personnel fulfilling a liaison officer capability from the multiple organizations involved in the emergency management arrangements invariably focuses upon those from the emergency services. This is despite the active participation of non-emergency organizations.

Non-emergency organizations, such as land management, non-government organizations and the military are instrumental in multi-agency coordination arrangements. In addition, critical infrastructure organizations are fundamental to any response efforts, particularly the maintenance of community lifelines such as health, transport, telecommunications, water and energy services.

However, although the role of liaison officer is considered a designated role that is recognized and supported by all participating agencies involved in emergency management arrangements, the role is often temporary in nature. All agencies are expected under operational doctrine and directives to designate a liaison officer to attend an emergency operations centre as requested. Nevertheless, the personnel fulfilling the role of liaison officers invariably hold other permanent positions within their agency and only fulfil this role as required often in a temporary capacity. This is typical of the temporary supra-organizations formed during disasters within strategic level emergency operations centres that comprise of personal who have full-time positions within their respective agencies but are expected to shift to different roles as the demand arises (Meltsner & Bellavita, 1983).

A lack of empirical research collectively investigating the full spectrum of liaison officers' involvement in emergency management arrangements deserves further investigation. In particular this concerns the liaison officers:

- Role in multi-agency coordination;

- How this role is fulfilled;
- Challenges encountered when performing the role;
- Mechanisms used to manage the constraints;
- How they influence multi-agency coordination in emergency management.

This research is guided by a desire to advance the capabilities of liaison officers who provide the linkages between organizations in strategic level emergency operations centres and who ultimately have the ability to improve multi-agency coordination.

This is important to this thesis because most of the research pertaining to multi-agency coordination in emergency management is often conducted not from a strategic or tactical level but at an operational level with first responders (Klein, Calderwood, & Clinton-Cirocco, 2010). This research will focus upon the liaison officers working in strategic level emergency operations centres where decision making has a cascading affect and often impacts the actions at the operational level. However, working in an unfamiliar and complex environment such as an emergency operations centre can exert additional constraints on the work of the liaison officer. Therefore I will adopt a human-environment interaction approach in an effort to develop and provide mechanisms that may be used to address the constraints identified in multi-agency coordination and thus mitigate the consequences of risk to the community (Veelen, Storms, & Aart, 2006).

Finally and in reference to the need for further research on this topic, Janssen et al (2010) in an introduction to a special issue on advances in multi-agency coordination arrangements in emergency management, depict the importance of workers, such as liaison officers, performing boundary spanning activities. "In spite of their crucial role, little is known about how boundary spanners influence cross-agency coordination and their effectiveness for disaster management success" (Janssen et al., 2010, p.4).

1.3 Global question guiding the research

In the previous section I introduced the view that multi-agency coordination in emergency management is necessary and complex. Entwined in these complexities are the liaison officers from the multiple organizations involved in the emergency response efforts. Contemporary literature provides little guidance how liaison officers engaged in providing organizational linkages and spanning organizational boundaries should be selected, trained and deployed to fulfil the many aspects of the roles and activities they need to perform. The inclusion of liaison officers in multi-agency coordination is recognized in contemporary emergency management research (see for examples Schraagen & Van de Ven, 2011; Wolbers & Boersma, 2013). Nevertheless there is limited evidence exploring how liaison officers explicitly influence multi-agency coordination in emergency management.

Liaison officers are present in all phases of the emergency management cycle. However, the emergency services are invariably the lead organization, particularly in the *response* phase. Nevertheless, a coordinated approach requires the active participation of all liaison officers in an effort to mitigate the consequences of the hazard to the affected community. Individual liaison officers from multiple organizations involved in a coordinated approach will ultimately influence aspects of the response efforts. The importance of liaison officers within multi-agency coordination arrangements in the setting of emergency management is uncharted territory. The global question guiding this research can be presented as follows:

How can liaison officers improve multi-agency coordination in emergency management?

The objective of the thesis presupposes that an exploratory process is adopted utilising empirical research methods. However, prior to commencing on the research journey the generic nature of the global research question, which can generate many different answers,

needs to be addressed. Consequently I needed to specify the problems further and therefore in an effort to achieve the objectives of the research it was necessary to understand three conditions. Firstly, foundational knowledge was imperative to understand how liaison officers from multiple organizations with often differing goals currently perform their role within multi-agency coordination arrangements. Secondly and in an effort to identify the constraints of operating within multi-agency coordination arrangements, it was crucial to explore and appreciate the challenges and associated demands that are encountered by liaison officers in their work domain. Finally, it was important to ascertain what specific mechanisms are required to facilitate multi-agency coordination in emergency management. These conditions led to the formulation of the following three research questions.

1.3.1 Research questions

Research question 1

How do liaison officers responsible for emergency management arrangements coordinate their activities in multi-agency arrangements?

The purpose in answering the first research question was to understand the role of the liaison officer working within the emergency management domain. This required analysis of the current context and I sought to identify through the actions of liaison officers what constitutes inter-organizational linkages, how the linkages are performed and finally to ascertain if the concept of boundary spanning depicted in other domains is applicable to this environment or needs to be modified.

Research question 2

What demands and challenges are placed on liaison officers within multi-agency coordination arrangements?

The second research question was aimed at developing and analysing the potential constraints that liaison officers face when performing their activities and develop a suitable framework. It sought to analyse the specific challenges faced by liaison officers operating in this environment, determine if these challenges are generic in nature or specific to liaison officers from certain organizations, and reveal what mechanisms they embrace to overcome the constraints.

Research question 3

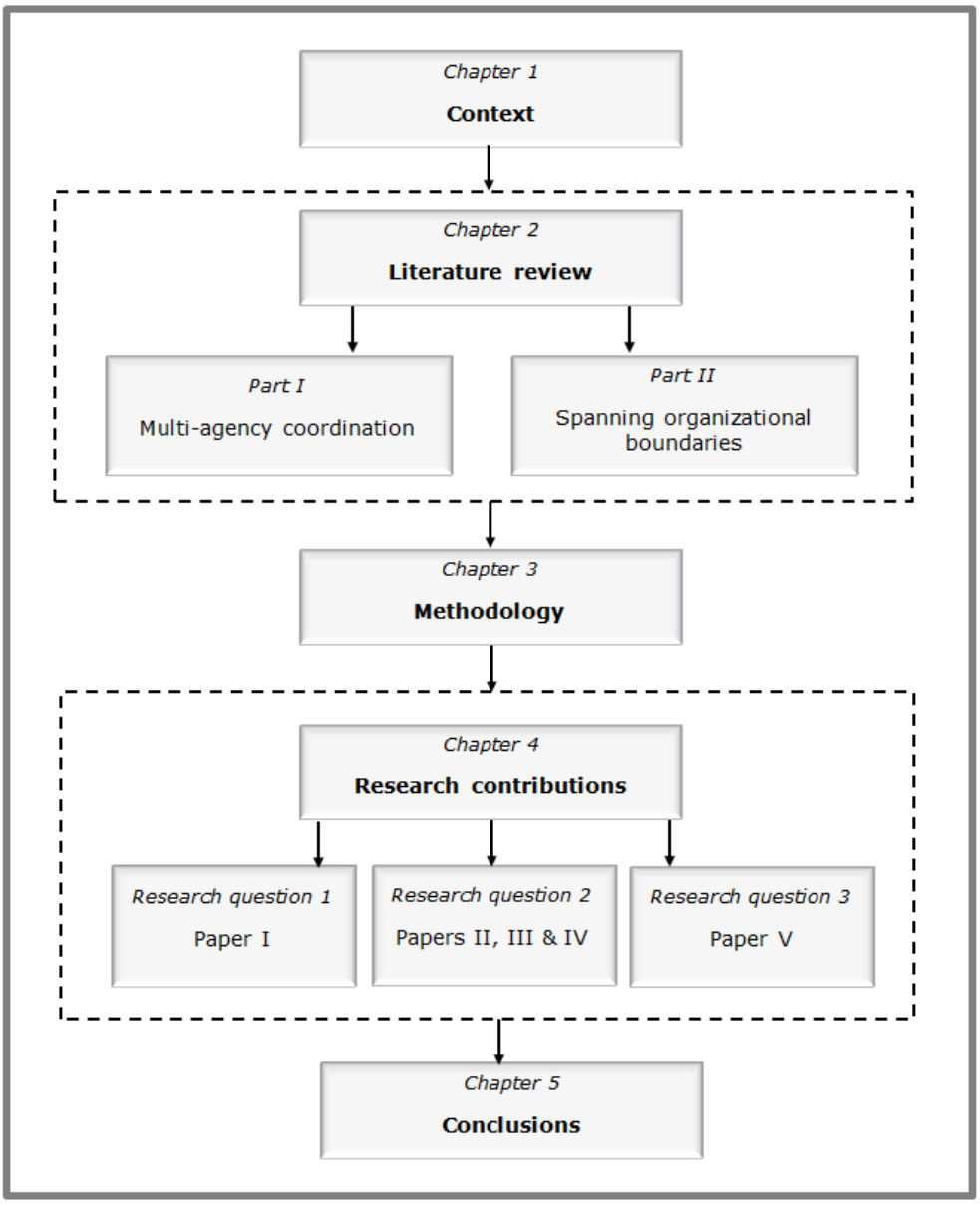
What improvements are needed to support liaison officers to fulfil their role and enable more effective multi-agency coordination?

In providing an answer to the third research question, I drew upon findings generated from the previous research questions that were intended to scope out the terrain of liaison officers working within multi-agency coordination arrangements. By analysing the challenges and subsequent mechanisms that liaison officers adopt to support multi-agency coordination, I was able to suggest solutions for how liaison officers can improve multi-agency coordination. Therefore the objective in answering the third research question was to develop a theoretical framework that models how liaison officers can facilitate multi-agency coordination in emergency management. The purpose of this was twofold. Firstly, the theoretical framework aimed to contribute to theory building in the discipline of emergency management and in human factors and ergonomics. Secondly it provides guidance for industry and in particular policy makers and liaison officers in performing inter-organizational linkages in emergency management that ultimately improves multi-agency coordination.

1.4 Guide to the thesis

This thesis by publication is based on the five research papers presented sequentially in the appendix. The thesis follows the University of Tasmania's requirements for *Thesis by Publication* as described in the preface and is structured as follows to address the objectives stated earlier in this chapter. Chapter 1 provided the context for the thesis and provided the global research problem and subsequent research questions guiding this project. I will then present in Chapter 2 the theoretical foundation and identify the advantages and limitations with respect to the related research and their contributions to a solution for the research problem defined in this chapter. In Chapter 3 the methodological stance adopted in this thesis will be specified and I will explain the rationale for using the described techniques. Chapter 4 introduces and summarizes the five research papers while providing details of co-authorship. Finally, Chapter 5 provides the conclusions where I will explain how the thesis has contributed to theory development, implications for industry and suggest an agenda for future research. Figure 1.2 provides an overview of the thesis and depicts the relationship between the five chapters and the research questions.

Figure 1.2 Thesis outline depicting the relationship between the various chapters



1.5 Summary

In this chapter I set the scene for this thesis by publication by introducing the research problem and why it is of significance in today's society. I then offered the research questions guiding this thesis and provided some background on the theme to be understood. A guide to the thesis was then presented which positioned the aims and objectives in the corresponding chapters.

The importance of multi-agency coordination in emergency management is that it is an indispensable requirement in any disaster. Improving multi-agency coordination in this environment can only benefit the communities impacted by disasters. However, before multi-agency coordination in emergency management can be enhanced, the challenges associated with this approach need to be explored. Consequently, in the following chapter I will examine the related literature to ascertain what the challenges of multi-agency coordination in emergency management are and if they offer solutions to the research problem stated earlier.

Chapter 2
Literature Review

Contents

2.1 Introduction

The objective of this chapter is to review the existing research and in particular the literature associated with the challenges of multi-agency coordination in emergency management and what mechanisms are in place to address them. I recognize that in multi-agency coordination there are two core issues, the ability to understand the situation and the actions required to

enable multi-agency coordination. The first issue pertains to sense making and principally understanding the situation. This is identified in section 2.2 and in particular I explore a construct that is useful for thinking about sense making in the domain of emergency management that is termed *situation awareness*. I explore differing aspects of situation awareness and discuss how it is applied in an emergency management context and report on some of the challenges associated with building situation awareness in this environment including the temporal, technological, communication and cultural challenges.

In section 2.3 I examine the second core issue which is the requirement for liaison officers to cross over between organizational boundaries and how this action is executed. The construct that is useful for this can be designated as *boundary spanning*. I then unpack what activities may be required by liaison officers when spanning organizational boundaries in an effort to build their situation awareness. Consequently I review the concept of boundary spanning from an historical and contemporary perspective focusing upon the activities required for the role. I then review the boundary spanning literature in the context of emergency management. Finally I conclude with identifying gaps in the related literature with respect to the research questions identified in Chapter 1.

Prior to commencing the literature review it is important to explain how this was conducted. Multi-agency coordination in emergency management is a multi-disciplinary research area and the literature selected for inclusion in this review was chosen because of its relevance to different aspects of this thesis. However, the literature was drawn from a wide body and consequently not every area has been described in the same depth. I used the following databases to perform my literature search: ProQuest; CAUL Wiley; SAGE Premier; and Taylor & Francis. The terms used to search for relevant literature included:

- Multi-agency and coordination and emergency and disaster management;

- Situation awareness and emergency and disaster management;
- Boundary spanning and spanners and emergency and disaster management;
- Liaison and officers and emergency and disaster management.

2.2 Multi-agency coordination

In order to understand the concept of multi-agency coordination in emergency management, it is important to briefly review the way in which other fields of research define the notion of coordination. Gulick (1937) suggested that coordination requires the linkage of strong functionally organised bureaucracies to solve problems. This is consistent with the definition provided by Malone and Crowston (1990) who believe that coordination is the ability to manage dependencies between entities. However, these traditional definitions of coordination tend to focus on the management of dependencies and have a limited applicability to fast response organizations (Faraj & Xiao, 2006) such as those that operate in emergency management. Indeed, organizations that are required to respond in these situations are exposed to coordination challenges due to the necessity to operate in uncertain, dynamic and complex environments. This is because suddenly-occurring events by their very nature require flexibility and adaptability to address the constraints of working in this fluid environment that poses numerous challenges to those encountered in static and stable organizations (Dugdale, Darcy, & Pavard, 2006; Kettl, 2003; Mendonça, 2007; Van de Walle & Turoff, 2008).

The challenges involved with the coordination of multiple organizations are often exemplified in a disaster purely because a disaster is more than simply a big emergency (Quarantelli, 1982). Kettl (2003) stated that coordination is about transforming complex and difficult situations into straight forward and routine operations. However, this may be

interpreted as simplistic when the reality is that the coordination of multiple organizations in a disastrous event encounters a myriad of technological and social complexities to achieve a common goal (McMaster & Baber, 2012). Some literature questions the necessity of coordination, particularly in the response phase of an emergency event where collaboration occurs infrequently and may even be unachievable (Berlin & Carlström, 2008; Helsloot, 2008; Scholtens, 2008). For the purpose of this thesis, coordination is defined as aligning one's actions with those of other relevant personnel and their organizations to achieve a shared goal (Comfort, 2007a). In an effort to attain a shared objective, liaison officers involved in multi-agency coordination arrangements need to make sense of and understand the situation at hand. This requires the sharing of information to satisfy the information requirements of the liaison officers representing the multiple organizations involved in the emergency management arrangements so they can develop their own situation awareness (Curnin & Owen, 2013) and develop the shared situational awareness required to facilitate inter-organizational coordination.

2.2.1 Situation Awareness

There have been numerous attempts to define situation awareness. Endsley (1995) described it as a term given to an individual's level of awareness of a situation, an operators understanding of 'what is going on'. Some theorists have represented situation awareness as a static snapshot (Endsley, 1995) and others have represented it as a process (Sarter & Woods, 1991; Smith & Hancock, 1995). According to Salmon et al (2008), Endsley's (1995) three level model of situation awareness describes it as a component of information processing as depicted in the second stage defined as comprehension of the situation. Bedney and Meister's (1999) functional model of orientational activity also highlights the importance of information in achieving situation awareness. The first stage of this model involves the interpretation of the incoming information (Bedney & Meister, 1999).

In addition, Taylor's (1990) situation awareness rating approach described ten dimensions to achieving situation awareness. Two of these dimensions emphasise the importance of information quality (Taylor, 1990). The concept of information interpretation is important in this thesis because liaison officers tasked with providing linkages between organizations in an emergency management event often encounter challenges associated with receiving and disseminating information. The preceding definitions of situation awareness pertain to a situation where an individual is required to attain situation awareness in a given state. However, these individual models are mostly unsuitable for organizations that require multiple personnel to gain a situation awareness of the event. Subsequently, there have been a number of models that have sought to address the issue of situation awareness in collaborative systems.

2.2.1.1 Team Situation Awareness

Team situation awareness is described by Salas et al (1995) as the shared understanding of a situation among team members at a given point in time. This theory is composed of individual situation awareness, team processes, information seeking, information processing and information sharing (Salmon, Stanton, Walker, Baber, et al., 2008). Wellens (1993) believes that team situation awareness involves "the sharing of a common perspective between two or more individuals regarding current environmental events, their meaning and projected future". The composition of this team situation awareness model includes the concepts of information space, situation space, action space and a communication bridge (Salmon, Stanton, Walker, Baber, et al., 2008).

Endsley and Roberston's (2000) team situation awareness model is an extension of the commonly used three level model of situation awareness described by Endsley (1995). However, the distinction between these two models lies in the fact that team members must not only have an individual situation awareness required for their specific elements but the

same situation awareness for those elements that the area shares (Endsley & Robertson, 2000). Both Salas et al (1995) and Wellens (1993) highlight the necessity of having the appropriate information in achieving adequate team situation awareness. However, it can be argued that it is not always a requirement to have the same situation awareness for all the individuals in a system. This is especially the case when different organizations may have differing objectives. The theory of distributed situation awareness developed by Stanton et al (2004, 2006) can address some of the complexities of informing situation awareness in complex and collaborative organizations. Distributed situation awareness could be an important component to supporting multi-agency coordination in emergency management.

2.2.1.2 Distributed Situation Awareness

Stanton et al (2006) suggest that "distributed situation awareness is a product of coordination between a system's elements and that the system collectively holds the situational awareness required for task performance". Each agent in a collaborative system, such as a liaison officer in emergency management, plays a critical role in the development of the situation awareness. The view of each agent is unique but compatible (not shared) and thus each agent is instrumental in the development and maintenance of other agent's situation awareness. Agents with limited situation awareness can enhance their situation awareness by interacting with other agents. The knowledge of other agent's knowledge, described as 'meta- situation awareness' is facilitated when individuals know where to retrieve the required information (Salmon, Stanton, Walker, Baber, et al., 2008). This interactive process is fundamental to the maintenance of agent's individual and distributed situation awareness and ultimately the overall network involved (Salmon, Stanton, Walker, & Jenkins, 2009). The concept of distributed situation awareness has been applied to a number of complex collaborative environments in both the military and civilian settings.

Stewart et al (2008) applied the theory of distributed situation awareness in a military context to investigate the interactions of human and non-human agents in an airborne warning and control system. In this case study one of the findings highlighted that it is was not necessary for individuals to share all their separate views of the situation. What was important was that the agents within the system have an awareness that is likely to have specific information so it can be interpreted and disseminated through the necessary networks to the relevant individuals (Stewart et al., 2008). This research reiterates the importance of individual situation awareness of one's own task and the necessity of the meta-situational awareness of the whole systems distributed situation awareness (Stewart et al., 2008).

Salmon et al (2008) investigated distributed situation awareness in the energy distribution domain. This case study identified that in collaborative systems such as an electrical distribution network, it is useful to focus on the coordinated behaviour of the system in its entirety rather than on the sharing of individual member's situation awareness. Salmon et al (2008, p381) concluded that "distributed situation awareness effectively couples distributed systems, in that the information comprising distributed situation awareness links remotely located agents and structures the communication between them". This research highlighted the importance of ensuring that team situation awareness in complex collaborative environments is viewed in its entirety rather than as individual team members situation awareness (Salmon, Stanton, Walker, Baber, et al., 2008).

Research by Fioratou et al (2010) focused on anaesthetists situation awareness in a hospital operating theatre and determined that distributed situation awareness was suited to the anaesthetist's practice that requires the continuous and mutually altering interaction between the anaesthetist and the environment (Fioratou, Flin, Glavin, & Patey, 2010). Reviewing a fatality that involved two anaesthetists, Fiorataou et al (2010) highlighted failings in the anaesthetist's situation awareness and the necessity for the anaesthetists to not

only have individual situation awareness but the sharing of individual situation awareness to provide an overview of the overall system. In this complex and collaborative working environment, Fioratou et al (2010) describes how the approach of distributed situation awareness may allow a more comprehensive understanding of the interactions of individuals working in an operating theatre and how these interactions could foster anaesthetic practice.

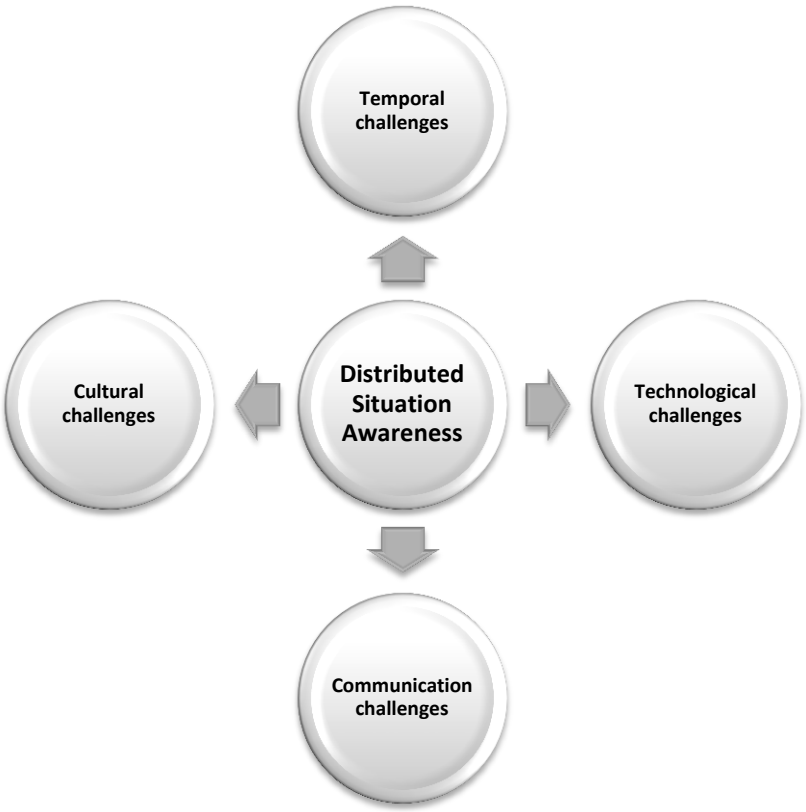
The concept of distributed situation awareness has been used in complex and collaborative working environments in both military and civilian environments. The concept highlights the need for individuals operating in these collaborative systems to ensure that situation awareness is viewed collaboratively but with an emphasis on providing the individual with the situation awareness that is specific to their needs. Distributed situation awareness may be suitable in the emergency management domain where liaison officers from multiple organizations have to operate collectively to achieve a common goal. However, it is important to understand the potential challenges faced by liaison officers tasked with developing their distributed situation awareness in this environment.

2.2.2 Challenges of developing situation awareness

Liaison officers involved in multi-agency coordination in emergency management need to develop their distributed situation awareness of the event. This necessitates the sharing of information between organizations but also an understanding of the possible constraints and potential collaborations with other organizations involved in the emergency management event (Comfort, 2007b). Developing distributed situation awareness within multi-agency coordination in emergency management is challenging and can be linked to four factors (see figure 2.1). It is reliant on the timely transmission of accurate and pertinent information. This can be compounded by the temporal nature of emergency management and the inherent time constraints that can impact information sharing in multi-agency coordination. Challenges with technological advancements mean that an insufficiency of information and in some

circumstances an overload of information can also be barriers to developing distributed situation awareness. Although information technology structures can provide a platform for communicating information there are communication challenges identified with emergency management events. Finally, the differing organizational cultures of the organizations involved in the emergency management event can constrain liaison officers from developing their distributed situation awareness.

Figure 2.1 Challenges of developing distributed situation awareness



2.2.2.1 Temporal constraints

Mishra, Allen and Pearman (2011) used empirical research to address information sharing in multi-agency emergency management incidents. The authors conducted twenty semi-structured interviews and thirty-five hours of observational studies of multi-agency emergency management exercises in the United Kingdom. This research identified that time,

social and technological factors were dimensions that affected information sharing. This research identified that there was often insufficient time to share information during an incident and therefore the information exchanged needed to be concise and succinct (Mishra et al., 2011).

Through the use of group interviews Gryszkiewicz and Chen (2012) explored how different temporal aspects of crisis management can be considered in the design of information systems for emergency management. The data indicated that the use of timelines to understand emergency management events that allow the user to visually comprehend the temporal arrangements of an incident can be a huge benefit to the operator (Gryszkiewicz & Chen, 2012). When designing information systems for emergency management the designers must include the concept of temporal dependencies and the need to incorporate this into information technology systems for each of the organizations involved (Gryszkiewicz & Chen, 2012). Information technology has been identified as one of the most encouraging factors in successfully linking emergency management processes in recent times (Vogt, Hertweck, & Hales, 2011). However, using information technology to develop a distributed situation awareness of the emergency management event can be challenging.

2.2.2.2 Technological challenges

There is a requirement for information systems to be adaptive and encompass advanced information technology to support the increased multi-agency coordination efforts in emergency management (Bharosa et al., 2011; Comfort, Dunn, Skertich, & Zagorecki, 2004; Franke, Charoy, & Ulmer, 2010; Gonzalez, Munkvold, Dugdale, & Li, 2012; Gryszkiewicz & Chen, 2012; Janssen et al., 2010; Mishra et al., 2011; Way & Yuan, 2012). There are many examples in the literature of information systems that utilise information technology to facilitate the sharing of information within multi-agency coordination arrangements (see for example Bui & Sankaran, 2001; Coates, Wilson, Hawe, & Crouch, 2011; Johnson, Zagorecki,

Gelman, & Comfort, 2011; Koning, Buul-besselink, Hemert, & Paulissen, 2012; Marecki, Schurr, & Tambe, 2006; Saoud, Mena, Dugdale, Pavard, & Ben, 2006).

However, there are challenges associated with using information technology in an emergency management setting. A lack of uniformity in standardizing information systems and in particular a lack of a common information technology infrastructure to visualise and disseminate information is a continuous challenge (Baber et al., 2007; Ley et al., 2012; Militello, Patterson, Bowman, & Wears, 2007). Therefore any information system used in emergency management has to take into account the information and decision making needs of the individuals, including liaison officers, across multiple organizations (Bharosa et al., 2011; Van de Walle & Turoff, 2008). Information technology platforms therefore need to ensure that there is not an insufficiency of information (National Research Council, 2005; Salmon et al., 2011) and must also avoid an overload of information (Gryszkiewicz & Chen, 2012; Militello et al., 2007) provided to organizations.

Furthermore, there is also a requirement for information systems to be incorporated into collaborative multi-agency exercises and simulation training (Paton & Jackson, 2002; Turoff, Chumer, Hiltz, & Klashner, 2004; Turoff, Chumer, Van de Walle, & Yao, 2004). This enables increased familiarity with the system which is often a perpetual challenge in the emergency management domain when incompatible information technology platforms are often only used in the actual response efforts. Nevertheless, the development of information technology and in particular the internet (Liu, 2008) has greatly improved communication amongst organizations and with the community. Despite this there are also challenges associated with communicating in emergency management events.

2.2.2.3 Communication challenges

Organizations involved with emergency management arrangements can now communicate using email, computer supported cooperative work technologies (Mackenzie et al., 2007) and dedicated emergency management information systems (Van de Walle & Turoff, 2008). These organizations can also communicate with the community using alert based systems by means of email (Chiu et al., 2009) or using social software such as public social media discussion forums such as Facebook, Wikis or Twitter (Ley et al., 2012; Lu & Yang, 2011; Reuter, Marx, & Pipek, 2011). In the event of a disaster requiring multi-agency coordination, organizations may have to rely on these technologies alongside the more conventional means of communications such as telephones, two way radios, pagers and facsimile (Kapucu, 2006a). Regardless of the communication channel used in emergency management the need for the receipt of the information between organizations is important in an effort to address challenges associated with the communication of inaccurate or incomplete information (McIntyre & Salas, 1995; Salmon et al., 2011; Schraagen & Van de Ven, 2011).

During extreme events there will be a greater density of communication to multiple organizations This increased flow of communication can cause failures in telecommunications as documented in the 2001 terrorist attacks in the United States of America. (Kapucu 2006a). Recent emergency management events have identified that critical infrastructures are highly dependent on each other. The catastrophic failure of an electricity structure would most likely render communications networks inoperable (Kruchten, Woo, Monu, & Sotoodeh, 2008)**.** Compounding these challenges is the incompatibility of some communication equipment between organizations (Kapucu, 2006a; Manoj & Baker, 2007; Smith, 2010). Adding to the challenges of communicating and sharing of information between organizations are the privacy and security constraints. These barriers can often occur between the police and private organizations that may not have the associated security

clearance to access the information. Subsequently there is a requirement for legislative changes by governments in order address some of these privacy and security obstacles (Kruchten et al., 2008; Reddick, 2011; Vogt et al., 2011). The challenges of ensuring effective communication in emergency management events is well documented in the literature (Aedo et al., 2010; Kapucu, 2006a; Manoj & Baker, 2007; McEntire, 2002; Smith & Dowell, 2000; Strom & Eyerman, 2005) and these communication challenges have also been highlighted during emergency management multi-agency exercises (Rencrantz & Olsson, 2012; Salmon et al., 2011).

There can be an over reliance on telecommunication and information technology platforms that may fail in a disaster. When there are limited telecommunication options available in these circumstances, communication often reverts back to face-to face communications. In the immediate aftermath of the 2001 World Trade Centre attacks, over forty per cent of communications between organizations was conducted in person (Kapucu, 2006a). This reliance on personal face to face communication and reduced dependence on telecommunications and information technology structures was undoubtedly due to the failure of energy networks following the event. However, there was still a necessity to communicate between and within organizations. Therefore the role of liaison officers tasked with developing their organizations distributed situation awareness within multi-agency arrangements is of paramount importance.

Liaison officers involved within multi-agency coordination in emergency management are not only confronted with the temporal, technological and communication challenges associated with the timely transmission of accurate and pertinent information in developing their distributed situation awareness. These liaison officers are also faced with challenges associated with the interaction of other organizations. The integration of these

organizations that often have diverse cultures can constrain efforts to achieve multi-agency coordination in emergency management (Waugh & Streib, 2006).

2.2.2.4 Cultural challenges

The concept of cultural challenges is not comprehensively articulated in the emergency management literature. Underscoring the complexities of developing an effective multi-agency emergency response are the varying organizational cultures and in particular those related to the hierarchical governmental organizations such as emergency services (Marcus, Dorn, & Henderson, 2006; Waugh & Streib, 2006). Deeply ingrained bureaucratic cultures of some organizations can compel an allegiance to their own organization-based independence that can foster a culture of rivalry among organizations and was highlighted during the 2001 terrorist attacks in New York City in an extreme example between the fire and police departments (Marcus et al., 2006). This cultural interplay and associated historical rivalry between the two groups highlighted the challenges associated with the sharing of information between organizations during a disaster (Iannella & Henricksen, 2007; Marincioni, 2007).

Organizational cultures highlight the collectively-held beliefs of the individuals within an organization (or unit) and establish the basis for social identity which can generate membership of in-groups and out-groups as well as stereotypes (Owen, 2013; Smircich, 1983). This can have a detrimental effect on information flow where the in-group often receive (and share between themselves) more information than those located in the out-group (Militello et al., 2007). Another example of the cultural challenges in emergency management pertains to the issue of gender. In particular this pertains to the cultural practices associated with a social identity of masculinity that can work to shut down communication and contribute specifically to the marginalisation of women's voices in the emergency management environment (Owen, 2013).

The need for organizational interoperability intensifies with the number of private and public organizations that become participants in the response operation increases and the range of problems they confront widens (Comfort & Kapucu, 2006). The fast action requirements of many temporary collaborative working organizations (Faraj & Xiao, 2006) such as those that occur in emergency management means there is often little time to develop trust in the traditional ways (Hyllengren et al., 2011). This is especially evident when organizations with shared cultural memberships that are based on shared norms such as the emergency services, hold a common understanding and set of expectations about what is required to establish and maintain a trusting relationship (Dietz, Gillespie, & Chao, 2010). This familiarity may not be readily available when engaging individuals from other non-emergency organizations that often have different organizational cultures which can challenge trust from the outset and present cultural constraints (Banai & Reisel, 1999; McKnight, Cummings, & Chervany, 1988). In this environment, cultural challenges may be addressed if liaison officers are capable of addressing topics pertaining to vulnerability, uncertainty, risk and expectations in short-lived temporary organizations (Meyerson et al., 1996).

The demands for inter-organizational communication in temporary organizations, such as those formed during disasters, increases significantly (Kapucu & Van Wart, 2006) requiring more information exchange in ways that are time-critical (Schraagen, Huis, & Koning, 2010). Humans are a crucial element in the exchange and communication of information in an effort to make sense of the event. Nevertheless, they are faced with multiple challenges in trying to build their distributed situation awareness of the event. To achieve effective coordination, liaison officers from multiple organizations have to span several organizational boundaries to provide linkages that facilitate information sharing and cooperation (Harrald, 2006; Janssen et al., 2010). Understanding how liaison officers

involved in emergency management multi-agency arrangements span organizational boundaries and thus provide linkages between other organizations is critical. This is especially important in an emergency event when critical infrastructures such as energy and communications are disrupted or destroyed, reducing the capacity of information technology platforms to function (Gheorghe et al., 2007). Despite their importance, the role of liaison officers and how they perform boundary spanning activities within multi-agency coordination in emergency management is not well theorized.

2.3 Spanning organizational boundaries

In order to comprehend the activities required to span organizational boundaries in emergency management and the subsequent concept of boundary spanning, I initially drew upon literature from the open systems theory to explore its historical origins. I then identified literature from multiple disciplines in an effort to review the specific activities pertaining to boundary spanning. This enabled me to build a picture of the activities required to span organizational boundaries. It was envisaged this could then be used in the research process to ascertain if the concept of boundary spanning depicted in other domains is applicable to liaison officers working in emergency management or if it requires modification.

2.3.1 Historical origins

As early as the 1960's the boundary spanning role was described as one in which a person from an organization is located in a different organizational system (Khan, Wolfe, Quinn, & Snoek, 1964). As an organization constantly interacts with its external environment there is a need for individuals to provide contact between their organization and external organizations (Katz & Khan, 1966). Thompson (1967) identified that the boundary spanners pursue a bargaining process that seeks to reduce uncertainties to their organization. Within this process the individuals act as mediators for their own organization (Thompson, 1967). This initial

view of boundary spanning from the open systems theory perspective led the way for empirical research and the development and classification of the activities undertaken by individuals tasked with spanning organizational boundaries.

Early empirical research sought to identify the activities affiliated to spanning organizational boundaries in a multitude of disciplines. Miles (1976) conducted a quantitative study involving research and design professionals and identified that all the candidates had a common role requirement that involved the coordination of projects across intra organizational and inter organizational boundaries (Miles, 1976) . One of these role requirements was described as boundary spanning which described representational and liaison activities allied to the role (Miles, 1976). Further research also recognized the activity of external representation (Aldrich & Herker, 1977) but also the importance of gathering, processing and transmitting information to other organizations (Aldrich & Herker, 1977; Jemison, 1984; Tushman & Scanlan, 1981). However, it is not until research is carried out by Ancona & Caldwell (1988; 1992) that the individual activities of boundary spanning are theorized.

In the first of two studies in high-technology companies, the authors describe and classify a set of attributes that link a group to its external environment (Ancona & Caldwell, 1988). The first stage in this research produced a comprehensive list of fifteen boundary spanning activities. However, it is not until their second study that they refined these fifteen activities to four boundary spanning activities. In their second study a quantitative approach is used to further understand the underlying structure of the previous boundary spanning activities. Based on the previous activities identified in the first study, a questionnaire was developed and distributed to four hundred and fifty research and development professionals in forty-five product development teams. This produced a response rate of approximately

eighty-nine per cent. Analysis produced a typology of four boundary spanning activities termed: (1) *ambassador*; (2) *task coordinator*; (3) *scout* and (4) *guard*.

Ancona and Caldwell's (1992) second study investigating boundary spanning activities provided a comprehensive description and analogy of each activity. They posited that the *ambassador* activity relies on the boundary spanner to provide access to the power structure of the organization. The activity of *task coordinator* provided access to the workflow structure and was aimed at managing horizontal dependence. The activity termed *scout* concerned the acquisition of pertinent ideas and information. The final activity designated as *guard* related to actions that were aimed at avoiding the release of information to external parties (Ancona & Caldwell, 1992).

2.3.2 Boundary spanning activities

Ancona & Caldwell's (1992) typology of four boundary spanning activities are used today more than twenty years since its inception to identify how workers span organizational boundaries in a number of diverse working environments. This section will review a selection of contemporary literature that is aligned to the boundary spanning activities portrayed in Ancona & Caldwell's (1992) typology. The application of this typology and the associated four activities of ambassador, task coordinator, scout and guard, need to be reviewed in other settings as a precursor to examining its appropriateness in the domain of emergency management.

2.3.2.1 Ambassador

Representing is a factor identified with the *ambassador* activity (Ancona & Caldwell, 1992). The ability to represent and influence are described in contemporary research on boundary spanning activities. One of the most seminal works to date that comprehensively describes boundary spanning activities is by Williams (2012). His book is the culmination of over a

decade of research exploring the role of boundary spanners in collaborative working practices, predominantly in the public sector (Williams, 2002, 2011). Williams presented a typology of four boundary spanning activities: (1) *reticulist*; (2*) interpreter/communicator*; (3) *coordinator*; and (4) *entrepreneur*. The *reticulist* activity can be identified as an individual that is skilled in bridging organizations, adept at influencing others by negotiation and who are mutually trusted by internal and external organizations to achieve a common goal (Williams, 2012). This *reticulist* activity bears similarities to the representing and influencing functions as it involves networking and providing representation across boundaries in order to temporarily connect organizations that need to become levers of change (Williams, 2012).

The activity of *ambassador* and in particular the requirement to represent the organization is also associated with empirical research in the education industry. Investigating the boundary spanning activities of university pro-vice chancellors, Pilbeam and Jamieson (2010) interviewed eight pro-vice chancellors from four universities. They identified that two vital activities were key features of a boundary spanner: (1) *information gathering and dissemination*, and (2) *providing external representation*. Facilitating links to other institutions, lobbying for resources and enhancing the reputation of the institution were key components detected as important aspects of the activity termed *providing external representation* (Pilbeam & Jamieson, 2010). Further examples of activities aligned to a representational capacity can be identified in other research conducted in the education industry.

Weerts and Sandman (2010) identified four distinct boundary spanning activities essential in advancing university and community engagement at research universities. The authors conducted eighty interviews with campus chief officers, campus engagement leaders, and community partners in an effort to compare patterns of engagement activity across research institutions (Weerts & Sandmann, 2010). The findings organise the data to articulate

four distinct but flexible boundary spanning activities: (1) *community based problem solver*; (2) *technical expert*; (3) *internal engagement advocate*; and (4) *engagement champion*. The activity of *community based problem solver* and that of *engagement champion* specify that the incumbent broker relationships between the host organization and external organizations. Within this activity they must also facilitate networks thus representing their own organization and create alliances and organizational networks with both internal and external stakeholders that are both strategic and symbolic (Weerts & Sandmann, 2010).

The stipulation in boundary spanning to provide organizational representation is also evident in recent empirical research conducted in the management consultancy industry. Sturdy and Wright (2011) examined the activities of forty-eight internal and external consultants from twenty-seven companies. From the data three primary activities of the internal consultant as an organizational boundary spanner emerged: (1) *gatekeeper*; (2) *broker*; and (3) *partner*. The boundary spanning activity of *broker* can be described as that of an intermediary and someone who is adept in bridging cultural boundaries working as organizational representatives (Sturdy & Wright, 2011). However, Fleming & Waguespack (2007) theorized that the concepts of brokerage and boundary spanning remain theoretically distinct. They make a distinction between brokering and boundary spanning and suggest that a broker can span boundaries, but not all boundary spanners are brokers (Fleming & Waguespack, 2007). Nevertheless, the activity of brokering and associated requirement to represent the organization is commonly associated with boundary spanning in numerous settings including but not limited to the health industry (Williams, 2011), information systems community (Kimble, Grenier, & Goglio-Primard, 2010; Levina & Vaast, 2005; Pawlowski & Robey, 2004), engineering (Johri, 2008), and in the business community (Johnson & Duxbury, 2010).

Johnson & Duxbury (2010) conducted seventy-nine interviews with expatriates working within the Canadian foreign ministry and produced a typology of nine boundary spanning activities: (1) *relationship building*; (2) *shaping*; (3) *intelligence gathering*; (4) *delivering*; (5) *coordinating/negotiating*; (6) *guarding*; (7) *information gathering*; (8) *representing*; and (9) *intermediary* (Johnson & Duxbury, 2010). The activity identified as *relationship building* was the single most frequently cited submission of all the boundary spanning activities and together with the activities of *representing* and *intermediary* depict activities associated with a person from one organization representing their organization in an external environment.

Conversely, in her taxonomy of five types of inter-group knowledge sharing, Hasan (2009) characterizes the boundary spanner as someone that can be a legitimate member and representative of both the internal and external organizations. However, the example given to report this was in a unique setting. The boundary spanner was someone who worked in a hospital and who was acting as an intermediary for a family member that was a patient in that hospital. The boundary spanner thus had a legitimate claim to membership of both groups (Hasan, 2009). Regardless of where the boundary spanning role is practised, either as a member of multiple organizations (Hasan, 2009) or solely representing their own organization in an external environment (Johnson & Duxbury, 2010; Pilbeam & Jamieson, 2010), the role encompasses the activity of coordination.

2.3.2.2 Coordinating

The coordination activity of boundary spanning is imperative in stabilizing mutual interdependencies between organizations (Harter & Krone, 2001). Coordinating collaboration with other external organizations is instrumental in successfully spanning organizational boundaries (Lee, Ohta, & Kakehi, 2010; Stephenson & Schnitzer, 2006). Nevertheless, this aspect of coordination can entail challenges and demands on boundary spanners in terms of

managing their time especially when organizing the process of multiagency collaboration (Williams, 2012).

Effective coordination facilitates the coupling of a host organization with external organizations thus enhancing the engagement process (Drach-Zahavy, 2011; Weerts & Sandmann, 2010). Often the delivery of a specific outcome is dependent upon the coordinated actions of many individuals (Kimble et al., 2010; Pilbeam & Jamieson, 2010) and therefore intrinsic to the success of the boundary spanning role and the core to enabling the work of the organization to be fulfilled is the ability to communicate effectively and convincingly with individuals from the external organizations (Johnson & Duxbury, 2010; Pilbeam & Jamieson, 2010). The importance of coordinating collaborative partnerships influences the boundary spanners ability to gather information from external organizations.

2.3.2.3 Scouting for information

The activity of gathering information across organizational boundaries is synonymous with the role of boundary spanning in current literature (see for examples Carlile, 2002; Drach-Zahavy, 2011; Gopal & Gosain, 2009; Hasan, 2009; Isbell, 2012; Johnson & Duxbury, 2010; Johri, 2008; Lee et al., 2010; Lindgren, Andersson, & Henfridsson, 2008; Pilbeam & Jamieson, 2010; Williams, 2011, 2012; Zhang, Viswanathan, & Henke, 2011). Yet the activity goes beyond simply gathering information and emphasises the importance of disseminating information in response to the demands of the external organizations (Johnson & Duxbury, 2010; Pilbeam & Jamieson, 2010; Sturdy & Wright, 2011; Williams, 2012). The gathering and dissemination of information in boundary spanning is consistent with the role of *informational intermediaries* that bridge informational asymmetries in order to achieve a common goal (Ebers, 1997; Ipe, Raghu, & Vinze, 2009). Additionally, accessing and processing necessary and crucial information that is relevant to the organizations objectives is considered a primary activity in boundary spanning (Drach-Zahavy, 2011; Pilbeam &

Jamieson, 2010; Zhang et al., 2011). Acquiring knowledge is not only confined to gathering information but can include accessing applicable intelligence (Johnson & Duxbury, 2010; Williams, 2012).

Johnson and Duxbury (2010) make the distinction that information that is non-sensitive and necessary to inform the boundary spanners immediate tasks is not intelligence. Intelligence is described as privileged or insider information not available through regular channels. Identifying sensitive, privileged and insider information can protect the organization and can assist the boundary spanner to remove obstacles of uncertainty for their actual work (Johnson & Duxbury, 2010). What cannot be underestimated with the activity of *information intermediary* is the power that is associated with it. This activity has the discretionary power to disseminate information to whoever they deem most suitable (Williams, 2012). The activity of scouting for information is reliant on the resource that facilitates the procurement of information. In the boundary spanning literature this is often referred to as the boundary object (Carlile, 2002; Gopal & Gosain, 2009; Levina & Vaast, 2005; Lindgren et al., 2008; Star, 1989).

Boundary objects

The concept of a boundary object is an item that is shared and shareable across diverse environments (Star, 1989). A boundary object can also be described as an object that establishes a shared syntax for individuals to represent their knowledge (Carlile, 2002). In the technological world that organizations invariably operate in, information systems are an important boundary object and resource for boundary spanning (Gopal & Gosain, 2009; Levina & Vaast, 2005; Lindgren et al., 2008). A critical aspect of information systems is the use of information technologies that can act as a key enabler in boundary spanning. Software can enable the boundary spanner to automatically acquire and share a broad context of information and knowledge (Lindgren et al., 2008). However, the success of the activity

associated with gathering information is intrinsically linked to the boundary object that is used in the boundary spanning process (Carlile, 2002; Levina & Vaast, 2005; Lindgren et al., 2008). In addition to disseminating information, boundary objects can facilitate the protection or guarding of information between organizations (Levina & Vaast, 2005).

2.3.2.4 Guard

Refusing external organizations demands for information can aid in the protection of the boundary spanner's own organization by preventing boundary exchange (Johnson & Duxbury, 2010). This guarding activity may also encompasses the demand of the boundary spanner to limit actions that may be underhanded by external organizations in their attempts to procure information about the boundary spanner's organization (Noble & Jones, 2006; Williams, 2002). In jealously guarding their organization (Johnson & Duxbury, 2010; Stephenson, 2005), boundary spanners need to have the capacity to feel comfortable with the tension implicit in this role (Pilbeam & Jamieson, 2010). This tension could result in the feeling of isolation succumbing susceptible to role overload and ultimately role stress (Friedman & Podolny, 1992; Marrone, Tesluk, & Carson, 2007; Pilbeam & Jamieson, 2010; Rigopoulou, Theodosiou, Katsikea, & Perdikis, 2012; Singh, Verbeke, & Rhoads, 1996). The increased tension that can be associated with boundary spanning can also be related to an increased contact between boundary spanners that can lead to an escalation of conflict (Ramarajan, Bezrukova, Jehn, & Euwema, 2010).

Boundary spanning can encompass an eclectic assortment of activities that are utilised in spanning organizational boundaries. The activities that have been reviewed in this section are used in varying combinations within multiple working environments. In an effort explore the concept of boundary spanning in emergency management it is first necessary to review the associated literature in this field.

2.3.3 Boundary spanning in emergency management

The emergency management literature does make several references to the concept of boundary spanning. However, this is not in particular reference to liaison officers. The boundary spanning activities described in the emergency management literature emphasise the importance of information flow. This is often in reference to the notion of multi-agency coordination. Within this body of literature the boundary spanning activities are often synonymous with the sharing and exchange of information between organizations.

In their description of role enactment Kreps and Bosworth (1993) make reference to the concept of boundary spanning. Kreps and Bosworth (1993) identify three dimensions of role enactment: (1) *status-role nexus*, (2) *role links*, and (3) *role performance*. These three dimensions were developed from archival materials from the Disaster Research Center featuring participants in involved in organized responses during the emergency period of disasters. In particular, within the dimension of *role links* the research makes reference to boundary spanning and individuals forming links with the representatives from external organizations during an organized response (Kreps & Bosworth, 1993). However, the article aims to describe role enactment in an emergency management context and does not go beyond this basic description of boundary spanning and the general association with providing links to other organizations in disasters.

Chen et al (2008) proposed a framework to analyse coordination patterns in the emergency response arena. This was based primarily on thirty-two interviews with emergency response personnel. One aspect of the framework explains that during emergency coordination the responder may fulfil a boundary spanning capability to fulfil coordination mechanism requirements (Chen, Sharman, Rao, & Upadhyaya, 2008). However, this is the only direct reference to boundary spanning in the entire article. Similarly, in his review of inter-organizational cooperation that may be required during an emergency event, Granot

(1997) makes a single reference to boundary spanning. In this research he defines boundary spanning in the context of emergency management and how it may be useful for exchanging ideas and information among individuals with similar interests (Granot, 1997).

Research conducted by McGuire and Silvia (2010) explored intergovernmental collaboration in emergency events. Using a data set of more than four-hundred county-level emergency management organizations in the United States of America, they investigated how public managers are required to work across organizational boundaries in collaborative networks during emergency events (McGuire & Silvia, 2010). The article only makes scant reference to the concept of boundary spanning but recognizes the importance of spanning organizational boundaries in an emergency management scenario.

It is perhaps Kapucu (2006, 2011) and Kapucu with Van Wart (2006) who makes most reference to the concept of boundary spanning in the emergency management literature. Kapucu (2006) firstly identifies the boundary spanner as someone who is associated with communication and information technologies among organizations in an effort to achieve effective decision making in emergency events. Additionally, using empirical data from Hurricane Charley in 2004 and the World Trade Centre terrorist attacks in 2001, Kapucu and Van Wart (2006) analyse the role of the public sector in dealing with catastrophic disasters. In the article, the effectiveness of boundary spanning organizations was one of four areas identified as critical for high performance in emergency events (Kapucu & Van Wart, 2006). Finally, following a comprehensive literature review, Kapucu (2011) analyses the current structure of international disaster management in the context of the United Nations reform initiatives and identifies the main actors in the system. Exploring the work of the actors in this environment, he associates the concept of boundary spanning by means of developing relationships with other institutional members via networks (Kapucu, 2011).

Undoubtedly, it is Bharosa, Janssen and Tan (2011) who provide the most comprehensive analysis of the concept of boundary spanning in emergency management. Based upon observations from field studies, Bharosa, Janssen and Tan (2011) identified the role of someone they termed an *information orchestrator*. An *information orchestrator* is someone who interacts with multiple organizations taking care of the information requirements that are beyond the boundary of a single organization (Bharosa et al., 2011). In this research an *information orchestrator* requires ten necessary capabilities to assure information quality in public safety networks. These ten capabilities include: quality auditing; boundary spanning; access to information libraries; web-service composition; enrichment; anticipation; information categorization; expertise gathering and consultation; reach back; and information quality feedback (Bharosa et al., 2011). Nevertheless, this research only investigated the concept of boundary spanning in the context of assuring information quality.

There is a void in the literature that comprehensively investigates the suitability of boundary spanning in an emergency management context. Liaison officers are tasked with spanning organizational boundaries within multi-agency coordination arrangements. It would therefore appear important to investigate the construct of boundary spanning from the perspective of the liaison officer. Just as there is no single proven approach to emergency management (Wettenhall, 2009), it cannot be assumed that boundary spanning is generic to all industries and therefore further research is called for.

2.4 Summary

This review concludes that multi-agency coordination in emergency management is complex. A major challenge is the ability for individuals, including liaison officers, to build their distributed situation awareness of the event. The development of technological systems and tools to overcome these challenges are often reliant on human facilitation. Due to the

uncertain and dynamic context in which emergency management events often play out, reliance on technology cannot be a foregone conclusion. Incompatibility of certain information technology systems provides challenges. Furthermore, the disruption of critical infrastructure can mean the most advanced technological systems are rendered useless in a disaster. Current approaches for multi-agency coordination in emergency management predominantly focus upon the technological aspects of coordination. The importance of the human factors warrants further investigation.

Liaison officers involved in multi-agency coordination arrangements in emergency management require distributed situation awareness. This necessitates that they successfully forge organizational linkages between organizations and this is achieved by boundary spanning. Multi-agency coordination in emergency management is multi-faceted and is contingent on multiple elements working in synchronization to ensure effectiveness. An element often overlooked in these situations is that of the liaison officer performing boundary spanning activities. Thus, in the subsequent chapters, I will explore the activities of liaison officers and suggest alternative approaches to address the challenges they encounter in accomplishing effective multi-agency coordination in emergency management.

Chapter 3
Methodology

Contents

3.1 Introduction

This chapter examines the research methodology I adopted in this project. It first outlines my methodological rationale. Next, the ethical considerations are considered. The following sections discuss the research approach, qualitative data collection methods I used in the study, followed by the methods used to analyse the data. The chapter presents a section on the limitations of the research methodology prior to offering a brief conclusion.

3.2 Methodological rationale

My philosophical stance informed the methodological process adopted in this research as discussed in previous chapters. The subject chosen in this thesis was under-researched and therefore it was not appropriate to use a theory testing approach which often favours quantitative methods to analyse large-scale phenomena as usually adopted with a positivism stance (Babbie, 2012; Travers, 2001). Consequently the context meant that a qualitative theory-development approach was required. Adopting an interpretivistic stance allowed me to observe aspects of the social world based on an individual's perceptions and experiences (Babbie, 2012; Robson, 2002). This was important because I needed to better understand how the participants make sense of the demands placed on them when they are working within the research setting. This approach better captures how, for example, the diverse histories, experiences, training and organizational memberships contribute to how people make sense of their operating environment and make choices about how to respond (rather than making rationalistic assumptions). Therefore, undertaking a qualitative research stance was deemed appropriate for this project that endeavoured to provide explanations to the research questions described in Chapter 1. Qualitative data can provide a richness that assists in locating the meaning of experiences within the social world and thus placing the phenomena within their context (Miles & Huberman, 1984). Using qualitative methods also enabled the spirit of the participants' experiences to be identified and therefore I gained an understanding of their experiences through their own perspective (Creswell, 1998). Consequently, it would seem appropriate that qualitative research is essential in explaining and generating theory about a phenomenon. However, using qualitative research to embark upon any social inquiry raises many ethical issues that I needed to address.

3.3 Ethics

The landscape of qualitative research continues to change creating new issues for researchers. This is particularly prevalent regarding the ethical dilemmas about how much information to disclose, to whom, in what context and the challenges of access to and sharing of this information (Miller, Birch, Mauthner, & Jessop, 2012). Additionally, interviewing participants involved in emergency management operations could raise sensitive issues for the interviewee who may draw upon experiences from traumatic emergency events. There was also a potential that participants may disclose something they did not wish to, leading to a feeling of vulnerability that may require the participant to implement coping strategies (Peterson, 2002). Raising delicate topics and recording these experiences meant there was a necessity to provide advice on where to seek additional support and ultimately protect the participant's confidentiality and anonymity.

In this project I adopted several measures to address these issues and endeavoured to ensure that this research was conducted in an ethical manner. Firstly, the project sought and received ethics approval for the individual interviews, observational studies and focus group interviews from the Tasmanian Social Sciences Human Research Ethics Committee in Australia (Ethics Ref No: H0008810) and followed the protocols for provision of information and consent. This involved lodging an amendment form for the Social Sciences - Minimal Risk Application, along with a copy of an introduction email sent to the participants, additional interview questions for the PhD component of the study, project information sheet and consent form for the individual interviews, focus group interviews and observational study (copies of these documents can be found in Appendix F, G and I).

Secondly, it was reiterated to the participants in the information sheet and verbally by me prior to commencing the interviews, observational studies or focus group interviews that participation was entirely voluntary and that the participant could terminate their participation

in the interview or observation studies at any time. Participants were informed and given documentation advising them that if they felt distressed in any way due to participation in the research then they were encouraged to contact relevant support services for counselling that were provided in the project information sheets.

Thirdly, I de-identified the names of the participants following their participation and prior to sending the audio file to a professional transcriber. This sought to protect the confidentiality and maintain anonymity of the interviewee. Participants were informed that no personal information will be sought, recorded or published. The interview transcripts were returned to the participants for checking and accuracy (Morse, Barrett, Mayan, Olson, & Spiers, 2002). Participants involved with the research were informed that the data gained was to be securely stored for a period of five years. Following the five-year period all data provided by participants will be destroyed. Paper records will be shredded and electronic records will be destroyed by reformatting the disk and/or drive or overwriting the data using another means that conforms to the University of Tasmania Secure Disposal of ICT Equipment Procedure (ICPTR 2.1). This action is imperative as simple deletion is insufficient and does not actually overwrite the information until the space is required, meaning that the information could still be retrieved for some time.

Finally, anonymity of all participants involved in the research will be maintained by me and the research team. However, if an anonymous quote from the focus group interview was used in a publication, there is a risk that a fellow participant involved in the focus group interview may recognize the quote and subsequently recognize the interviewee who made the quote. Additionally, the inadvertent description of the study setting and events may reveal the identity of the participants (Hoonaard, 2003). Therefore, while every effort was made to assure anonymity this could not be guaranteed and I explicitly explained these risks to each participant prior to participation in the focus group interview.

3.4 Research approach

The methodological stance I adopted in this research is based on an inductive approach that provides for the systematic and inductive generation of theory from data acquired by rigorous research methods (Charmaz, 2006; Glaser & Strauss, 1967; Patton, 1990). Key characteristics of the inductive process that was adopted in this research was the regular comparison of data analysis, the role of the literature review which situated the challenges of multi-agency coordination in emergency management and the current mechanisms in place to address them, data verification through theoretical sampling and the development and refinement of concepts to explain behaviour and experiences (Glaser, 1978). In particular, this qualitative method was based upon work conducted by Eisenhardt (1989) who argues that theory development can be undertaken using a case study design. A case study can be described as an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular group of people that can be used to generate theory (Eisenhardt, 1989; Simons, 2009; Thomas, 2011).

A case study approach allowed for the interchange of inductive and deductive methods of analysis as described by Eisenhardt (1989). This inductive process to analysing allowed me to regularly compare theory and data. However, I first needed a suitable framework to account for the work occurring in emergency management. As discussed in Chapter 2, because of the multifaceted, unpredictable and often temporal challenges that are encountered in emergency management multi-agency coordination (Comfort & Kapucu, 2006; Janssen et al., 2010; Schraagen & Van de Ven, 2008), I required a methodological framework that was appropriate for use in high reliability environments. For the purpose of this research a high reliability environment is one where organizations operate in an unforgiving social and political environment, an environment rich with the potential for error, where the scale of consequences precludes learning through experimentation (Rochlin, 1993). These

environments are often found in organizations such as nuclear power-plant operations, naval aircraft carriers, and air traffic control systems (Weick, Sutcliffe, & Obstfeld, 1999). Subsequently the methodological framework I used to guide theory development in my research was core-task analysis.

This methodology is a conceptual modelling approach for the analysis of empirical qualitative data for defining the constraints that a particular domain puts on the actors working in it. Due to the open ended and dynamic system of the research setting, where the external environment and subsequent interaction with the workers is decisive, this methodological framework appeared suitable for this complex and uncertain domain. In addition, I also used the concept of boundary spanning as a mechanism to investigate the problems of liaison officers working in multi-agency coordination arrangements. Further details of boundary spanning can be located in Chapter 2 and further explanation on the core-task analysis methodological approach is provided next.

3.4.1 Core-task analysis

Core-task analysis is a conceptual modelling approach for the analysis of empirical qualitative data for defining constraints that a particular domain puts on its control by humans via resources of skill, knowledge and collaboration (Norros, 2014). This methodological framework was chosen due to its previous use and applicability to high reliability environments. This framework was developed in studies conducted in several complex and dynamic working domains. These include nuclear power plant operations, anaesthesia and the navigation of large ships (Norros, 2004). This methodological framework continues to be applied in other complex working areas and has most recently been applied in working environments involving automated train systems (Karvonen et al., 2011) and communication network operations (Norros, Norros, Liinasuo, & Seppanen, 2012). Thus it would appear that

it is suited to researching high reliability environments such as found in an emergency management.

The aim of core-task analysis is to identify the *core-task* of a specific working practice. The concept of the *core-task* indicates the objectives and the outcome of work that should be accounted for by the workers in everyday task performance. Core-task analysis adopts a systemic notion of human activity where the situated actions are conceived from an ecological, human-environment interaction perspective (Norros, 2004). Core-task analysis takes into account three interrelated dimensions that workers must consider to achieve salient task outcomes in particular work domains. These are the contextual elements of *dynamism*, *complexity* and *uncertainty*. In order to manage these dimensions core-task analysis states that the workers need *collaboration, skill* and *knowledge* (Norros, 2004). Core-task analysis hypothesizes that *collaboration* contributes to reducing the complexity in dynamic situations in an effort to enable proper functioning of a system. This makes it ideally suited to the dynamic, uncertain emergency response environment of state level emergency operations centres. It also theorizes that *skill* is a process for coping with uncertainty in a situation that requires action to respond to the problem. Finally, core-task analysis hypothesises that *knowledge* and its processes facilitate coping in a complex environment and enable reflection on the inherent uncertainties in the environment (Norros, 2004). When dealing with dynamic, uncertain and evolving emergency events, knowledge is likely to extend beyond that obtained from core organizational training (which does not necessarily include multi-agency crises) and expand to bring to the fore people's history, experience and relationships. The latter can be articulated drawing on a qualitative approach such as core-task analysis. Based on the applicability of these dimensions to emergency management it would appear that this was an appropriate framework to apply in strategic level emergency operations centres.

In Chapter 1 I briefly acknowledged this research project could have used other methods such as cognitive task analysis approaches. The methodological approach chosen for this research aimed to conceptually model the defining constraints that the work domain in the research setting puts on a particular group of humans working in this environment. It was envisaged that this would assist in identifying the challenges and ensuing mechanisms employed to facilitate multi-agency coordination in the research setting. Consequently the research sought an alternative method to traditional task analyses which can be associated with action orientated approaches such as hierarchal task analysis (see for examples Annett, 2003; Marsden & Kirby, 2005; Shepherd, 2001; Stanton & Young, 1999) or cognitive approaches as described in cognitive task analysis (see for examples Klein, 2000; Militello & Hutton, 1998; Rasmussen, 1986). Application of the core-task analysis methodology emphasised a systemic notion of human activity where the situated actions are conceived from an ecological and human-environment interaction perspective (Norros, 2004).

Core-task analysis allowed the identification of the socio-technical and socio-cultural complexities of liaison officers operating within the research setting. This methodological framework facilitated the exploration of the tasks performed by the participants in a particular environment but importantly it also sought to improve their ability to manage the identified expected and unexpected work situations (Hollnagel, 2014). Applying core-task analysis in the context of an exploratory case study approach was deemed an appropriate process to explore a phenomenon that is considered new and innovative (Eisenhardt, 1989). Complementing the use of the core-task analysis framework in exploring the developing area of liaison officers in emergency management was the construct of boundary spanning.

3.4.1.1 Boundary spanning

In the literature review (Chapter 2) I outlined two core issues necessary in understanding emergency management multi-agency coordination. The first is the ability to understand the

situation and make sense of the events. The construct used in the literature pertaining to emergency management arrangements is often termed situation awareness and I provide an overview of the associated research in the Chapter 2. The second construct that I explored in the literature review are the actions required to enable multi-agency coordination and in particular the requirement for liaison officer's to cross over between organizational boundaries and how this action is executed. The construct that is useful for this can be designated as boundary spanning. Liaison officers involved in emergency management multi-agency coordination are required to work at the boundaries of their organization and be the interface between other organizations and their own in crisis events and do so with organizations with whom they may be unfamiliar. Hence it is important to locate a suitable construct with which to examine the demands of these workers. The typology of boundary spanning activities developed by Ancona & Caldwell (1992) is suited to examine the demands of liaison officers in the research setting and is examined in *Paper I.* In this thesis I applied the concept of boundary spanning to a novel and emergent inter-agency context.

3.5 Data collection

The study drew upon three complementary qualitative methods. The use of three qualitative research methods were used collectively to triangulate the overall findings and to maximise validity (Flick, 2004). Incorporating triangulation by amalgamating the findings through combining different methods of collecting data of the same phenomenon essentially aimed to overcome the challenges associated with validity by mitigating the deficiencies of one method with the strengths of other methods (Denzin & Lincoln, 2005). In the order they were conducted the three qualitative methods were: (1) individual interviews, (2) observational studies and (3) focus group interviews. In addition, the study involved a planning stage that involved visiting the various emergency operations centres where the liaison officers would

work. This preparatory phase allowed me to acquaint myself with the work domain that the participants would be expected to work in.

I joined an existing research team funded through the Australian Bushfire Cooperative Research Centre. The global research undertaken by the research team was a project titled: *Organizing for Effective Incident Management.* The specific PhD scholarship that I was awarded was to examine how workers in emergency management support effective multi-agency coordination at a strategic level. In an Australian context, emergency management arrangements are often based on three levels: (1) operational, (2) tactical, and (3) strategic. These three levels often, but not always, correspond to the following jurisdictional activation levels: (1) local, (2) regional, and (3) state and/or federal. An important element of any research conducted in collaboration with an Australian Cooperative Research Centre is the importance of engaging industry. Australian Cooperative Research Centre programs support end user driven research collaborations that address major challenges facing Australia (Commonwealth of Australia, 2012). Subsequently, the research team included academics from the University of Tasmania, Central Queensland University, and industry lead end users from a land management organization and the Australasian Fire and Emergency Service Authorities Council. The research setting involved three Australian state level emergency operations centres. This setting was chosen because this is where representatives from various organizations responsible in managing an emergency event come together to respond to the hazard impacting the community.

3.5.1 Preparatory phase

The preparatory phase of the study involved visiting the three state level emergency operations centres early in the research program. These were the Victoria State Control Centre in Melbourne, the Tasmanian State Fire Operations Centre located in Hobart and the New South Wales Rural Fire Service State Operations Centre situated in Sydney. These visits

allowed me to acquaint myself with the environment that the liaison officers would be expected to operate in. This aspect of the preparatory phase allowed me to gain an understanding of the work environments and also allowed me to learn about the information systems and specific terminology that would be used by the liaison officers.

During the preparatory phase I regularly met with members of the emergency operations centre management teams to discuss the direction of the research. The management teams oversee the running of the centre on a day to day basis during routine operations and in emergency events. They often provide strategic direction for the centre and act as an intermediary between the organizations who would be expected to work in the centre during an emergency event. Consequently, their opinions on any research conducted in the emergency operations centre are crucial, particularly as the research was to provide insight and value to them. All three management teams identified the need to enhance multi-agency coordination at the state level during large scale emergency incidents and recognised the importance and attributes of liaison officers. Subsequently, I utilised their expert judgement on the selection of the sample on which organizational liaison officers should participate in the research (Teddlie & Yu, 2007).

This purposive form of sampling was deemed most appropriate as the research sought to generate a sample that would address the research questions. Purposive sampling enabled me to compare and contrast the roles of the numerous participants. Indeed, the contrast and comparative principles are fundamental to qualitative data analysis strategies (Glaser & Strauss, 1967; Mason, 2002). In particular, the literature highlighted the often problematic coordination associated with critical infrastructure organizations operating in an emergency management multi-agency coordination environment. Often research investigating multi-agency coordination in emergency management predominantly focuses upon the core

emergency services that are often limited to police, fire and ambulance agencies (Bharosa, Lee, & Janssen, 2010; Chen et al., 2008; Militello et al., 2007; Mishra et al., 2011).

Instrumental in the selection of participants for this research was guidance provided by the three state level emergency operation centre management teams. Advice was sought from the management teams as to what organizations were present during the activation of a state level emergency operations centre for a bushfire. For example, when there are multiple bushfires across multiple areas within the same state that are beyond the capacity of regional emergency management arrangements, the state level emergency operations centre will be activated. This will require liaison officers from the emergency services to be present and usually necessitates that liaison officers from federal government organizations, land management organizations and critical infrastructure organizations attend. Consequently, participants were selected based on this information. All the participants were senior professionals within their respective organizations who would be expected to fulfil the role of a liaison officer in a state level emergency operations centre. A pre-requisite was that the participants had to have performed the role previously in a state level emergency operations centre. This could have been during an actual event or in a multi-agency exercise and allowed the participants to draw upon past experiences. For the purpose of this research participants were categorized as from the emergency services or non-emergency organizations.

The group classified as non-emergency organizations was further grouped into critical infrastructure or other organizations. For the purpose of this study I adopted the Australian Government's definition of critical infrastructure, described as essential services that are important for everyday life such as energy, food, water, transport, communications, health, banking and finance (Commonwealth of Australia, 2010). However, I only sought to include organizations that would be typically requested to attend a state level emergency operations centre during the response phase of a crisis. Therefore the participants were from energy,

water, transport, communications, and health organizations as these are regularly called upon to be in the state level emergency operations centres. Participants from the other organizations represented federal government, non-government and land management organizations. It is noteworthy that a high number of participants from land management organizations were selected due to their involvement in Australian bushfires events. Ultimately, by incorporating a large number of participants that were from non-emergency organizations I sought to enhance the knowledge of these particular liaison officers and thus fill a gap identified in the literature.

3.5.2 Individual interviews

Qualitative research interviews attempt to understand the world from the participants view point by unfolding the meaning of peoples' experiences and ultimately uncovering their lived world (Kvale, 1996). Encompassing this strategy enabled me to understand the demands of the work from the perspective of the interviewee (King, 2004). Semi-structured interviews were chosen due to the inherent flexibility that this method offers combined with the rich and highly illuminating material it can yield (Denzin & Lincoln, 2005; Fontana & Frey, 2005). Additionally, the use of individual interviews allowed for the unanticipated and spontaneous responses that emerge through open-ended questioning (Babbie, 2012).

A series of preformulated questions (refer to Appendix F on page 261) for a full list of the questions) were guided by a thorough review of the literature pertaining to the topic under exploration and developed in consultation with the research team (Jacob & Furgerson, 2012). The purpose of this was to focus the discussion of the interview on the project aims (Witzel, 2000). Prior to commencing the majority of the interviews, a pilot study was carried out with three participants. The three participants were liaison officers who could all be requested to work in a state level emergency operations centre. The supervisory team and I deemed that it was not necessary to change any of the semi-structured interview questions. Due to the initial

quality of the data extracted from the pilot interviews and applicability of the participants to the research it was decided that these interviews would be included in the final data collection (van Teijlingen & Hundley, 2002). A total of forty-three individual interviews were conducted with liaison officers who worked in state level emergency operations centres (see Table 3.1). Initially, thirty-nine liaison officers were interviewed. A further four liaison officers from critical infrastructure organizations were subsequently interviewed to further investigate the cultural challenges specific to these liaison officers. A grand total of forty-three interviews were conducted between July and October 2012. The logistical and time constraints of conducting in-depth interviews face to face imposed limitations on the number of interviews that could be conducted within the time frame of the study.

Table 3.1 Individual interview participant demographics

Emergency Services (16 pax)	*Critical infrastructure (16 pax)*	*Other organizations (11 pax)*
Police – 2	Water services – 3	Land management – 7
Fire – 7	Energy – 5	Non-government – 2
Ambulance – 2	Communications – 2	Military -1
State Emergency Service - 5	Transport – 5	Federal agency – 1
	Health – 1	

This research relied on the active participation of the interviewees and their preparedness to disclose and discuss potentially sensitive information about experiences in a specified work environment. Tantamount to achieving this was the necessity for me to build a good rapport with the participants (Ryan, Coughlan, & Cronin, 2009). Of the total number of forty-three participants interviewed, thirty-five interviews were conducted face to face and

the remaining eight participants were interviewed by telephone. The advantages of telephone interviewing in this project was most notably the logistical challenges of travelling to the participant's workplace which was often interstate and the subsequent cost implication (Holbrook, Green, & Krosnick, 2003). The disadvantage pertains to the non-verbal signs that are missed and cannot be explored by telephone. However, the majority of the interviewees were interviewed face to face in their work environment or an alternative environment deemed most suitable and chosen by the participant. Moreover, the insights gained by both methods were not substantially different.

Of the eight participants that were interviewed by telephone, I had previously met four of these participants in person and discussed at length the research. Prior to conducting the telephone interviews with the remaining four participants I had extensive telephone conversations with the participants about the research project. This informal contact with all the participants prior to conducting the interviews fostered a rapport between me and the interviewees (Ryan et al., 2009). The interviews lasted in length from 23 to 61 minutes depending on the amount of time the participant was able to commit. This generated transcripts between 3,370 and 11,236 words. This resulted in a total of 73 hours and 45 minutes of individual interviews generating a total data set of 254,273 words.

3.5.3 Observational studies

Observational research involves the direct observation of individuals in their natural setting (Carlson & Morrison, 2009). Observational studies are common in most fields that study people, including medicine, economics, epidemiology, education, psychology, political science and sociology (Rosenbaum, 2010). Observation is a highly valued and effective research method and can be used in triangulation to validate other qualitative research (Caldwell & Atwal, 2005). The rationale for conducting observational studies in this research was so I could witness the role of liaison officers in a state level emergency operations centre

in an effort to corroborate the findings from the individual interviews. The study sites chosen for this observational phase were the three state level emergency operations centres described earlier. The observation studies were conducted by me fulfilling the role of observer as participant. This stance enabled me to participate in the group activities as desired and 'shadow' the liaison officers allowing attendance at all briefings, meetings and interaction with other members in the state level emergency operations centre (Kawulich, 2005).

Participant observation can be used as a way to increase the validity of the study, as the observations allowed me to have a greater understanding of the context and phenomenon under study (DeWalt & DeWalt, 2002). This meant that the participants in the environment where the observational studies were conducted were aware of my observation activities. My "peripheral membership role" allowed me to closely observe and interact with the participants whilst they performed their role. It also allowed me to establish an insider's identity without participating in those activities that constitute membership of the multi-agency team (Adler & Adler, 1994).

During the observations the participants were asked a series of questions (refer to Appendix G) that were later refined (refer to Appendix H). Opportunistic detailed notes were also taken during the observational studies and after the event. The challenge with this phase of the research was that I sought to investigate the role of the liaison officers specifically at the state level. Multi-agency bushfire exercises are often only conducted on an annual basis at a state level due to the significant logistics and time required to execute an exercise. Subsequently, I was only able to observe the role of liaison officers in three state bushfire exercises. Therefore, additional observations were conducted during actual catastrophic bushfire events requiring state level multi-agency coordination efforts. I was privileged enough to conduct two periods of observational studies in two different states during actual bushfires. Over a sixteen month period between August 2012 and December 2013 I had the

opportunity to observe a total of fifteen liaison officers from multiple organizations across three state level emergency operation centres in a combination of multi-agency exercises and actual emergency events culminating in a total of thirty-nine hours of real time observations (see Table 3.2).

A challenge when conducting observations is that it can be viewed as research that is conducted with an element of bias. Therefore I had to understand how their theoretical methods may affect observation, analysis, and interpretation (Kawulich, 2005). This can be overcome by using multiple observers. However, due to logistical constraints this was not feasible in this study. Nevertheless I sought to address this challenge by building a solid relationship between myself and the participants in order to improve the research process (Rubin & Rubin, 2011). I also went into the observations with an open, nonjudgmental attitude, and with an interest in learning more about the participants role in the multi-agency environment and was subsequently aware of the necessity of been a good listener (DeWalt & DeWalt, 2002).

Table 3.2 Observational study demographics

Observational study	*Scenario*	*Liaison officers organization*	*Number of participants (15 pax)*	*Duration in hours (39 hours total)*
No. 1	Exercise	Emergency services	1	4
No. 2	Exercise	Emergency services	2	8
No. 3	Exercise	Other organization	1	5
No. 4	Bushfire	Emergency services Critical infrastructure Other organization	2 7 1	16
No. 5	Bushfire	Other organization	1	6

3.5.4 Focus group interviews

The rationale for conducting focus group interviews was to further explore the seven categories identified as constraints in the data from the individual interview phase. These challenges were identified as: (1) temporal constraints of working in the environment; (2) a lack of collaborative training; (3) the complexities of working in a multi-organizational work domain; (4) the challenges of providing a physical presence in the work domain; (5) the cultural challenges associated with the inherently different organizational cultures working in the domain; (6) reduced clarification on the organizational roles of liaison officers; and (7) challenges of sharing information to inform liaison officers situation awareness. Additionally it was used as an opportunity to provide feedback on the existing research conducted in this project.

The sample for the group interviews was drawn from the participants who were previously involved in the individual interviews or observational studies. The groups were comprised of liaison officers from emergency services and those from non-emergency organizations (see Table 3.3). Upon consultation with the research team and emergency operations centre management teams it was determined that a mixed group design that may not necessarily have frequent contact with each other would facilitate the best discussion. It was envisaged that a group environment would enable participants to discuss their perceptions, ideas and opinions and thoughts in a non-threatening environment (Krueger & Casy, 2000).

This type of environment can yield important data providing individual perceptions on a given topic (Stewart, Shamdasani, & Rook, 2002). The groups were recruited to consist of between six and eight participants. The rationale for this size is based upon the belief that the group should include enough participants to provide a diversity of information but not too large that the participants feel uncomfortable sharing their beliefs (Baumgartner, Strong, &

Hensley, 2002; Langford, Schoenfeld & Izzo, 2002; Onwuegbuzie, Dickinson, Leech, & Zoran, 2009)

Three focus group interviews were conducted between June 2013 and October 2013 in two different states, two in Victoria and one in Tasmania. When conducting the group interviews I undertook the role of the researcher. In addition, a representative from an organization involved in the emergency management arrangements acted as a moderator. It was decided that for continuity and due to their direct involvement with the study that I would participate in all three focus group interviews (Moen, Antonov, Nilsson, & Ring, 2010). Two moderators were used for the group interviews and chosen because both were sufficiently familiar with the topic to understand the responses and to probe effectively. For continuity the moderator for the two focus group interviews held in Victoria was the same person. Neither of the moderators was involved in the interview phase. The moderator in Victoria was a member of the management team for the state level emergency operations centre. The moderator in Tasmania was a retired senior officer from the emergency services. Both moderators are experienced managers with extensive experience of regulating group meetings at a strategic level. Upon discussion with my supervisory team it was determined that both moderators were indeed experienced in this field, unobtrusive, non-judgemental, had the ability to involve all participants, maintain the ground rules and keep the group focused (Stewart et al., 2002). All the group interviews were audio recorded and each participant was identified by a pseudonym. This maintained anonymity and confidentiality of the participants. The audio recordings were transcribed verbatim by a professional transcriber. The group interviews lasted between 70 and 105 minutes generating transcripts between 12,200 and 15,200 words resulting in a total data set of 39,879 words.

Table 3.3 Demographics of group interviews

Focus group	*Organizations involved*	*Number of participants*	*Duration (minutes)*	*Transcript word count*
No. 1	Emergency services Critical infrastructure	4 4	105	15,198
No. 2	Emergency services Critical infrastructure Other agencies	2 3 2	90	12,210
No. 3	Emergency services Critical infrastructure	2 2	70	12,471

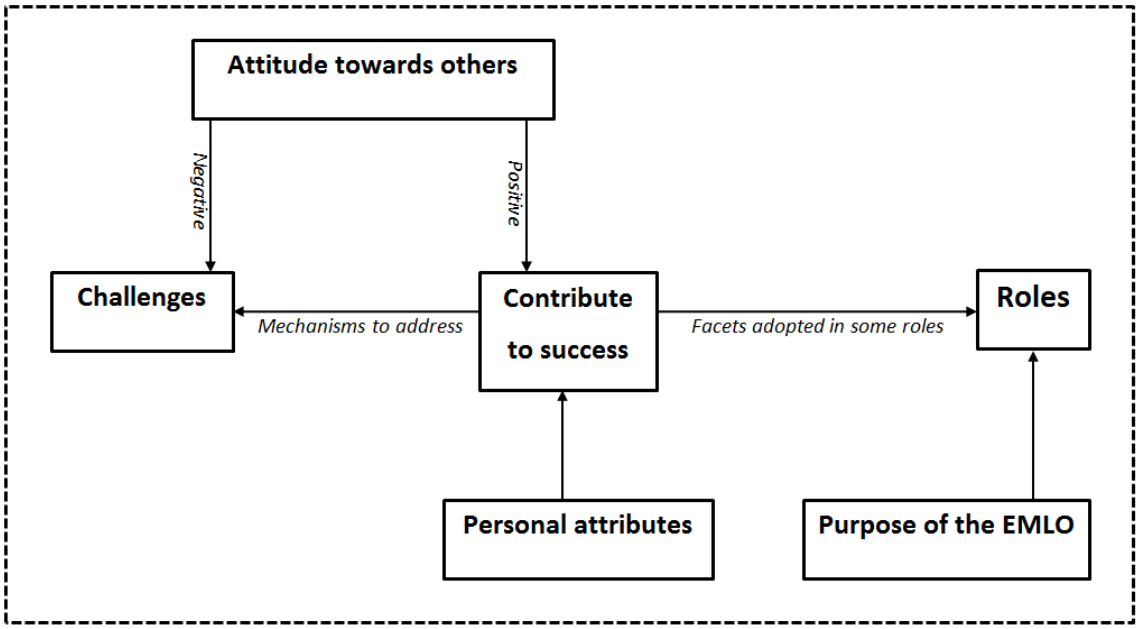
3.6 Data analysis

Qualitative research needs to display what was performed during the data reduction, conclusion drawing and verification processes (Miles & Huberman, 1984). The data was analysed using the data analysis software QSR-NVivo 10. This software provides transparency and facilitates the analysis of data, theoretical development and presentation of findings (Hoover & Koerber, 2011; Hutchison, Johnston, & Breckon, 2010). Firstly, five individual interview transcripts were randomly chosen and examined for generic themes and were categorised in the language used by the participants. This revealed key words and phrases that indicated significant themes based on the participants answers to the individual interview questions. This initially yielded a total of six major themes (see Table 3.4) that were all interconnected. Figure 3.1 demonstrates the relationships between the various themes.

Table 3.4 The six major themes

Number	*Theme*
1	Attitude towards others
2	Constraints
3	Contributes to success
4	Personal attributes
5	Purpose of the liaison officer
6	Roles

Figure 3.1 Interrelationship between the major themes



The next stage involved systematically grouping similar data from the themes (Strauss & Corbin, 1998) in an effort to answer the research questions. This created multiple sub categories radiating from the six major themes. Figure 3.2 provides an example of the sub categories for the theme *Roles* as displayed in NVivo 10. For the purpose of the first research question, Ancona & Caldwell's (1992) typology of boundary spanning roles was used as a

concept to ascertain if the boundary spanning activities identified in the individual interviews could be aligned to this typology of boundary spanning roles. The core-task analysis methodological framework was also used to align the boundary spanning activities to one of three dimensions identified as creating different types of demands on aspects of the workers actions. *Paper I* elucidates how the data pertaining to the first research question was analysed.

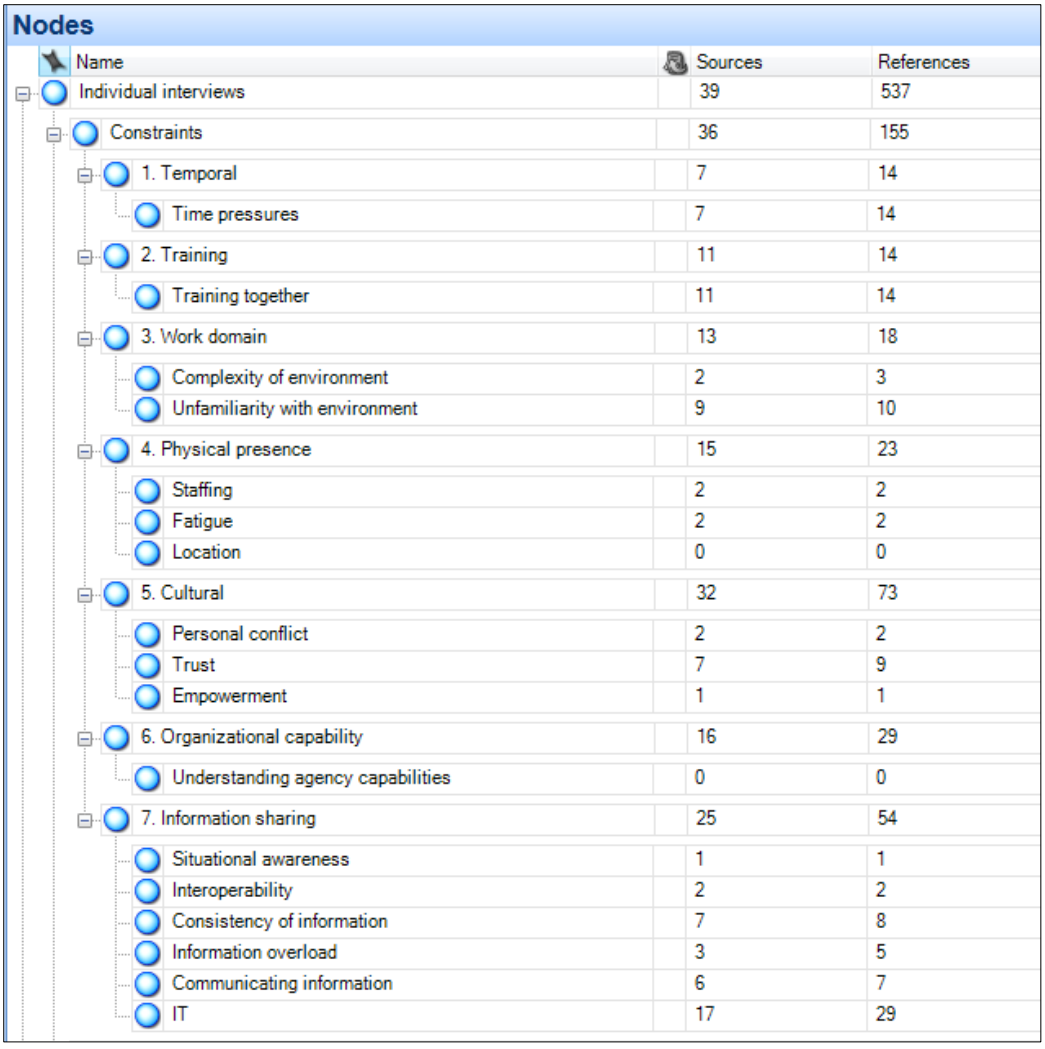
Figure 3.2 An example of the sub categories for the theme titled *Roles*

Nodes

Name	Sources	References
Individual interviews	39	537
Roles	39	163
Boundary spanning descriptors	39	292
1. Domain expert	15	21
Knowledge of external agency	15	21
2. Communicater	14	23
Diplomacy	5	7
Communication	10	16
Influencer	1	2
3. Rescource coordinator	17	24
Organising rescource requests	17	24
4. Legitimate enabler	14	25
Decison maker	14	25
5. Networker	18	31
Networking	18	31
6. Organizational expert	25	37
Follow protocols	4	4
Knowledge of own agency	24	33
7. Information analyst	22	44
Analyzing the information	22	44
8. Representative	29	46
Linkage	7	8
Leadership	2	3
Liaison	1	1
Coordination	2	4
Representing	20	30
9. Information conduit	30	70
Situation awareness	5	6
Exhanging information	28	63
Mechanism to fulfill role	1	1

The data analysis section in *Paper II* articulated how the data was analysed to identify the constraints faced by the participants in the work domain and the mechanisms they adopted to overcome these. Figure 3.4 provides an example of the visual interpretation as displayed in NVivo 10 of the seven categories pertaining to the constraints faced by the liaison officers in the strategic level emergency operations centre as outlined in *Paper II*. *Paper IV* explicitly investigated the cultural challenges faced by critical infrastructure liaison officers that were initially identified and presented in *Paper II*. The data analysis for this particular theme is explained in the methodology section in *Paper IV*.

Figure 3.3 An example of the sub categories for the theme titled *Constraints*



Nodes

Name	Sources	References
Individual interviews	39	537
Constraints	36	155
1. Temporal	7	14
Time pressures	7	14
2. Training	11	14
Training together	11	14
3. Work domain	13	18
Complexity of environment	2	3
Unfamiliarity with environment	9	10
4. Physical presence	15	23
Staffing	2	2
Fatigue	2	2
Location	0	0
5. Cultural	32	73
Personal conflict	2	2
Trust	7	9
Empowerment	1	1
6. Organizational capability	16	29
Understanding agency capabilities	0	0
7. Information sharing	25	54
Situational awareness	1	1
Interoperability	2	2
Consistency of information	7	8
Information overload	3	5
Communicating information	6	7
IT	17	29

To optimize validity and reliability I developed a set of coding lists. The coding lists contained the specific categories in the chosen theme, a brief description of each category, guidelines for how to complete the coding exercise, and examples extracted from the data (Saldaña, 2012). A second member of the research team with extensive experience in qualitative research methods reapplied the coding instructions as per the particular coding list (an example of a coding list can be located in Appendix J). Using Cohen's Kappa coefficient statistical measurement an inter-rater reliability was achieved and is detailed in the corresponding research papers.

At the commencement of each focus group interview the challenges identified in the individual interviews were presented to the group. One of the focus group interview questions asked the participants if the findings related to their personal experiences as liaison officers in emergency management multi-agency coordination. There was a general consensus from the participants that the constraints identified in the data analysis of the individual interviews were representative of their experience as liaison officers. The group elaborated on the constraints that were identified in the individual interviews and the group responses were coded and eleven categories identified. Similar data from these eleven categories were then systematically grouped to one of the seven major categories identifying the constraints that I developed from the individual interviews.

The data from the focus group interviews consolidated the findings in the individual interviews. An additional question in the focus group interviews asked the participants what strategies they believed needed to be established to facilitate effective multi-agency coordination at a state level. Analysis of this data revealed most of these strategies could be integrated into framework illustrating the mechanisms used to manage the core-tasks of liaison officer as illustrated by Figure 2 in *Paper II.* A commonality between all these strategies was the necessity for them to occur in the preparedness or response phase of an

emergency management event. This is illustrated in *Paper V* with Figure 3.7 providing an image distinguishing between the activities in the preparedness phase and response phase of an emergency event.

Finally the data from the observational studies was used to consolidate the findings from the individual and focus group interviews. In particular, *Paper III* reveals how the data from the observational study was collected and used to corroborate the findings in that particular study. Ultimately, the use of these three qualitative research methods were used collectively to triangulate the overall findings from the project and develop a theoretical framework for facilitating emergency management multi-agency coordination as offered in *Paper V*.

3.7 Limitations

It has been documented that there can be a lack of transparency in qualitative research in so far that it is difficult to see why and how a researcher reached their conclusions (Strauss & Corbin, 1998). In this chapter I have sought to address this concern by describing the methodological rationale, data collection methods and analytical process incorporated in this research. The use of QSR NVivo 10 assisted in providing transparency of the data analysis phase and was illustrated in the examples given in Figures 3.2 and 3.3 (Hoover & Koerber, 2011; Hutchison et al., 2010). The strength of this qualitative research is the use of in-depth semi-structured interviews as the primary data source. I sought to increase the validity of this method by triangulating the findings from the individual interviews by incorporating data collected from the focus group interviews and observational studies.

A limitation of the research is rooted in the observational studies. The fact I was the only person present during the observational studies adds some bias to the data. However, due to the collection of 'live' data that is often extremely difficult to collect during large scale

emergency events (McMaster & Baber, 2012), I believe this limitation was acceptable as it provided a rare and valuable insight into liaison officers work in the emergency operations centre. A second limitation may be the relatively small sample size collected from three strategic level emergency operations centres in Australia. However, due to the purposive sample methods adopted in this project and the specific inclusion requirements of the participants involved in this research, I believe it provides a foundation for replicability in future research. In addition, the inclusion of liaison officers from multiple organizations provided rich and complex descriptions of the participants investigated in this research that may be applicable to other liaison officers in Australia who work in strategic level emergency operations centres.

3.8 Summary

This chapter examined and provided reasoning for the methodology chosen for this research. Firstly, the methodological rationale was explained. Secondly, the ethical considerations were given. Next, my research approach was specified and the methodological framework and rationale why it was chosen for this project was explained. A description of the data collection methods was then given and details of the three qualitative methods I used were specified. The followings section elucidated on the data analysis phase of the research. This included an explanation of the data application software I used to assist this process. This section also sought to cross reference the stages of data analysis with the methodology sections in the papers outlined in the following chapter. In an effort to provide some transparency with the data analysis phase, two examples of coding were offered representing the visual interpretation as displayed in NVivo 10. Finally, the limitations of the research were provided. Despite the acknowledgement of the limitations I believe that the findings are generalizable to specific audiences and particularly other liaison officers working in strategic

level emergency operations centres in Australia. Findings from the analysis of the data are provided in the five papers that are introduced next in Chapter 4.

Chapter 4
Research Contributions

Contents

4.1 Introduction

This chapter will endeavour to provide an explanation about how the research questions described in Chapter 1 were addressed. This will be demonstrated through the presentation of five outlined research papers. *Papers I, II* and *III* have been published. *Papers III* and *IV* have been submitted and currently under review with a selection of international journals. Each of the papers corresponds to one of the research questions as illustrated by Figure 1.2 in Chapter 1. The following section provides a brief synopsis of why and how the research papers correspond to each of the three research questions detailed in Chapter 1. This is followed with the statement of co-authorship. The following sections present the title, authors,

abstract as per the journal article and each author's contribution for the five papers as they appear in *Appendices A, B, C, D* and *E*. Finally, the chapter will offer a brief conclusion.

4.2 How the papers relate to the research questions

Paper I established the foundation for the research in this thesis and specifically explored the first research question which asked: *How do liaison officers responsible for emergency management arrangements coordinate their activities in multi-agency arrangements?* The paper investigated this question and used the concept of boundary spanning to examine the actions of liaison officers in the research setting. The paper explained how liaison officers in the research domain currently perform their role in multi-agency coordination arrangements. The activities that the participants use in this role were aligned to the boundary spanning framework defined by Ancona & Caldwell (1992) and discussed in Chapter 2. Finally, an innovative typology of boundary spanning activities specific to the research domain was developed. These activities were aligned to one of the three resources described in the core-task analysis methodological framework that the liaison officers must take into account to achieve their activities in the work setting: (1) dynamism; (2) complexity and (3) uncertainty. The paper endeavoured to answer the first research question by identifying what currently constitutes inter-organizational linkages in strategic level emergency management arrangements and how the linkages are performed.

Papers II, *III* and *IV* collectively sought to address the second research question that stated: *What demands and challenges are placed on liaison officers within multi-agency coordination arrangements?* Initially *Paper II* set the scene and explored the challenges faced by liaison officers operating in a strategic level emergency operations centre using a case study design. This paper identified the constraints encountered by the liaison officers participating in the research and what mechanisms they used to overcome these challenges.

The findings were integrated into the core-task analysis methodological framework as described by Norros (2004) that was designed to analyse complex work in risky environments and discussed in Chapter 3. The result highlighted the core-task demands of liaison officers working in the chosen emergency operations centre. This led me to believe that the core-task analysis methodology was well suited to the high reliability environment of emergency management. *Paper II* indicated that liaison officers working in the research setting were confronted with information and cultural challenges. These two demands were elucidated upon in *Papers III* and *IV*.

Paper III focussed and elaborated on the information challenges identified in *Paper II*. As mentioned previously, I joined an existing research team funded through the Australian Bushfire Cooperative Research Centre which meant that existing data sets were available that could be integrated into this particular research project. Therefore this paper used the observational data collected by me for this project and also used an organizational survey that was distributed under the auspices of the Victorian Office for the Fire Services Commissioner in Australia. The survey investigated the information needs of the various personnel working in this multi-jurisdictional emergency operations centre. This paper expanded on the information challenges identified in *Paper II*. It investigated the perceived information requirements of the participants and identified the mechanisms that they used to facilitate the exchange of information in strategic level emergency management multi-agency coordination. This paper further contributed to the second research question and reaffirmed the information challenges identified in *Paper II.* In addition, the findings from this paper disclosed that face to face communication and specialised information technology applications were the preferred choice of communicating information. Nevertheless, a lack of familiarity with the software used in the research setting compounded the challenges related to obtaining information. This inadequacy with the familiarity of information technology applications may

be associated with a lack of inclusion in preparedness phase activities and links to the cultural challenges also illustrated in Paper *II.*

Paper IV explicitly drew upon the cultural challenge linked to fostering trusting relationships in emergency management. This paper examined the role swift trust plays in emergency management coordination and how role clarity acts as an enabler within temporary organisational configurations Thus, this paper contributed to the second research question by depicting a mechanism that may be adopted by liaison officers to manage some of the specific core-task demands illustrated in *Paper II*.

Finally, *Paper V* utilised the findings from the previous four papers in response to the third research question: *What improvements are needed to support liaison officers to fulfil their role and enable more effective multi-agency coordination? Paper V* presents a theoretical framework developed for improving multi-agency coordination arrangements in emergency management at a strategic level. This paper considers what activities are required to support liaison officers and in which phase of the emergency management cycle they should be applied. The article suggests how the framework can be adopted by policy makers and ultimately the liaison officers practicing these activities in an effort to enable them to cope more efficiently within the work domain and ultimately facilitate multi-agency coordination within strategic level emergency management arrangements.

As part of the research team I also participated in writing and producing a number of reports for the Australian Bushfire Cooperative Research Centre. In addition, I participated in two other research contributions. The first was a publication as a result of a presentation at an international conference and the second was in a book chapter, though my role in the latter was not as first author. These contributions are:

Curnin, S., & Owen, C. (2013). A typology to facilitate multi-agency coordination. *Proceedings of the 10th International Information Systems for Crisis Response and Management Conference* – Baden-Baden, Germany, May 2013.

Owen, C., Bosomworth, K., & Curnin, S. (2014). The challenges of change in future emergency management: Conclusions and future developments. In Owen, C (Ed), *Human factors Challenges in Emergency Management*, Ashgate Publishing Ltd.

4.3 Statement of Co-Authorship

The following people and institutions contributed to the publication of work undertaken as part of this thesis:

Steven Curnin,

School of Education, University of Tasmania, Australia = **Candidate**

Christine Owen,

School of Education, University of Tasmania, Australia = **Author 1**

Cain Trist,

Fire Services Commissioner, Victoria, Australia = **Author 2**

Douglas Paton,

School of Psychology, University of Tasmania, Australia = **Author 3**

David Parsons,

Sydney Water, New South Wales, Australia = **Author 4**

Benjamin Brooks,

Australian Maritime College, University of Tasmania, Australia = **Author 5**

We the undersigned agree with the above stated "proportion of work undertaken" for each of the above published (or submitted) peer-reviewed manuscripts contributing to this thesis:

Signed:

Dr Christine Owen	Associate Professor Karen Swabey
Supervisor	Head of School
School of Education	School of Education
University of Tasmania	University of Tasmania
Date: 15 September 2014	16 September 2014

4.4 Papers

The following section introduces the five papers that are located in their entirety in the appendices. *Papers I*, *II* and *III* are all replicated as they appear in the journal papers that they were published. Alternatively the papers can be accessed in their original PDF format from the publisher's website. *Papers IV* and *V* are formatted in a generic design consistent with the style of the thesis.

4.4.1 Paper I

Spanning organizational boundaries in emergency management (Curnin & Owen, 2014)

Multiagency emergency management coordination requires stakeholders to span organizational boundaries and facilitate collaboration among other agencies within temporary supraorganizations. Multiagency coordination is important in emergency management as

disasters often require the collaboration of multiple agencies into temporary supraorganizations. However, little is known about the boundary spanning activities that influence this collaboration. Based on 39 semi structured interviews with senior emergency management practitioners spanning organizational boundaries, this paper proposes a typology of boundary spanning activities for emergency management. Embracing these activities may address some of the challenges associated with the collaboration of multiple agencies in a disaster.

Status: Published in the International Journal of Public Administration, Vol. 37, No 5, pp. 259 -270

Author's details and their roles: The candidate (80% contribution) was the primary author and main writer who conducted the fundamental literature review and collected the data according to the method described in the paper. Together with author 1 (20% contribution) the candidate performed analysis of the resultant qualitative data. The candidate took the lead in developing the typology with author 1.

4.4.2 Paper II

Managing the constraints of boundary spanning in emergency management (Curnin, Owen & Trist, 2014)

Stakeholders tasked with boundary spanning in emergency management are fundamental in facilitating multi-agency coordination. However, there is a scarcity of research investigating the characteristics of emergency management boundary spanners and how they achieve this function in the complex environment of emergency operation centres. An exploratory case study approach was adopted and applied in a strategic level emergency operations centre. The study used three very different but interrelated qualitative research techniques based

upon the Core-Task Analysis framework to categorise the work of stakeholders fulfilling a boundary spanning role in this setting. The data identified that stakeholders performing boundary spanning activities in a strategic level emergency operations centre face a number of constraints. These can include unfamiliarity with the work domain, its personnel, and structure which can lead to temporal, cultural and information challenges. In order to manage these constraints boundary spanners working in a strategic level emergency operations centre need to adopt certain characteristics in order to accomplish their activities. A significant outcome from the data was the necessity to engage in these important undertakings in the pre-response phase in an effort to facilitate successful multi-agency coordination in an actual emergency event.

Status: Published in Cognition, Technology & Work, Vol. 16, No 4, pp. 549-563.

Author's details and their roles: The candidate (80% contribution) was the primary author and main writer who conducted the fundamental literature review and collected the data according to the methods described in the paper. Together with author 1 (15% contribution) the candidate analysed the resultant qualitative data. The candidate developed the resulting framework with author 1. Author 2 (5% contribution) provided technical expertise and in particular wrote the section concerning the research domain.

4.4.3 Paper III

Obtaining information in emergency management: a case study from an Australian emergency operations centre (Curnin & Owen 2013)

Stakeholders involved in emergency management multi-agency coordination require information to inform their situation awareness to plan and coordinate their response and mitigation strategies. This study investigates the perceived information requirements of

senior strategic level emergency management personnel and how they obtain this information. The results are based on empirical data from two sources: an organizational survey and observational study during an emergency event. The findings indicate that the most influential cognitive artefacts used to obtain information are in person communication and use of specialised application software. However, challenges associated with using the latter can result in an increased use of in person communication which can limit the exchange of information throughout the system of actors. Understanding the strengths and limitations of how these stakeholders obtain information in this Australian emergency operations centre to inform their situation awareness is essential in facilitating multi-agency coordination in this environment.

Status: Published in International Journal of Human Factors and Ergonomics, Vol. 2, Nos 2/3, pp. 131-158

The candidate was the primary author and main writer. The candidate (70% contribution) conducted the fundamental literature review and collected the observational data according to the method described in the paper. Author 1 (30% contribution) collated and analysed the data from the organizational survey. The candidate together with author 1 collectively analysed the data and formulated the findings and subsequent conclusions.

4.4.4 Paper IV

Role clarity, swift trust and multi-agency coordination (Curnin, Owen, Paton, Trist, & Parsons, 2015)

The purpose of this paper is to further the understanding of swift trust in temporary organizations by examining the role swift trust plays in emergency management coordination and how role clarity acts as an enabler within temporary organisational configurations A

qualitative interview study was conducted with 32 liaison officers working in 3 strategic level emergency operations centres in Australia. Role clarity was identified as an important factor in the successful formation of emergency management temporary organizations by emergency services and critical infrastructure liaison officers working in multi-agency arrangements. By providing role clarity, liaison officers may enable collaborative working practices between organizations involved in emergency management and thus facilitate multi-agency coordination. The function of role clarity in the context of swift trust is largely overlooked in emergency management. Therefore this study has contributed to the knowledge of swift trust by empirically verifying the impact of role clarity by liaison officers working in the research setting.

Status: Published in the Journal of Contingencies and Crisis Management, DOI: 10.1111/1468-5973.12072

Author's details and their roles: The candidate (70% contribution) was the primary author and main writer who conducted the fundamental literature review and collected the data according to the methods described in the paper. Together with author 1 (15% contribution) and author 2 (5% contribution) the candidate performed analysis of the resultant qualitative data. Authors 2 and 4 (5% contribution) provided technical knowledge and assisted in writing the sections pertaining to their individual expertise. Author 3 (5% contribution) provided input regarding their particular academic expertise and its applicability in the research setting. The candidate together with guidance from authors 2 and 4 formulated the discussion and conclusion sections.

4.4.5 Paper V

Curnin, S., Owen, C., Paton, D., and Brookes, B. (2015) A theoretical framework for negotiating the path of emergency management multi-agency coordination

Multi-agency coordination represents a significant challenge in emergency management. The need for liaison officers working in strategic level emergency operations centres to play organizational boundary spanning roles within multi-agency coordination arrangements that are enacted in complex and dynamic emergency response scenarios creates significant research and practical challenges. The aim of the paper is to address a gap in the literature regarding the concept of multi-agency coordination from a human-environment interaction perspective. We present a theoretical framework for facilitating multi-agency coordination in emergency management that is grounded in human factors and ergonomics using the methodology of core-task analysis. As a result we believe the framework will enable liaison officers to cope more efficiently within the work domain. In addition, we provide suggestions for extending the theory of core-task analysis to an alternate high reliability environment.

Status: Published in Applied Ergonomics, Vol. 47, pp. 300-307.

Author's details and their roles: The candidate (70% contribution) was the primary author and main writer who developed the resultant framework. Authors 1 (20% contribution), 3 (5% contribution) and 5 (5% contribution) provided guidance and contributed their own specialist academic expertise.

4.5 Summary

This chapter initially put into context how the five papers in this thesis by publication specifically relate to the three research questions described in Chapter 1. This chapter then provided the names and institutions of the co-authors and statement of co-authorship. I was the primary author and main writer for all five of the aforementioned papers. The ultimate objective of the chapter was to introduce the reader to the five papers in sequential order as they address the three research questions. This was achieved by providing for each paper the

title, authors, abstract, status of the article and the author's contributions. It is anticipated that the papers provided a logical progression in the research process as described in Chapter 3. The articles are presented in the appendix. Each of the five papers provide their own discussion and conclusion sections. Nevertheless, it is within the following that I will elucidate how the five research papers provided a theoretical contribution and input to industry.

Chapter 5
Conclusions

Contents

5.1 Introduction

This final chapter will firstly discuss the concepts illustrated in the five research papers introduced in Chapter 4 and how they build upon theory. The theoretical contribution of each individual paper will be explained and how they collectively contributed to the final product of a theoretical framework to facilitate multi-agency coordination in emergency management. The following section will then look at the contribution to industry and in particular the liaison officers engaged in this project. Finally, the chapter will suggest direction for future research associated with this project and lastly an epilogue will be provided.

5.2 Theory development

The aim of a substantial body of research is its originality and contribution to knowledge (Winter, Griffiths, & Green, 2000). It is my belief that the five research papers presented in

this thesis have contributed to theory development in a number of ways. The following sections will explore sequentially each of the individual papers' contribution to building theory. As I have stated in previous chapters, my PhD was part of an Australian Bushfire Cooperative Research Centre project. This project was specifically investigating emergency management multi-agency coordination at a strategic level. Consequently, it was necessary for me to conduct my research in a suitable setting. As the majority of strategic level emergency management arrangements are conducted at an emergency operations centre, I used three state level emergency operations centres in Australia for the research setting.

As I reviewed in Chapter 2, the overwhelming majority of literature investigating multi-agency coordination focuses upon the perspective of the emergency services (see for examples Bharosa, Lee, & Janssen, 2010; Chen, Sharman, Rao, & Upadhyaya, 2008; Militello, Patterson, Bowman, & Wears, 2007; Mishra, Allen, & Pearman, 2011). However, multi-agency coordination is much more than just the emergency services (Scholtens, 2008)**.** This was likewise echoed by the management teams in the research settings. Therefore, I chose to examine emergency management multi-agency coordination from the perspective of the liaison officers who work at the boundaries of organizations in strategic level emergency operations centres. To investigate multi-agency coordination holistically, I selected liaison officers from the emergency services (e.g. fire, police, and ambulance services), critical infrastructure agencies (e.g. energy, water, communications, transport, and health), land management agencies (e.g. environmental, national parks, forestry), non-government organizations (e.g. red-cross) and federal agencies (e.g. Australian Defence Force, Bureau of Meteorology, and Attorney Generals Department). Once the research setting and participants were finalized I could then explore what activities liaison officers used in their working practices.

5.2.1 Expanded typology of boundary spanning activities

To theorize the role of liaison officers I used the concept of boundary spanning and examined if the activities of liaison officers involved in emergency management could be aligned to existing boundary spanning typologies described in the literature. This was described in *Paper I* as a typology of boundary spanning activities enacted by liaison officers working within strategic level emergency management arrangements. Findings from this paper answered the first research question: *How do liaison officers responsible for emergency management arrangements coordinate their activities in multi-agency arrangements?* This was conducted by constructing a foundation of knowledge to understand how liaison officers in the chosen research setting coordinate their activities in multi-agency coordination. The thirty-nine individual interviews I conducted with liaison officers from multiple organizations who worked in two different emergency operations centres provided a rich and illuminating account of the activities they use to perform their work. I was then able to compare the activities with the boundary spanning activities presented in other domains as identified in the literature review. This allowed me to explore why and how boundary spanning in emergency management differed to other non-high reliability environments. Most notably this was due to the complexity, dynamism and uncertainty associated with operating in this environment.

The data revealed the specific activities liaison officers used in the research setting and subsequently a typology of boundary spanning activities of liaison officers working in strategic emergency operations centres was developed as illustrated by Table 3 in *Paper I*. With the development of this typology I was able to compare similarities with the boundary spanning typology developed by Ancona and Caldwell (1992) as discussed in this paper. Significantly, this typology created a theoretical foundation for the work carried out by liaison officers in a setting requiring multi-agency coordination and applied the concept of boundary spaning to a domain where it had previously had no application. The development

of a typology of liaison officer boundary spaning activities provided a foundation for embarking on the second specific research question.

5.2.2 The core-task demands of liaison officers

With an understanding of the boundary spanning activities performed by liaison officers provided in *Paper I*, I could endeavour to answer the second research question: *What demands and challenges are placed on liaison officers within multi-agency coordination arrangements?* To address this I adopted a case study approach using one of the three state level operations centres participating in this research project. The particular emergency operations centre used for the case study was chosen as the majority of the liaison officers interviewed worked in this centre. In addition, it was one of the larger centres and therefore the likelihood of activation for an emergency event was greater and thus the opportunity to undertake empirical research was more achievable. As detailed in *Paper II*, I used three complementary qualitative research techniques. Drawing upon the data elicited from the individual interviews, observational studies and focus group interviews I was able to develop a framework defining the constraints that the work domain puts on the liaison officers and the core-task demands that subsequently emerged as illustrated by Figure 2 in *Paper II*.

Significantly, this paper demonstrated the application of the core-task analysis methodological framework to an environment where it had not previously been applied. This methodological framework was deemed most suitable for this research as it directed systematic attention to the particular constraints of the work as bases of defining the demands on the liaison officers and mechanisms they enacted to manage the associated constraints. The rich findings produced from the data were portrayed in *Paper II*. In particular, two of the demands identified in this framework, the cultural challenges associated with working in a complex multi-organizational environment and the information uncertainty, warranted additional investigation. I envisaged that additional exploration of the challenges linked to

information uncertainty experienced by liaison officers in the research setting would contribute to the situation awareness literature.

5.2.3 How liaison officers inform their situation awareness

The findings from *Paper III* allowed for further articulation in answering the second research question and provided an explanation how liaison officers working in an emergency operations centre perceived their information requirements and how they acquire this information explicitly to inform their distributed situation awareness. These findings contributed to building theory in the realm of research examining the use of cognitive artefacts to support emergency management multi-agency coordination which is limited. This topic provided a deeper theoretical understanding of how personnel working in strategic level emergency operations centres use existing cognitive artefacts to support their needs. Findings discussed in this paper also indicated that a person's location in the research setting affected their ability to access certain cognitive artefacts. The location of a liaison officer in the emergency operations centre was also perceived as a cultural constraint by participants from critical infrastructure organizations. The subject of culture in emergency management is often under researched. Therefore I deemed that the cultural challenges identified in the data warranted further exploration.

5.2.4 The emergence of swift trust in emergency management

Paper IV allowed for the concept of swift trust to be examined in emergency management coordination and specifically how role clarity can act as an enabler and also a constraint within temporary organisational configurations. Data from the individual interviews identified that role clarity was an important factor in the successful formation of emergency management temporary organizations by emergency services and critical infrastructure liaison officers working in multi-agency arrangements. The facet of role clarity as identified in swift trust is similar to another concept identified in emergency management organizations

termed *Professional Capital*. The concept of *Professional Capital* represents the standards of professional performance that demonstrate competence and justify the decisions of managers to interact with other stakeholders (Wukich, 2011). This concept has similarities that complement the dimension of role clarity as recognized in swift trust. Ultimately this particular article has contributed to the theory of swift trust in an emergency management context by empirically verifying the impact and importance of role clarity from liaison officers working in three Australian strategic level emergency operations centres.

5.2.5 A theoretical framework for improving multi-agency coordination

Paper V draws upon the findings and recommendations from *Papers I*, *II*, *III* and *IV* in an attempt to provide answers to the third specific research question: *What improvements are needed to support liaison officers to fulfil their role and enable more effective multi-agency coordination?* This ultimately resulted in the development of a theoretical framework grounded in human factors and ergonomics that can improve multi-agency coordination in state level emergency operations centres. This is illustrated as Figure 2 in *Paper V*. The framework extends my previous work in the research setting and outlines the interdependency of the core-task demands of liaison officers and why these activities should be implemented in the preparedness and response phases on an emergency event. Significantly, this paper builds upon the theory of core-task analysis in the practice of human factors and ergonomics. This paper considered how a new issue recently assimilated into the core-task analysis methodological framework can be adapted to an alternative high reliability environment such as emergency management. Importantly, the development of this theoretical framework offers some guidance for industry.

5.3 Implications for industry

I believe that this thesis has enhanced theory as previously discussed and subsequently provided research that could be utilised in evidence-based practice in emergency management. The concept of evidence based practice is well chronicled in the context of health (see for examples Auf der Heide, 2006; LoBiondo-Wood & Haber, 2013; Sackett & Rosenberg, 1996; Walshe & Rundall, 2001). Nevertheless, in the context of emergency management, developing evidence-based policy and practice for the future based on research is to some extent an emerging phenomenon (Arbon & Smith, 2000; McLennan & Handmer, 2011). As part of an Australian Cooperative Research Centre I endeavoured to contribute this research to the requirements of industry (Commonwealth of Australia, 2012).

As this research was a close partnership with industry it was of paramount importance to make available any emergent findings that could be adopted and used in the research setting. Consequently, facets of the typology illustrated in *Paper I* (Table 3) and from the frameworks depicted in *Paper II* (Figure 2) and *Paper V* (Figure 2) have already been adopted by certain organizations within the emergency management industry. Aspects of the typology of boundary spanning activities (*Paper I* illustrated in Table 3) are now implemented in operational doctrine by one of the participating state level emergency operations centres. The operational doctrine uses aspects of the typology of boundary spanning activities to clarify and provide guidance of the expected role of the liaison officers working in this multi-hazard state level emergency operations centre (see Appendix K for further details).

Significantly, elements from the typology of boundary spanning activities (*Paper I* Table 3), the core task demands of a liaison officer (*Paper II* Figure 2) and theoretical framework for facilitating multi-agency coordination (*Paper V* Figure 2) have recently been incorporated into industry training guidelines. Notably, a workshop for liaison officers

working in Australian state level emergency operations centres has also been developed and this has incorporated a large number of the findings from this research. This has led to two of the emergency operations centres who participated in this research to host pilot workshops and consequently endorse the workshop as suitable training for liaison officers deployed in their centres. This is a significant achievement by all those involved in the research and is a true testament of industry and academia working synergistically to develop evidence-based policy and practice for the future.

Although this research has only been adopted by emergency operations centres involved with the project it is envisaged that the findings may be applicable to other state level emergency operations centres in Australia. Dissemination of the findings of this research at industry conferences will assist in targeting a larger audience of professionals and organizations involved with providing liaison officers in strategic level emergency operations centres.

5.4 A future research agenda

The research presented in this thesis should be supplemented with additional analysis and thus extended. The following section will suggest a number of possible extensions that I think are the most valuable. Firstly is the requirement to investigate whether the theoretical framework presented in *Paper V* is indeed valuable for facilitating multi-agency coordination. Therefore it is necessary to explore whether liaison officers from alternate emergency operations centres actually engage in the core-tasks described in the specific phases of the emergency management process. This could be evaluated empirically and validated in the preparedness phase during multi-agency exercising and in the response phase in the course of a real-time emergency event. If such research could be conducted successfully I believe much could be learned about the strengths and limitations of the theoretical framework.

Another valuable way to assess this approach is to gauge the applicability of the activities identified in this research to a wider sample. This could incorporate multiple case studies using potentially quantitative data techniques to get a broader understanding of liaison officer's role and ultimately their contribution to multi-agency coordination efforts in an Australian context. In addition, due to modification of the core-task analysis framework future research can look at other facets affecting the activities of liaison officers involved in multi-agency coordination such as dialogic communication. In this context future research could be used to explore how organizations differ culturally and if this has an impact on the liaison officer's role.

Finally, this research could be expanded to explore the role of liaison officers involved with multi-agency coordination at different levels of emergency management arrangements. In particular, investigation into the activities at operational and tactical levels could reveal if there are differences to those activities we identified at the strategic level. This could assist in identifying the specific requirements of liaison officers working within multi-agency coordination efforts at the differing levels of emergency management and how industry need to address these challenges.

5.5 Epilogue

To answer the global research question a theoretical framework for facilitating multi-agency coordination in emergency management has been offered. This theoretical framework is rooted in human factors and ergonomics with attention to the socio-cultural setting in order to account for the open ended and dynamic domain of emergency management. The journey that led to this framework is documented in the five sequential research papers introduced in Chapter 4 and presented in their entirety in the appendix. This research has already had practical application in the emergency management industry. Specifically this is regarding

operational doctrine and training pertaining to liaison officers involved with multi-agency coordination arrangements. This is testament to the continued involvement of lead end users and liaison officers from multiple organizations that have been a constant and instrumental component of this research process. I expect that this contribution is also beneficial for other high-reliability environments that include dynamic inter-organizational processes such as those found in acute health systems and the military. Finally, I hope that this thesis will stimulate further innovative research in the area of strategic emergency management multi-agency coordination.

References

A

Adler, P. A., & Adler, P. (1994). Observation techniques. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 377–392). Thousand Oaks, CA: Sage.

Aedo, I., Díaz, P., Carroll, J. M., Convertino, G., & Rosson, M. B. (2010). End-user oriented strategies to facilitate multi-organizational adoption of emergency management information systems. *Information Processing & Management*, *46*(1), 11–21.

Aldrich, H., & Herker, D. (1977). Boundary Spanning Roles Organization. *The Academy of Management Review*, *2*(2), 217–230.

Ancona, D. G., & Caldwell, D. F. (1988). Beyond Task and Maintenance Defining External Functions In Groups. *Group & Organization Studies*, *13*(4), 468–494.

Ancona, D. G., & Caldwell, D. F. (1992). Bridging the Boundary : External Activity and Performance in Teams Organizational. *Administrative Science Quarterly*, *37*(4), 634–665.

Annett, J. (2003). Hierarchial Task Analysis. In E. Hollnagel (Ed.), *Handbook of Cognitive Task Design* (pp. 17–35). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Arbon, P., & Smith, C. (2000). Research development in the field of emergency management. *Australian Journal of Emergency Management*, *15*(1), 6–10.

Auf der Heide, E. (2006). The importance of evidence-based disaster planning. *Annals of Emergency Medicine*, *47*(1), 34–49.

B

Babbie, E. R. (2012). *The Basics of Social Research* (6th ed.). USA: Wadsworth Publishing Co Inc.

Baber, C., Cross, J., Smith, P., & Robinson, D. (2007). Supporting Implicit Coordination Between teams in Disaster Management. In J. Loffler & M. Klann (Eds.), *Mobile Response* (pp. 39–50). Berlin Heidelberg: Springer-Verlag.

Banai, M., & Reisel, W. (1999). Would you trust your foreign manager? An empirical investigation. *International Journal of Human Resource Management*, *10*(3), 477–487.

Baumgartner, T. A., Strong, C. H., & Hensley, L. D. (2002). *Conducting and reading research in health and human performance* (3rd ed.). New York: McGraw-Hill.

Bedney, G., & Meister, D. (1999). Theory of Activity and Situation Awareness. *International Journal of Cognitive Ergonomics*, *3*(1), 63–72.

Berkes, F., Colding, J., & Folke, C. (2003). *Navigating social-ecological systems: Building*

Berlin, J., & Carlström, E. (2008). The 90 Second Collaboration: A Critical Study of Collaboration Exercises at Extensive Accident Sites. *Journal of Contingencies and Crisis Management*, *16*(4), 177–185.

Bharosa, N., Janssen, M., & Tan, Y. H. (2011). A research agenda for information quality assurance in public safety networks: information orchestration as the middle ground between hierarchical and netcentric approaches. *Cognition, Technology & Work*, *13*(3), 203–216.

Bharosa, N., Lee, J., & Janssen, M. (2010). Challenges and obstacles in sharing and coordinating information during multi-agency disaster response: Propositions from field exercises. *Information Systems Frontiers*, *12*(1), 49–65.

Boin, A. (2004). Lessons from crisis research. *International Studies Review*, *6*(1), 165–194.

Boin, A., & McConnell, A. (2007). Preparing for Critical Infrastructure Breakdowns: The Limits of Crisis Management and the Need for Resilience. *Journal of Contingencies and Crisis Management*, *15*(1), 50–59.

Buber, M. (1970). *I and thou (W. Kaufmann, Trans.)*. New York: Charles Scribner's Sons.

Bui, T. X., & Sankaran, S. R. (2001). Design considerations for a virtual information center for humanitarian assistance/disaster relief using workflow modeling. *Decision Support Systems*, *31(2)*, 165–179.

C

Caldwell, K., & Atwal, A. (2005). Non-participant observation: using video tapes to collect data in nursing research. *Nurse Researcher*, *13*(2), 42–54.

Carlile, P. R. (2002). A Pragmatic View of Knowledge and Boundaries : Boundary Objects in New Product Development. *Organization Science*, *13*(4), 442–455.

Carlson, M. D., & Morrison, R. S. (2009). Study design, precision, and validity in observational studies. *Journal of Palliative Medicine*, *12*(1), 77–82.

Charmaz, K. (2006). *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. Thousand Oaks, CA: Sage Publications Ltd.

Chen, R., Sharman, R., Rao, H. R., & Upadhyaya, S. J. (2008). An Exploration of Coordination in Emergency Response Management. *Communications of the ACM*, *51*(5), 66–73.

Chiu, D. K. W., Lin, D. T. T., Kafeza, E., Wang, M., Hu, H., Hu, H., & Zhuang, Y. (2009). Alert based disaster notification and resource allocation. *Information Systems Frontiers*, *12*(1), 29–47.

Coates, G., Wilson, D. T., Hawe, G. I., & Crouch, R. S. (2011). Adaptive Co-ordinated Emergency Response to Rapidly Evolving Large-Scale Unprecedented Events (REScUE). In *8th International ISCRAM Conference* (pp. 1–5).

Comfort, L. (2005). Risk, Security, and Disaster Management. *Annual Review of Political Science*, *8*(1), 335–356.

Comfort, L. (2007a). Crisis Management in Hindsight: Cognition, Communication, Coordination, and Control. *Public Administration Review*, *67*(s1), 189–197.

Comfort, L. (2007b). Crisis Management in Hindsight: Cognition, Communication, Coordination, and Control. *Public Administration Review*, *67* (Supp), 189–197.

Comfort, L., Dunn, M., Skertich, R., & Zagorecki, A. (2004). Coordination in complex systems : increasing efficiency in disaster mitigation and response. *International Journal of Emergency Management*, *2*(1-2), 62–80.

Comfort, L., & Kapucu, N. (2006). Inter-organizational coordination in extreme events: The World Trade Center attacks, September 11, 2001. *Natural Hazards*, *39*(2), 309–327.

Comfort, L., Waugh, W. L. J., & Cigler, B. (2012). Emergency Management Research and Practice in • Public • Administration: Emergence, Evolution, Expansion, and • Future Directions. *Public Administration Review*, *72*(4), 539–547.

Commonwealth of Australia. (1998). *Manual 03 - Australian Emergency Management Glossary*. Attorney General's Department, Emergency Management Australia.

Commonwealth of Australia. (2010). *Critical infrastructure resilience strategy*. Barton, ACT.

Commonwealth of Australia. (2012). *Cooperative Research Centres.* Retrieved October 09, 2012, from https://www.crc.gov.au/Information/default.aspx

Creswell, J. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage.

Curnin, S., & Owen, C. (2013). Obtaining information in emergency management: a case study from an Australian emergency operations centre. *International Journal of Human Factors and Ergonomics*, *2*(2/3), 131–158.

D

De Bruijne, M., & van Eeten, M. (2007). Systems that Should Have Failed: Critical Infrastructure Protection in an Institutionally Fragmented Environment. *Journal of Contingencies and Crisis Management*, *15*(1), 18–29.

Denzin, D. L., & Lincoln, Y. S. (2005). The discipline and practice of qualitative research. In D. L. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 1–32). Thousand Oaks, CA: SAGE Publications.

DeWalt, K. M., & DeWalt, B. R. (2002). *Participant observation: a guide for fieldworkers*. Walnut Creek, CA: AltaMira Press.

Dietz, G., Gillespie, N., & Chao, G. (2010). Unravelling the complexities of trust and culture. In M. Saunders, D. Skinner, G. Dietz, N. Gillespie, & R. Lewicki (Eds.), *Organizational Trust: A Cultural Perspective* (pp. 3–41). Cambridge,UK: Cambridge University Press.

Drach-Zahavy, A. (2011). Interorganizational teams as boundary spanners : The role of team diversity , boundedness , and extrateam links. *European Journal of Work and Organizational Psychology*, *20*(1), 89–118.

Dugdale, J., Darcy, S., & Pavard, B. (2006). Engineering effective cooperation and communication: a bottom-up approach. *International Journal of Emergency Management*, *3*(1), 58–65.

E

Ebers, M. (1997). "Explaining inter-organizational network formation." In M. Ebers (Ed.), *The formation of inter-organizational networks* (pp. 3–40). Oxford: Oxford University Press.

Eisenhardt, K. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, *14*(4), 532–550.

Endsley, M. R. (1995). Toward a Theory of Situation Awareness in Dynamic Systems. *Human Factors*, *37*(1), 32–64.

Endsley, M. R., & Robertson, M. (2000). Situation awareness in aircraft maintenance teams. *International Journal of Industrial Ergonomics*, *26*(2), 301–325.

F

Faraj, S., & Xiao, Y. (2006). Coordination in Fast-Response Organizations. *Management Science*, *52*(8), 1155–1169.

Fioratou, E., Flin, R., Glavin, R., & Patey, R. (2010). Beyond monitoring: distributed situation awareness in anaesthesia. *British Journal of Anaesthesia*, *105*(1), 83–90.

Fleming, L., & Waguespack, D. M. (2007). Brokerage, Boundary Spanning, and Leadership in Open Innovation Communities. *Organization Science*, *18*(2), 165–180.

Flick, U. (2004). Triangulation in Qualitative Research. In U. Flick, E. von Kardoff, & I. Steinke (Eds.), *A Companion to Qualitative Research* (pp. 178–183). London: Sage Publications Ltd.

Fontana, A., & Frey, J. H. (2005). The interview: From neutral stance to political involvement. In D. L. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 695–729). Thousand Oaks, CA: SAGE Publications.

Franke, J., Charoy, F., & Ulmer, C. (2010). A Model for Temporal Coordination of Disaster Response Activities. In *Proceedings of the 7th International ISCRAM Conference* (pp. 1–11).

Friedman, R. a., & Podolny, J. (1992). Differentiation of Boundary Spanning Roles: Labor Negotiations and Implications for Role Conflict. *Administrative Science Quarterly*, *37*(1), 28-47.

G

Gheorghe, A., Masera, M., de Vries, L., Weijnen, M., & Kroger, W. (2007). Critical infrastructures: the need for international risk governance. *International Journal of Critical Infrastructures*, *3*(1/2), 3–19.

Glaser, B. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, California: Sociology Press.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for Qualitative Research*. Transcaction publishers.

Gonzalez, J. J., Munkvold, B. E., Dugdale, J., & Li, F. Y. (2012). Multidisciplinary Challenges in an Integrated Emergency Management Approach. In *Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012* (pp. 1–5).

Gopal, A., & Gosain, S. (2009). Research Note--The Role of Organizational Controls and Boundary Spanning in Software Development Outsourcing: Implications for Project Performance. *Information Systems Research*, *21*(4), 960–982.

Granot, H. (1997). Emergency inter-organizational relationships. *Disaster Prevention and Management*, *6*(5), 305–310.

Gryszkiewicz, A., & Chen, F. (2012). Temporal aspects in crisis management and its implications on interface design for situation awareness. *Cognition, Technology & Work*, *14*(2), 169–182.

Gulick, L. (1937). Notes on the theory of organization. With special reference to government. In L. Gulick & L. Urwick (Eds.), Papers on the Science of Administration (pp. 1–46). New York: Institute of Public Administration.

H

Haddow, G., Bullock, J., & Coppola, D. (2011). *Introduction to emergency management* (4th editio.). Burlington, MA: Butterworth-Heinemann.

Harrald, J. R. (2006). Agility and Discipline: Critical Success Factors for Disaster Response. *The ANNALS of the American Academy of Political and Social Science*, *604*(1), 256–272.

Harter, L., & Krone, K. (2001). The Boundary-Spanning Role of a Cooperative Support Organization : Managing the Paradox of Stability and Change in Non-Traditional organizations. *Journal of Applied Communication Research*, *29*(3), 248–277.

Hasan, H. M. (2009). A taxonomy of modes of knowledge sharing between disparate groups. In *Pacific Asia Conference on Information Systems* (pp. 1–13).

Helsloot, I. (2005). Bordering on Reality: Findings on the Bonfire Crisis Management Simulation. *Journal of Contingencies and Crisis Management*, *13*(4), 159–169.

Helsloot, I. (2008). Coordination is a prerequisite for good collaboration, isn't it? *Journal of Contingencies and Crisis Management*, *16*(4), 173–176.

Holbrook, A., Green, M., & Krosnick, J. (2003). Telephone versus face-to-face interviewing of national probability samples with long questionnaires: Comparisons of respondent satisficing and social desirability response bias. *Public Opinion Quarterly*, *67*(1), 79–125.

Hollnagel, E. (2014). Human factors/ergonomics as a systems discipline? "The human use of human beings" revisited. *Applied Ergonomics*, *45*(1), 40–4.

Hoonaard, W. van den. (2003). Is anonymity an artifact in ethnographic research? *Journal of Academic Ethics*, *1*(2), 141–151.

Hoover, R., & Koerber, A. (2011). Using NVivo to Answer the Challenges of Qualitative Research in Professional Communication: Benefits and Best Practices Tutorial. In *Professional Communication, IEEE Transactions on 54.1* (pp. 68–82).

Hutchison, A. J., Johnston, L. H., & Breckon, J. D. (2010). Using QSR-NVivo to facilitate the development of a grounded theory project: an account of a worked example. *International Journal of Social Research Methodology*, *13*(4), 283–302.

Hyllengren, P., Larsson, G., Fors, M., Sjöberg, M., Eid, J., & Olsen, O. K. (2011). Swift trust in leaders in temporary military groups. *Team Performance Management*, *17*(7/8), 354–368.

I

Iannella, R., & Henricksen, K. (2007). Managing Information in the Disaster Coordination Centre : Lessons and Opportunities. In *Proceedings of the 4th International ISCRAM Conference* (pp. 1–11).

International Organization for Standardization. (2011). *Societal security - Emergency management - Requirements for incident response*, Geneva.

Ipe, M., Raghu, T. S., & Vinze, A. (2009). Information intermediaries for emergency preparedness and response: A case study from public health. *Information Systems Frontiers*, *12*(1), 67–79.

Isbell, M. G. (2012). The Role of Boundary Spanners as the Interorganizational Link in Nonprofit Collaborating. *Management Communication Quarterly*, *26*(1), 159–165.

J

Jacob, S. A., & Furgerson, S. P. (2012). Writing Interview Protocols and Conducting Interviews: Tips for Students New to the Field of Qualitative Research. *The Qualitative Report*, *17*(T&L Art, 6), 1–10.

Janssen, M., Lee, J., Bharosa, N., & Cresswell, A. (2010). Advances in multi-agency disaster management: Key elements in disaster research. *Information Systems Frontiers*, *12*(1), 1–7.

Jemison, D. B. (1984). The Importance of Boundary Spanning Roles in Strategic Decision-Making. *Journal of Management Studies*, *21*(2), 131–152.

Johnson, D., Zagorecki, A., Gelman, J. M., & Comfort, L. (2011). Improved Situational Awareness in Emergency Management through Automated Data Analysis and Modeling. *Journal of Homeland Security and Emergency Management*, *8*(1).

Johnson, K., & Duxbury, L. (2010). The view from the field: A case study of the expatriate boundary-spanning role. *Journal of World Business*, *45*(1), 29–40.

Johri, A. (2008). Boundary Spanning Knowledge Broker : An Emerging Role in Global Engineering Firms. In *38th ASEE/IEEE Frontiers in Education Conference* (pp. S2E7–12).

K

Kapucu, N. (2006a). Interagency Communication Networks During Emergencies: Boundary Spanners in Multiagency Coordination. *The American Review of Public Administration*, *36*(2), 207–225.

Kapucu, N. (2006b). The Evolving Role of the Public Sector in Managing Catastrophic Disasters: Lessons Learned. *Administration & Society*, *38*(3), 279–308.

Kapucu, N. (2011). Collaborative governance in international disasters: Nargis cyclone in Myanmar and Sichuan earthquake in China cases. *International Journal of Emergency Management*, *8*(1), 1–25.

Kapucu, N., & Van Wart, M. (2006). The evolving role of the public sector in managing catastrophic disasters: lessons learned. *Administration & Society*, *38*(3), 279–308.

Karvonen, H., Aaltonen, I., Wahlström, M., Salo, L., Savioja, P., & Norros, L. (2011). Hidden roles of the train driver: A challenge for metro automation. *Interacting with Computers*, *23*(4), 289–298.

Kates, R., Colten, C., Laska, S., & Leatherman, S. (2006). Reconstruction of New Orleans after Hurricane Katrina: a research perspective. In *Proceedings of the National Academy of Sciences*, p. 103 (40) 14653–14660.

Katz, D., & Khan, R. (1966). *The social psychology of organizations*. New York: Wiley.

Kawulich, B. (2005). Participant Observation as a Data Collection Method. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *6*(2).

Kettl, D. F. (2003). Contingent Coordination: Practical and Theoretical Puzzles for Homeland Security. *American Review of Public Administration*, *33*(3), 253–277.

Khan, R. L., Wolfe, D. M., Quinn, R. P., & Snoek, J. D. (1964). *Organizational Stress: Studies in Role Conflict and Ambiguity*. New York: Wiley & Sons, Inc.

Kimble, C., Grenier, C., & Goglio-Primard, K. (2010). Innovation and knowledge sharing across professional boundaries: Political interplay between boundary objects and brokers. *International Journal of Information Management*, *30*(5), 437–444.

King, N. (2004). Using Interviews in Qualitative Research. In C. Cassell & G. Symon (Eds.), *Essential Guide to Qualitative Methods in Organizational Research* (pp. 11–22). Thousand Oaks, CA: Sage Publications Ltd.

Klein, G. (2000). Cognitive task analysis of teams. In J. M. Schraagen, S. Chipman, & V. Shalin (Eds.), *Cognitive task analysis* (pp. 417–429). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Klein, G., Calderwood, R., & Clinton-Cirocco, A. (2010). Rapid Decision Making on the Fire Ground: The Original Study Plus a Postscript. *Journal of Cognitive Engineering and Decision Making*, *4*(3), 186–209.

Koning, L. De, Buul-besselink, K. Van, Hemert, D. Van, & Paulissen, R. (2012). MIRROR : Improving coordination in multidisciplinary crisis management teams. In *Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012* (pp. 1–5).

Kreps, G. A., & Bosworth, S. L. (1993). Disaster , Organizing , and Role Enactment : A Structural Approach. *American Journal of Sociology*, *99*(2), 428–463.

Kruchten, P., Woo, C., Monu, K., & Sotoodeh, M. (2008). A conceptual model of disasters encompassing multiple stakeholder domains. *International Journal of Emergency Management*, *5*(1/2), 25–56.

Krueger, R., & Casy, M. (2000). *Focus groups: A practical guide for applied researchers* (3rd ed.). Thousand Oaks, CA: Sage.

Kvale, S. (1996). *Interviews. An Introduction to Qualitative Research Writing*. Thousand Oaks, CA: Sage Publications Ltd.

L

Langford, Barry E Schoenfeld, G., & Izzo, G. (2002). Nominal grouping sessions vs focus groups. *Qualitative Market Research: An International Journal*, *5*(1), 58–70.

Leavitt, W. M. (2006). Infrastructure Interdependency and the Creation of a Normal Disaster: The Case of Hurricane Katrina and the City of New Orleans. *Public Works Management & Policy*, *10*(4), 306–314.

Lee, K., Ohta, T., & Kakehi, K. (2010). Formal boundary spanning by industry liaison offices and the changing pattern of university – industry cooperative research : the case of the University of Tokyo. *Technology Analysis & Strategic Management*, *22*(2), 189–206.

Levina, N., & Vaast, E. (2005). The Emergence of Boundary Spanning Competence in Practice: Implications for Implementation and Use of Information Systems. *MIS Quarterly*, *29*(2), 335–363.

Ley, B., Pipek, V., Reuter, C., & Wiedenhoefer, T. (2012). Supporting improvisation work in inter-organizational crisis management. In *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12* (pp. 1529–1538). New York, New York, USA: ACM Press.

Lindgren, R., Andersson, M., & Henfridsson, O. (2008). Multi-contextuality in boundary-spanning practices. *Information Systems Journal*, *18*(6), 641–661.

Liu, B. (2008). Online disaster preparation: evaluation of state emergency management web sites. *Natural Hazards Review*, *9*(1), 43–48.

LoBiondo-Wood, G., & Haber, J. (Eds.). (2013). *Nursing research: Methods and critical appraisal for evidence-based practice* (8th ed.). St. Louis, Missouri: Elsevier Mosby.

Lu, Y., & Yang, D. (2011). Information exchange in virtual communities under extreme disaster conditions. *Decision Support Systems*, *50*(2), 529–538.

Lutz, L. D., & Lindell, M. K. (2008). Incident Command System as a Response Model Within Emergency Operation Centers during Hurricane Rita. *Journal of Contingencies and Crisis Management*, *16*(3), 122–134.

M

Mackenzie, C., Hu, P. F.-M., Fausboll, C., Nerlich, M., Benner, T., Gagliano, D., … Xiao, Y. (2007). Challenges to remote emergency decision-making for disasters or Homeland Security. *Cognition, Technology & Work*, *9*(1), 15–24.

Malone, T. W., & Crowston, K. (1990). What is coordination theory and how can it help design cooperative work systems? *Proceedings of the 1990 ACM Conference on Computer-Supported Cooperative Work - CSCW '*90, 357–370.

Manoj, B. S., & Baker, A. H. (2007). Communication challenges in emergency response. *Communications of the ACM*, *50*(3), 51.

Marcus, L. J., Dorn, B. C., & Henderson, J. M. (2006). Meta-leadership and national emergency preparedness: A model to build government connectivity. *Biosecurity and Bioterrorism : Biodefense Strategy, Practice, and Science*, *4*(2), 128–34.

Marecki, J., Schurr, N., & Tambe, M. (2006). Agent-Based Simulations for Disaster Rescue Using the DEFACTO Coordination System. In R. L. Popp & J. Yen (Eds.), *Emergent Information Technologies and Enabling Policies for Counter-Terrorism* (pp. 281–298). John Wiley & Sons.

Marincioni, F. (2007). Information technologies and the sharing of disaster knowledge : the critical role of professional culture. *Disasters*, *31*(4), 459–476.

Marrone, J. A., Tesluk, P. E., & Carson, J. B. (2007). A Multilevel Investigation of Antecedents and Consequences of Team Member Boundary-Spanning Behavior. *Academy of Management Journal*, *50*(6), 1423–1439.

Marsden, P., & Kirby, M. (2005). Allocation of functions. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas, & H. Hendrick (Eds.), *Handbook of Human Factors and Ergonomics Methods* (pp. 338–346). London: Taylor and Francis.

Marti, J., & Hollman, J. (2008). Dynamic recovery of critical infrastructures: real-time temporal coordination. *International Journal of Critical Infrastructures*, *4*(1/2), 17–31.

Mason, J. (2002). *Qualitative Researching* (2nd ed.). Sage Publications Ltd.

Mayer, R., Davis, J., & Schhorman, F. (1995). An Integrative Model of Organizational Trust. *Acaademy of Management Review*, *20*(3), 709–734.

McEntire, D. A. (2002). Coordinating multi-organisational responses to disaster : Lessons from the March 28 , 2000 , Fort Worth Tornado. *Disaster Prevention and Management*, *11*(5), 369–379.

McEntire, D. A. (2012). *Disaster response and recovery*. Wiley.

McGuire, M., & Silvia, C. (2010). The Effect of Problem Severity, Managerial and Organizational Capacity, and Agency Structure on Intergovernmental Collaboration: Evidence from Local Emergency Management. *Public Administration Review*, *March/Apri*, 279–288.

McIntyre, R., & Salas, E. (1995). Measuring and managing for team performance: emerging principles from complex environments. In R. Guzzo & E. Salas (Eds.), *Team effectiveness and decision making in organizations* (pp. 9–45). San Francisco: Jossey-Bass.

McKnight, D., Cummings, L., & Chervany, N. (1988). Initial trust formation in new organizational relationships. *Acaademy of Management Review*, *23*(3), 473–490.

McLennan, B., & Handmer, J. (2011). *Reviewing research for policy-making and practice*, Bushfire Cooperative Research Centre, (pp. 1–14).

McMaster, R., & Baber, C. (2012). Multi-agency operations: cooperation during flooding. *Applied Ergonomics*, *43*(1), 38–47.

Meltsner, A., & Bellavita, B. (1983). The Policy Organization. Beverly Hills, CA: Sage Publications Ltd.

Mendonça, D. (2007). Decision support for improvisation in response to extreme events: Learning from the response to the 2001 World Trade Center attack. *Decision Support Systems*, *43*(3), 952–967.

Meyerson, D., Weick, K., & Kramer, R. (1996). Swift Trust in Temporary Groups. In R. Kramer & T. Tyler (Eds.), *Trust in Organizations: Frontiers of Theory and Research* (pp. 166–195). Thousand Oaks, CA: Sage Publications Ltd.

Miles, M. B., & Huberman, A. M. (1984). Drawing valid meaning from qualitative data: Toward a shared craft. *Educational Researcher*, *13*(5), 20–30.

Miles, R. (1976). Role requirements as sources of organizational stress. *Journal of Applied Psychology*, *61*(2), 172–179.

Militello, L., & Hutton, R. (1998). Applied Cognitive Task Analysis (ACTA): A practitioner's toolkit for understanding cognitive task demands. *Ergonomics*, *41*(11), 1618–1641.

Militello, L., Patterson, E. S., Bowman, L., & Wears, R. L. (2007). Information flow during crisis management: challenges to coordination in the emergency operations center. *Cognition, Technology & Work*, *9*(1), 25–31.

Miller, T., Birch, M., Mauthner, M., & Jessop, J. (2012). *Ethics in Qualitative Research*. Thousand Oaks, CA: Sage Publications Ltd.

Mishra, J. L., Allen, D. K., & Pearman, A. D. (2011). Information sharing during multi-agency major incidents. *Proceedings of the American Society for Information Science and Technology*, *48*(1), 1–10.

Moen, J., Antonov, K., Nilsson, J. L. G., & Ring, L. (2010). Interaction between participants in focus groups with older patients and general practitioners. *Qualitative Health Research*, *20*(5), 607–16.

Morse, J., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, *1*(2), 13–22.

Moynihan, D. P. (2007). *From forest fires to hurricane Katrina: case studies of incident command systems*. Washington DC.

Mullins, G., & Kiley, M. (2002). "It"s a PhD, not a Nobel Prize': how experienced examiners assess research theses. *Studies in Higher Education*, *27*(4), 368–386.

N

National Research Council. (2005). *Summary of a Workshop on Using Information Technology to Enhance Disaster Management* (pp. 1–4). Washington, DC.

Noble, G., & Jones, R. (2006). The Role of Boundary-Spanning Managers in the Establishment of Public-Private Partnerships. *Public Administration*, *84*(4), 891–917.

Norros, L. (2004). *Acting under uncertainty. The core-task analysis in ecological study of work.* VTT Publications, Espoo.

Norros, L. (2014). Developing human factors/ergonomics as a design discipline. *Applied Ergonomics*, *45*(1), 61–71.

Norros, L., Norros, I., Liinasuo, M., & Seppanen, K. (2012). Impact of human operators on communication network dependability. *Cognition, Technology & Work*, *15*(4), 363–372.

O

Onwuegbuzie, A., Dickinson, W., Leech, N. L., & Zoran, A. G. (2009). A qualitative framework for collecting and analyzing data in focus group research. *International Journal of Qualitative Methods*, *8*(3), 1–21.

Owen, C. (2013). Gendered communication and public safety: Women, men and incident management. *Australian Journal of Emergency Management*, *28*(2), 3–10.

P

Paton, D., & Jackson, D. (2002). Developing disaster management capability: an assessment centre approach. *Disaster Prevention and Management*, *11*(2), 115–122.

Paton, D., & Owen, C. (2013). Incident management. In K. Bradley Penuel, M. Statler, & R. Hagen (Eds.), *Encyclopedia of Crisis Management* (pp. 502–506). Thousand Oaks, CA: Sage Publications Ltd.

Patton, M. (1990). *Qualitative evaluation and research methods* (2nd ed.). Thousand Oaks, CA: Sage Publications Ltd.

Pawlowski, S., & Robey, D. (2004). Bridging user organizations: Knowledge brokering and the work of information technology professionals. *Mis Quarterly*, *28*(4), 645–672.

Pearce, T., & Fortune, J. (2006). Command and Control in Policing: A Systems Assessment of the Gold, Silver and Bronze Structure. *Journal of Contingencies and Crisis Management*, *3*(3), 181–187.

Perry, R. W. (2003). Emergency Operations Centres in an Era of Terrorism: Policy and Management Functions. *Journal of Contingencies and Crisis Management*, *11*(4), 151–159.

Peterson, J. (2002). Sheer foolishness: shifting definitions of danger in conducting and teaching ethnographic field research. In G. Lee-Treweek & S. Linkogle (Eds.), *Danger in the Field: Ethics and Risk in Social Research* (pp. 181–196). Routledge.

Pilbeam, C., & Jamieson, I. (2010). Beyond Leadership and Management: The Boundary-spanning Role of the Pro-Vice Chancellor. *Educational Management Administration & Leadership*, *38*(6), 758–776.

Q

Quarantelli, E. L. (1982). Social and organizational problems in a major emergency. *Emergency Planning Digest*, *9*(January - March), 7–10.

Quarantelli, E. L. (1997). Problematical aspects of information/communication revolution for disaster planning and research: ten non-technical issues and questions. *Disaster Prevention and Management*, *6*(2), 94–106.

R

Ramarajan, L., Bezrukova, K., Jehn, K., & Euwema, M. (2010). From the outside in: The negative spillover effects of boundary spanners' relations with members of other organizations. *Journal of Organizational Behavior*, 32(6), 886-905.

Rasmussen, J. (1986). A Framework for Cognitive Task Analysis in Systems Design. In E. Hollnagel, G. Mancini, & D. Woods (Eds.), *Intelligent Decision Support in Process Environments* (NATO ASI S., pp. 175–196). Springer Berlin Heidelberg.

Reddick, C. (2011). Information technology and emergency management : preparedness and planning in US states. *Disasters*, *35*(1), 45–61.

Reid, J. (2006). *Addressing lessons from the emergency response to the 7 July 2005 London bombings:what we learned and what we are doing about it.* London.

Rencrantz, C., & Olsson, R. (2012). A concept for inter-organizational crisis management exercises. In *Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012* (pp. 1–4).

Reuter, C., Marx, A., & Pipek, V. (2011). Social Software as an Infrastructure for Crisis Management - a Case Study About Current Practice and Potential Usage. In *Proceedings of the 8th International ISCRAM Conference* (Vol. 1, pp. 1–10). ISCRAM.

Rigopoulou, I., Theodosiou, M., Katsikea, E., & Perdikis, N. (2012). Information control, role perceptions, and work outcomes of boundary-spanning frontline managers. *Journal of Business Research*, *65*(5), 626–633.

Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practitioner Researchers*. Oxford: Blackwell Publishers.

Rochlin, G. (1993). Defining "high reliability" organizations in practice: A taxonomic prologue. In K. Roberts (Ed.), *New challenges to understanding organizations* (pp. 11–32). New York: Macmillan.

Rosenbaum, P. R. (2010). *Design of Observational Studies*. Springer Series in Statistics.

Rubin, H., & Rubin, I. (2011). *Qualitative Interviewing: The Art of Hearing Data*. Sage Publications Ltd.

Ryan, F., Coughlan, M., & Cronin, P. (2009). Interviewing in qualitative research: The one-to-one interview. *International Journal of Therapy and Rehabilitation*, *16*(6), 309-314.

S

Sackett, D., & Rosenberg, W. (1996). Evidence based medicine: what it is and what it isn't. *British Medical Journal*, *312*(7023), 71–72.

Salas, E., Prince, C., Baker, D., & Shrestha, L. (1995). Situation awareness in team performance: Implications for measurement and training. *Human Factors*, 37(1), 123–136.

Salas, E., Rosen, M. A., Burke, C., & Nicholson, D. (2007). Markers for enhancing team cognition in complex environments: the power of team performance. *Aviation, Space and Environmental Medicine*, *78*(5), 77–85.

Saldaña, J. (2012). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage Publications Ltd.

Salmon, P., Stanton, N., Jenkins, D., & Walker, G. (2011). Coordination during multi-agency emergency response: issues and solutions. *Disaster Prevention and Management*, *20*(2), 140–158.

Salmon, P., Stanton, N., Walker, G., Baber, C., Jenkins, D., McMaster, R., & Young, M. (2008). What really is going on? Review of situation awareness models for individuals and teams. *Theoretical Issues in Ergonomics Science*, *9*(4), 297–323.

Salmon, P., Stanton, N., Walker, G., & Jenkins, D. (2009). *Distributed Situation Awareness: Theory, Measurement and Application to Teamwork*. England: Ashgate Publishing Ltd.

Salmon, P., Stanton, N., Walker, G., Jenkins, D., Baber, C., & McMaster, R. (2008). Representing situation awareness in collaborative systems: a case study in the energy distribution domain. *Ergonomics*, *51*(3), 367–84.

Saoud, N. B., Mena, T. Ben, Dugdale, J., Pavard, B., & Ben, M. (2006). Assessing large scale emergency rescue plans : an agent based approach. *International Journal of Intelligent Control Systems*, *11*(4), 260–271.

Sarter, N., & Woods, D. (1991). Situation Awareness: A critical but ill-defined phenomenon. *International Journal of Aviation Psychology*, *1*(1), 45–57.

Scholtens, A. (2008). Controlled Collaboration in Disaster and Crisis Management in the Netherlands , History and Practice of an Overestimated and Underestimated Concept. *Journal of Contingencies and Crisis Management*, *16*(4), 195-207.

Schraagen, J. M., Huis, M., & Koning, L. De. (2010). Information Sharing During Crisis Management in Hierarchical vs . Network Teams. *Journal of Contingencies and Crisis Management*, *18*(2), 117–127.

Schraagen, J. M., & Van de Ven, J. (2008). Improving Decision Making in Crisis Response Through Critical Thinking Support. *Human Factors*, *2*(4), 311–327.

Schraagen, J. M., & Van de Ven, J. (2011). Human factors aspects of ICT for crisis management. *Cognition, Technology & Work*, *13*(3), 175–187.

Shepherd, A. (2001). *Hierarchial Task Analysis*. London: Taylor and Francis.

Simons, H. (2009). *Case study research in practice*. London: Sage Publications Ltd.

Simpson, D., & Lasley, C. (2010). Understanding critical infrastructure failure: examining the experience of Biloxi and Gulfport, Mississippi after Hurricane Katrina. *International Journal of Critical Infrastructures*, *6*(3), 246–276.

Singh, J., Verbeke, W., & Rhoads, G. (1996). Do organizational practices matter in role stress processes? A study of direct and moderating effects for marketing-orientated boundary spanners. *Journal of Marketing*, *60*(3), 69–86.

Smircich, L. (1983). Concepts of culture and organizational analysis. *Administrative Science Quarterly*, *28*(3), 339–358.

Smith, D. (2003). Business continuity and crisis management. *Management Quarterly*, (January), 27–33.

Smith, D. M. (2010). *A study of command and control of multi-agency disaster response operations*. University of Phoenix, Arizona, USA.

Smith, K., & Hancock, P. (1995). Situation awareness is adaptive, externally directed consciousness. *Human Factors*, *37*(1), 137–148.

Smith, W., & Dowell, J. (2000). A case study of co-ordinative decision-making in disaster management. *Ergonomics*, *43*(8), 1153–66.

Stanton, N., & Young, M. (1999). *A Guide to Methodology in Ergonomics*. London: Taylor and Francis.

Stanton, N., Hedge, A., Brookhuis, K., Salas, E., & Hendrick, H. (2004). Handbook of Human Factors Methods. Boca Raton, FL: CRC Press.

Stanton, N., Stewart, R., Harris, D., Houghton, R. J., Baber, C., McMaster, R., … Green, D. (2006). Distributed situation awareness in dynamic systems: theoretical development and application of an ergonomics methodology. *Ergonomics*, 49(12-13), 1288–311.

Star, S. L. (1989). The structure of ill-structured solutions: Boundary objects and heterogeneous distributed problem solving. In M. Huhn & L. Gasser (Eds.), *Readings in Distributed Artificial Intelligence* (pp. 37–54). Menlo Park, CA: Morgan Kaufman.

Stephenson, M. (2005). Making humanitarian relief networks more effective: operational coordination, trust and sense making. *Disasters*, *29*(4), 337–50.

Stephenson, M., & Schnitzer, M. H. (2006). Interorganizational Trust, Boundary Spanning, and Humanitarian Relief Coordination. *Nonprofit Management & Leadership*, *17*(2), 211–234.

Stewart, D., Shamdasani, P., & Rook, D. (2002). *Focus Groups: Theory and Practice* (2nd ed.). Sage Publications Ltd.

Stewart, R., Stanton, N., Harris, D., Baber, C., Salmon, P., Mock, M., … Kay, A. (2008). Distributed situation awareness in an Airborne Warning and Control System: application of novel ergonomics methodology. *Cognition, Technology & Work*, *10*(3), 221–229.

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research*. Thousand Oaks, CA: Sage Publications Ltd.

Strom, K. J., & Eyerman, J. (2005). Interagency Coordination : Lessons Learned From the 2005 London Train Bombings. *National Institute of Justice Journal*, (261), 28–32.

Sturdy, A., & Wright, C. (2011). The active client: The boundary-spanning roles of internal consultants as gatekeepers, brokers and partners of their external counterparts. *Management Learning*, *42*(5), 485–503.

T

Tasmanian Governemnt. (2013). *Tasmanian Bushfires Inquiry* (pp. 1–263).

Taylor, R. (1990). Situational Awareness Rating Technique (SART): The development of a tool for aircrew systems design. In *Situational Awareness in Aerospace Operations (AGARDCP- 478)* (pp. 3/1–3/17). Neuilly Sur Seine, France: NATO-AGARD.

Teague, B., McLeod, R., & Pascoe, S. (2010). *2009 Victorian Bushfires Royal Commission Final Report*. Melbourne.

Teddlie, C., & Yu, F. (2007). Mixed Methods Sampling: A Typology With Examples. *Journal of Mixed Methods Research*, *1*(1), 77–100.

Thomas, G. (2011). A Typology for the Case Study in Social Science Following a Review of Definition, Discourse, and Structure. *Qualitative Inquiry*, *17*(6), 511–521.

Thompson, J. D. (1967). *Organizations in action*. New York, McGraw-Hill book company.

Travers, M. (2001). *Qualitative Research through Case Studies*. London: Sage Publications Ltd.

Turoff, M., Chumer, M., Hiltz, R., & Klashner, R. (2004). Assuring homeland security: continuous monitoring, control & assurance of emergency preparedness. *Journal of Information*, *6*(3), 1–24.

Turoff, M., Chumer, M., Van de Walle, B., & Yao, X. (2004). The design of a dynamic emergency response management information system. *Journal of Information Technology Theory and Application*, *5*(4), 1–36.

Tushman, M., & Scanlan, T. (1981). Boundary spanning individuals : Their role in information transfer and their antecedents. *Academy of Management Journal*, *24*(2), 289–305.

V

Van de Walle, B., & Turoff, M. (2008). Decision support for emergency situations. *Information Systems and E-Business Management*, *6*(3), 295–316.

Van Teijlingen, E., & Hundley, V. (2002). The importance of pilot studies. *Nursing Standard*, 16 (40)., 33-36.

Veelen, B. Van, Storms, P., & Aart, C. van. (2006). Effective and efficient coordination strategies for agile crisis response organizations. *Proceedings of the 6th International ISCRAM Conference*, (May), 202–213.

Vogt, M., Hertweck, D., & Hales, K. (2011). Optimizing ICT Portfolios in Emergency Management : A Modular Alignment Approach. In *Proceedings of the 8th International ISCRAM Conference* (pp. 1–11).

W

Walsh, D., Christen, T., Christen Jr, H., Lord, G., & Miller, G. (2011). *National incident management system: Principles and practice*. Jones & Bartlett Publishers.

Walshe, K., & Rundall, T. G. (2001). Evidence-based management: from theory to practice in health care. *The Milbank Quarterly*, *79*(3), 429–57, IV–V.

Waugh, W. L. J., & Streib, G. (2006). Collaboration and leadership for effective emergency management. *Public Administration Review*, *66*(s1), 131–140.

Way, S. C., & Yuan, Y. (2012). Towards a Context-Aware Multi-Party Emergency Coordination System Framework. In *Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012* (pp. 1–5).

Weerts, D. J., & Sandmann, L. R. (2010). Universities Community Engagement and Boundary- Spanning Roles at Research Universities. *The Journal of Higher Education*, *81*(6), 702–727.

Weick, K., Sutcliffe, K., & Obstfeld, D. (1999). Organizing for high reliability: Processes of collective mindfulness. In R. Sutton & B. Staw (Eds.), *Research in Organizational Behavior* (pp. 81–123). Stanford, CT: JAI Press.

Wellens, A. R. (1993). Group situation awareness and distributed decision making: From military to civilian applications. In N. Castellan (Ed.), Individual and Group Decision Making: Current Issues (pp. 267–287). Mahwah, New Jersey: Erlbaum Associates.

Wettenhall, R. (2009). Crises and Natural Disasters: a Review of Two Schools of Study Drawing on Australian Wildfire Experience. *Public Organization Review*, *9*(3), 247–261.

Wildavsky, A. (1988). *Searching For Safety*. New Brunswick, NJ: Transaction Publishers.

Williams, P. (2002). The Competent Boundary Spanner. *Public Administration*, *80*(1), 103–124.

Williams, P. (2011). The life and times of the boundary spanner. *Journal of Integrated Care*, *19*(3), 26–33.

Williams, P. (2012). *Collaboration In Public Policy And Practice: Perspectives On Boundary Spanners*. Bristol, UK: The Policy Press.

Winter, R., Griffiths, M., & Green, K. (2000). The "Academic" Qualities of Practice: What are the criteria for a practice-based PhD? *Studies in Higher Education*, *25*(1), 25–37.

Wise, C. R. (2006). Organizing for homeland security after Katrina: Is adaptive management what's missing? *Public Administration Review*, *66*(3), 302–318.

Witzel, A. (2000). The Problem-Centered Interview. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *1*(1).

Wolbers, J., & Boersma, K. (2013). The Common Operational Picture as Collective Sensemaking. *Journal of Contingencies and Crisis Management*, *21*(4), 186–199.

Wukich, C. (2011). Working Together: Exploring the Factors That Influence Interorganizational Cooperation. University of Pittsburgh.

Z

Zhang, C., Viswanathan, S., & Henke, J. W. (2011). The boundary spanning capabilities of purchasing agents in buyer–supplier trust development. *Journal of Operations Management*, *29*(4), 318–328.

Zimmerman, R. (1985). The relationship of emergency management to governmental policies on man-made technological disasters. *Public Administration Review*, *45*(Special Issue: Emergency Management: A Challenge for Public Administration), 29–39.

Appendix A: Paper I

Spanning Organizational Boundaries in Emergency Management

Steven Curnin and Christine Owen
Faculty of Education, University of Tasmania, Hobart, Australia and
Bushfire Cooperative Research Centre, Australia

Multiagency emergency management coordination requires stakeholders to span organizational boundaries and facilitate collaboration among other agencies within temporary supraorganizations. Multiagency coordination is important in emergency management as disasters often require the collaboration of multiple agencies into temporary supraorganizations. However, little is known about the boundary spanning activities that influence this collaboration. Based on 39 semistructured interviews with senior emergency management practitioners spanning organizational boundaries, this paper proposes a typology of boundary spanning activities for emergency management. Embracing these activities may address some of the challenges associated with the collaboration of multiple agencies in a disaster.

Keywords: boundary spanning, emergency management, emergency operations center, multiagency coordination

INTRODUCTION

Modern society is becoming increasingly susceptible to natural and manmade disasters that often necessitate a multi-agency approach (Schraagen & Van de Ven, 2008; Van Scotter, Pawlowski, & Cu, 2012). However, a problem of multi-agency coordination is complex and yet to be solved (Comfort et al., 2004; McEntire, 2002; Militello et al., 2007). The collaboration of multiple agencies that need to interact with each other synergistically to achieve a unified approach (Veelen et al., 2006) is challenging. Agency stakeholders situated within these temporary supra-organizations must facilitate collaboration among other agencies spanning organizational boundaries (McGuire & Silvia, 2010). The complexity of multi-agency coordination requires that we gain further knowledge about how these stakeholders perform these boundary spanning activities.

There is limited empirical research investigating the concept of boundary spanning in emergency management (Janssen et al., 2010) and the suitability of utilising existing boundary spanning typologies for this complex and dynamic working environment. This article seeks to address these limitations by providing a qualitative analysis using 39 semi-structured interviews of senior emergency management practitioners who currently span organizational boundaries in emergency management during multi-agency coordination.

This article is guided by the following two research questions:

1. Are the boundary spanning activities in emergency management different to those identified in other environments?
2. What are the activities of boundary spanners operating at a strategic level in an emergency management context?

It is expected that this qualitative approach will elaborate and extend the current concept of boundary spanning and yield a more detailed comprehensive picture of the boundary spanning activities of agency stakeholders typically found in emergency management multi-agency coordination. Using an established boundary spanning typology may also provide the theoretical underpinnings required to understand the broader boundary spanning activities in emergency management and suggest mechanisms for supporting agency stakeholders involved in multi-agency coordination. The article begins by introducing the theoretical concept of boundary spanning followed by the research design and the findings sections. The discussion section and conclusion will describe the implications for

stakeholders involved in strategic level emergency management operations and provide suggestions for future research directions.

BOUNDARY SPANNING: CONCEPT AND DIMENSIONS

The boundary spanning literature contains numerous definitions of this concept. The first description of boundary spanning has its beginnings in open systems theory (Katz & Khan, 1966; Khan et al., 1964; Thompson, 1967) with some of the first empirical research to describe boundary spanning from the research and design industry (Miles, 1976; Tushman, 1977). Further research attempted to classify the functions performed by boundary spanners in the study of formal organizations (Aldrich & Herker, 1977) and the influence of boundary spanning roles in strategic decision making (Jemison, 1984). However, it is not until research is carried out by Ancona & Caldwell (1988; 1992) that the individual role of boundary spanning is theorized. In the first of two studies in high-technology companies, the authors describe and classify a set of attributes that link a group to its external environment (Ancona & Caldwell, 1988). The first stage in this research produced a comprehensive list of fifteen boundary spanning activities. However, it is not until their second study that they refine the activities of boundary spanning to the four main activities of ambassador, task coordinator, scout, and guarding (see Table 1).

TABLE 1
Typology of Boundary Spanning Activities after Ancona and Caldwell (1992)

Category of activity	*Description of activity*
Ambassador	Represent, promote, communicate the progress of your agency internally and externally, identify agency threats, acquire resources
Task coordinator	Coordinate activities, negotiate and procure items for your own agency with external organizations
Scout	Scan the organization internally and externally for information relevant to your agency's goals
Guard	Avoid releasing information to others

Over the last two decades Ancona & Caldwell's (1992) typology analysing the four boundary spanning activities is evident in a number of recent typologies synthesising the boundary spanning activities in a multitude of disciplines (e.g. Drach-Zahavy, 2011; Johnson & Duxbury, 2010; Pilbeam & Jamieson, 2010; Williams, 2012). This typology has stood the test of time for the context it has been applied but may not be applicable to dynamic and complex environments such as emergency management. In the literature there are several references to the concept of boundary spanning in emergency management (Bharosa et al., 2011; Chen et al., 2008; Ipe et al., 2009; Kapucu, 2006a; McGuire & Silvia, 2010). These references emphasise the boundary spanning activity associated with the sharing and exchange of information between agencies and is often in reference to the notion of multi -agency coordination (Bharosa et al., 2011; Kapucu, 2006a).

Nevertheless, to date there is limited empirical research that specifically investigates the roles of boundary spanning in emergency management. This identifies a gap in the research considering the complexity of emergency management multi-agency coordination. A lack of partnerships between agencies can inhibit collaboration between agencies. This can be a result of agencies that do not usually have a history of working together (Janssen et al., 2010; Waugh & Streib, 2006) and incompatibility of systems, processes and terminology between agencies (Ley et al., 2012; Van de Walle & Turoff, 2008). Subsequently, stakeholders assigned to span these organizational boundaries are fundamental to the collaborative process. Kapucu (2006; 2008; 2011) makes numerous references to boundary spanning in the context of interagency or collaborative networks but does not specifically investigate the particular activities of the boundary spanner. It is perhaps Bharosa, Janssen & Tan (2011) that explore the activities that are most closely associated to boundary spanning. They describe an information orchestrator who interacts with multiple agencies taking care of the information needs that are beyond the boundary of a single agency. This research provides a thorough description of the information coordination challenges of boundary spanning. However, boundary spanning is more than this one activity and dictates the consolidation of multiple activities. Just as there is no single proven approach to emergency management (Wettenhall, 2009), it cannot be assumed that boundary spanning is

generic to all industries. Therefore, in an effort to understand the boundary spanning activities in emergency management, further investigation is called for.

Features of Ancona and Caldwell's (1992) typology of four boundary spanning activities can be recognized in subsequent typologies conceptualizing boundary spanning in numerous disciplines. Recent empirical research in the public sector (Williams, 2002, 2011, 2012), education (Pilbeam & Jamieson, 2010; Weerts & Sandmann, 2010) and business sector (Johnson & Duxbury, 2010; Sturdy & Wright, 2011) have attempted to conceptualise boundary spanning activities. One of the most seminal works to date that comprehensively synthesises the activities of the boundary spanner is by Williams (2012). His book is the culmination of over a decade of research exploring boundary spanning activities in collaborative working practices, predominantly in the public sector (Williams, 2002, 2011). Williams, in keeping with Ancona & Caldwell's four stage typology, also developed a typology of four boundary spanning activities: *reticulist*; *interpreter/communicator*; *coordinator*; and *entrepreneur*. Similar to the ambassador activity described by Ancona & Caldwell (1992), Williams (2012) describes the role of *reticulist* as an individual that is skilled in bridging organizations, adept at influencing others by negotiation and one who is mutually trusted by internal and external organizations to achieve a common goal. This typology also identifies the activity of *coordination* as acknowledged by Ancona & Caldwell (1992).

In the education industry both Pilbeam & Jamieson (2010), and Weerts & Sandmann (2010) propose typologies based upon four boundary spaning activities. Pilbeam and Jamieson (2010) interviewed eight university pro-vice chancellors and identified a total of four characteristics related to boundary spanning: *communicating*; *networking*; *information conduit*; and *composure*. Weerts & Sandmann (2010) conducted eighty interviews across six public research universities and identified four distinct boundary spanning activities essential in advancing university and community engagement: *community based problem solver*; *technical expert*; *internal engagement advocate*; and *engagement champion*. In the management industry recent empirical research by Sturdy & Wright (2011) interviewed thirty-two internal and external consultants from twenty-seven companies and identified three primary activities of the organizational boundary spanner: *gatekeeper*; *broker*; and *partner*. Similarities to the activities described by Ancona & Caldwell are evident in all these typologies, most notably the activities of ambassador, coordinator and information scout.

However, it is recent empirical research conducted in the business community by Johnson & Duxbury (2010) that draws directly upon the work of Ancona & Caldwell (1992). Johnson & Duxbury (2010) conducted seventy-nine interviews with expatriates working within the Canadian foreign ministry and used Ancona & Caldwell's (1992) typology as a theoretical framework to extend the current conceptualizations of the boundary spanner in this field. The data yielded numerous similarities to this theoretical framework and produced a typology of nine boundary spanning activities: *relationship building*; *shaping*; *intelligence gathering*; *delivering*; *coordinating/negotiating*; *guarding*; *information gathering*; *representing*; and *intermediary*. Over the last two decades aspects of Ancona & Caldwell's (1992) typology describing four activities of boundary spanning can be identified in the description of boundary spanning in a multitude of disciplines. However, the application of this typology to the dynamic and complex environment of emergency management is limited. Multi-agency coordination in disasters is imperative for society's wellbeing and therefore the boundary spanning activities essential for this coordination is vital.

RESEARCH DESIGN

The intention of this qualitative study using semi-structured interview data was to yield rich and highly illuminating material (Denzin & Lincoln, 2005; Fontana & Frey, 2005) about the role of senior emergency management practitioners currently fulfilling a boundary spanning position in emergency management multi-agency coordination. Underpinning the analysis of the data was a grounded theory approach constantly comparing theory and data. This approach utilised two pre-existing frameworks.

The first framework was a typology of boundary spanning activities developed by Ancona & Caldwell (1992). This typology follows research in the research and design industry that investigated the activities that are

performed at the boundary of an organization that link a group to its external environment (see Table 1). However, as mentioned in the preceding section describing the literature on boundary spanning, despite its extensive application in numerous disciplines there are limitations to Ancona & Caldwell's (1992) typology in emergency management. Ancona & Caldwell's (1992) typology has predominantly been used in relatively stable working environments (e.g. Research & Design industry, Education, Business). Therefore it was appropriate to complement Ancona & Caldwell's (1992) typology by using a theoretical framework that was suited to complex and dynamic environments such as emergency management.

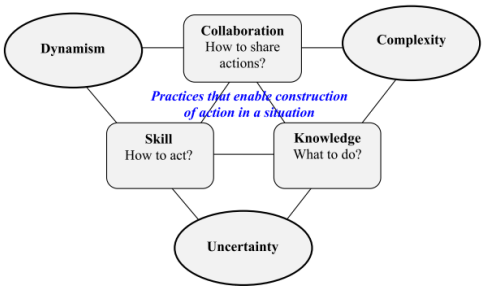


FIGURE 1 Model of generic environmental constraints on action described by Norros (2004).

Subsequently, the second framework was based upon a Core-Task Analysis methodology. This methodology has been applied previously in dynamic, complex and uncertain environments such as nuclear power plant operations (Norros, 2004), anaesthetist's clinical practice (Klemola & Norros, 1997) and maritime piloting (Nuutinen & Norros, 2007). Core-Task Analysis is an ecological research method focusing on understanding the dynamic nature of a system and the practitioners actions within that environment (Norros, 2004). This theoretical framework defines three constraints of modern working environments. These are *dynamism*, *complexity* and *uncertainty*. Operating in these environments creates different types of demands on aspects of the workers actions (Norros, 2004). These aspects are *skill*, *knowledge* and *collaboration* (see Figure 1). Elements of this framework are reiterated in the theory of Surprise Management that is drawn from chaos and transformation theories. This theory similarly highlights the uncertainty of emergency management events and the demands it places on workers to also have cutting-edge knowledge and skills required to operate in this environment (Farazmand, 2007). This research will use the three aspects of action as described in the Core Task Analysis methodology to categorise the boundary spanning activities in emergency management. Core-Task Analysis has had limited application in emergency management which encompasses multiple organizations. As boundary spanning is intrinsic to multi-agency coordination it was therefore fitting to apply these two theoretical concepts to stakeholders operating in this environment.

Senior Emergency Management Practitioners

Recent research investigating the challenges of multi-agency coordination in emergency management predominantly focused upon stakeholders from the core emergency services that were typically limited to police, fire and ambulance agencies (Bharosa et al., 2010; Chen et al., 2008; Militello et al., 2007; Mishra et al., 2011). Subsequently, this research sought to use a broader sample of senior emergency management practitioner's from agencies that currently fulfil a boundary spanning capacity during an emergency event requiring a multi-agency approach (see Table 2). This purposive sampling was deemed most appropriate as the research sought to generate a sample that would address the research questions (Teddlie & Yu, 2007).

Forty participants that represent the type of stakeholders typically found in multi-agency coordination were recruited from two strategic level emergency operations centres in the Australian states of Victoria and Tasmania. In Australia strategic emergency management arrangements are often conducted at a state level from state emergency operations centres. Due to unforeseen circumstances one participant had to withdraw, therefore, thirty-nine semi-structured interviews were conducted. There are a number of reasons why forty participants were chosen. Firstly, it follows guidelines for actual sample sizes using grounded theory methodology where between twenty to fifty interviews was deemed a suitable number (Creswell, 1998; Morse, 1994). Secondly, the research sought to investigate a range of stakeholders from multiple organizations from a strategic view point. Therefore stakeholders involved in state level emergency management arrangements were only recruited and stakeholders from regional or local emergency operations centres were excluded from the sample. However, the logistical and time constraints of conducting in-depth interviews face to face imposed limitations on the number of interviews that could be conducted within the time frame of the study.

The research differed from previous empirical studies of emergency management multi-coordination (e.g. Chen, Sharman, Rao, & Upadhyaya, 2008; Militello, Patterson, Bowman, & Wears, 2007; Mishra, Allen, & Pearman, 2011) and encompassed not only emergency service stakeholders but those from non-emergency service agencies. Over half of the thirty-nine stakeholders interviewed were from agencies that are not technically deemed an emergency service but who are nevertheless required in a multi-agency coordination approach. Table 2 indicates that the participants in the study can be categorized into three distinctive groups: (1) emergency service, (2) critical infrastructure, and (3) other non-emergency agencies with key roles in emergency management coordination. A pilot study was conducted to determine the suitability of the interview questions (Baker, 1994).

TABLE 2

Participant demographics

Emergency Operations Centre	*Emergency Service (16)*	*Critical Infrastructure (12)*	*Other Non-Emergency Agency (11)*
Victoria (31)	Police (1) Ambulance (1) Fire (6) State Emergency Service (4)	Water Services (2) Communications (2) Energy (2) Transport (4) Health (1)	Military (1) Non for profit organizations (2) Land Management Agencies (5)
Tasmania (8)	Police (1) Ambulance (1) Fire (1) State Emergency Service (1)	Energy (1)	Meteorology (1) Land Management Agencies (2)

All the interviews were scheduled at times and places convenient to the participants between July and October 2012. Thirty-four interviews were conducted face to face and the remaining five were conducted by telephone. The names of the participants were de-identified to protect the confidentiality and maintain anonymity. Following agreement from the participants, the interviews were audio taped and subsequently transcribed verbatim by a professional transcriber for data analysis. The interviews lasted between 24 and 61 minutes generating transcripts of between 3,600 and 11,200 words. The interview transcripts were returned to the participants for checking and to ensure accuracy (Morse et al., 2002).

Analysis of Interview Data

Qualitative research needs to adequately display what was performed during the data reduction, conclusion drawing and verification processes (Miles & Huberman, 1984). Our analytical technique allowed for the interchange of inductive and deductive methods of analysis as described by Eisenhardt (1989). This grounded theory approach to analysing allowed the researchers to constantly compare theory and data. This approach enabled two pre-existing theoretical frameworks to be specified (see Table 1 and Figure 1). Using theory elaboration permitted the study design to derive from pre-existing frameworks that were guiding the study (Bluhm, Harman, Lee, & Mitchell, 2011). Theory elaboration can be beneficial to designs where no previous conceptualization exists (Lee, Mitchell, & Sablynski, 1999). This technique was reported by Johnson & Duxbury (2010) who used this technique in an exploratory case study which sought to elaborate and extend the current conceptualization of the boundary spanning role of expatriates working within the Canadian foreign ministry. It therefore appeared appropriate to use this technique in this research in an effort to allow for the expansion of boundary spanning theory by addressing the specific activities in an emergency management context.

The data was analysed using the data analysis software QSR-NVivo 10. This software can not only provide transparency but facilitate the analysis of data, theoretical development and presentation of findings (Hoover & Koerber, 2011; Hutchison et al., 2010). Recent empirical research from numerous disciplines identified some traits of the boundary spanning activities described in Ancona & Caldwell's (1992) typology. Therefore, this typology was used as an orientating framework, in conjunction with the Core-Task Analysis methodology, for the analysis of the data (see Table 1 and Figure 1). Based on elements of the Core-Task Analysis methodology, practices of *collaboration*, *skill* and *knowledge* were used as categories for the activities identified in the data. Firstly, the data was examined and first-order descriptions of boundary spanning activities were categorised in the language used by the participants. This initially yielded a total of eighteen activities.

The next stage involved systematically grouping similar data (Strauss & Corbin, 1998) which reduced the activities to nine. In conjunction with this stage the activities were compared with the categories in Ancona & Caldwell's (1992) typology for similarities. The activities were assigned to one of the three categories adapted from the Core-Task Analysis methodology. Data analysis was ceased when it became apparent that all the data had been assigned to one of the categories and no new themes emerged. To ensure validity and reliability a predefined coding framework was developed by the initial researcher. The second researcher reapplied the coding framework to the data and using Cohen's Kappa coefficient statistical measurement and achieved an inter-rater reliability of 88%. This indicates a substantial or good level of agreement (Fleiss, Levin, & Paik, 2003; Landis & Koch, 1977). We describe the dimensions in the section that follows.

FINDINGS

Analysis of the data identified nine boundary spanning activities of senior emergency management practitioners currently working in two Australian state level emergency operation centres. These are: representative; communicator; networker; legitimate enabler; information conduit; information analyst; resource coordinator; organizational expert; and domain expert (see table 3). These activities were systematically associated with one of the three categories identified in the Core-Task Analysis methodology. The analysis of the nine boundary spanning activities is structured according to their association with one of the following three categories: *collaboration*; *skill*; or *knowledge*. With respect to each category the analysis included the features and association of the activity with these categories and any association with Ancona & Caldwell's (1992) typology.

Collaboration

Core-Task Analysis methodology hypothesizes that *collaboration* contributes to reducing the complexity in dynamic situations in an effort to enable proper functioning of a system (Norros, 2004). The data analysis identified that the following four activities were associated to this category: representative; communicator; networker; and legitimate enabler. Each individual activity will be described in the following section.

TABLE 3

A Typology of Stakeholder's Boundary Spanning Activities at the Strategic Emergency Management Level

Category	*Activity*	*Percentage of participants who described the activity*
Collaboration	Representative	51
	Communicator	36
	Networker	46
	Legitimate enabler	36
Skill	Information conduit	72
	Information analyst	56
	Resource coordinator	44
Knowledge	Organizational expert	62
	Domain expert	38

Representative

The most frequently cited activity described by the participants within this category was the requirement for the stakeholder to represent their agency within the supra-organization. The collaboration of multiple agencies in a state level emergency operations centre often requires an agency representative as the lead contact. This representative activity is closely aligned to the ambassador activity in Ancona & Caldwell's (1992) typology. It is also consistent with the boundary spanning activities in other domains that describe the boundary spanners ability to provide external representation (Johnson & Duxbury, 2010; Pilbeam & Jamieson, 2010) as the following participant explains:

> "Now whether it's VICPOL (Victoria Police) or whether it's from one of the TELCOS (Telecommunication agencies) or something like that, they'll come in and they're there representing their organization." [Participant 3, Emergency Services, Victoria]

Within the representative activity a common theme was the ability to ascertain how that agency could contribute and assist to the situation as described by the next participant:

> "So they need to be able to represent our organization in a professional manner and understand what the other agencies are requiring." [Participant 18, Other Non-Emergency Agency, Victoria]

The ability of agency stakeholders to assist the decision makers in an emergency event was reliant on their communication skills.

Communicator

Communication amongst agencies in emergency management multi-agency coordination is essential for effective collaboration (Comfort, 2007b; Waugh & Streib, 2006). The ability to communicate to all levels of personnel in an organization is evident as an activity in boundary spanning literature (Ancona & Caldwell, 1992; Pilbeam & Jamieson, 2010; Williams, 2012). More often and consistent with emergency management multi-agency coordination is the requirement to communicate with personnel both horizontally and vertically with multiple organizations (Kapucu, Arslan, & Demiroz, 2010). Having the capacity to communicate significant information effectively in the dynamic environment of emergency management is reiterated by the following participant:

> "You have to be able to deliver important messages succinctly and not forcefully, but you need to be able to deliver the message so that other people are aware of the importance of it or the impact on other organizations. But in saying that you also need to be able to listen to other people's point of view and be able to relate to that or be able to go, oh yeah, I can see where you're coming from." [Participant 33, Emergency Services, Tasmania]

The importance and ability to converse effectively and convincingly with multiple stakeholders in order to present the views of the agency is imperative in establishing relationships with external stakeholders.

Networker

Networking is an important activity in the collaboration of multiple organizations (McEntire, 2004)**.** There is no direct reference to the activity of networking in Ancona & Caldwell's (1992) typology but the ability to network has been identified and included as a boundary spanning activity within the education industry (Pilbeam & Jamieson, 2010; Weerts & Sandmann, 2010). The ability to establish networks and build a rapport with external stakeholders is described by the following participant:

> "The type of person I want to put in the there is someone who's going to get up, walk the room, find out who's around, work out what they're doing, more than what's written on paper and engage with the people they need to get the information from or alternatively the people that they should feed information to and are going to listen to it." [Participant 10, Emergency Services, Victoria]

However, a recurrent theme in this data regarding the activity of networking is the requirement to form established networks in the pre-response phase in an effort to facilitate successful negotiations during the actual emergency event. This is described by the following two participants:

> "The characteristics of a successful person in that position are someone who has those networks established pre-incident, I think that is the real key." [Participant 25, Emergency Services, Victoria]

> "It's very difficult for someone to come in cold. Ideally the person will have established relationships with the other key players from organizations and will be familiar and used to working with them." [Participant 39, Other Non-Emergency Agency, Tasmania]

Legitimate enabler

Boundary spanning invariably requires the incumbent to make decisions on a regular basis on behalf of their organization (Pilbeam & Jamieson, 2010). However, dynamic situations such as emergency management require action (Norros, 2004) which invariably means there is a necessity for stakeholders to make things happen. This activity goes beyond the simple decision making function. Instead it demands that the stakeholder has the authority and empowerment to commit to their agency's actions or be a direct link to the appropriate person who can make a decision on behalf of the agency. This is particularly evident in the activity of resource coordinator where stakeholders are expected to have the authority or certainly the ability to access a decision quickly regarding the potential commitment of their agency's assets. This activity has a close association with the activities of representative and resource coordinator which both require the stakeholder to have the delegated authority to commit to their agency's actions. This is echoed by the following two participants:

> "So I think it helps to have some authority. It doesn't have to be too senior but it has to also allow the person to be able to make decisions and not afraid to make decisions. You know, you then don't have to start running it past the next person, and the next person, which just delays the process. You know, if we put a junior ranked person there, they'd be going, gee I'm not sure if I can or

> if I have the authority or the delegation to do that, so if you put someone in there that can make the decision it just speeds up the process." [Participant 11, Emergency Services, Victoria]

> "The person who is the liaison has to have enough knowledge about our organization and be senior enough to be able to make decisions if necessary." [Participant 8, Non-Emergency Agency, Tasmania]

Having the authorisation and subsequent empowerment to commit to the agency's actions or the ability to contact a suitable person empowered to make a decision on behalf of the agency, are reliant on the information available to the stakeholder. The importance of the stakeholder's ability to access information, transmit information, analyse information and coordinate resources are described in the following category of *skill*.

Skill

The Core-Task Analysis methodology theorizes that *skill* is a process for coping with uncertainty in a situation that requires action to respond to the problem (Norros, 2004). In the analysis phase three activities were aligned to the category of *skill*: information conduit; information analyst; and resource coordinator. These three activities all require skill to create possibilities to survive (Norros, 2004) in the emergency management environment.

Information conduit

The most frequently cited activity described by all the participants was that of information conduit. The skill of scanning the environment inside and outside the organization for ideas and collecting information from individuals outside of the stakeholder's agency is well described by Ancona & Caldwell (1992). The scouting of information encompasses the activity of a conduit that not only collates information but also disseminates information within an organization and across organizational boundaries as the following participants explain:

> "They're there to gather information. They're there also to present the issues that this might create for their organization or the information that they actually need to make decisions." [Participant 1, Other Non-Emergency Agency, Victoria]

> "One of the key things that we would want to know is, where's our infrastructure and where's the fire and where's the collision path? You're going to have to have access to our information to get those answers." [Participant 35, Critical Infrastructure, Tasmania]

The data also reveals the close association between transmitting information and the analysis of information.

Information analyst

Of the entire activities discussed in the data, information analyst was the third most cited. There is no direct reference of the analytical capability to interpret information in Ancona & Caldwell's (1992) typology. Despite this there are numerous references identifying the importance of this activity in recent literature describing the boundary spanning activities in the domains of management and education (Johnson & Duxbury, 2010; Pilbeam & Jamieson, 2010; Sturdy & Wright, 2011; Williams, 2012). This activity requires a skill in reducing the complexity of the situation. Subsequently this activity was placed in the category of *skill* as many of the participants felt that the activities of information conduit and information analyst were symbiotic as described by the following two participants:

> *"…what you end up being faced with is lots of information and as all that information start swirling, you have to be able to process what it really means for the agency that I represent or what I know that could make a difference to the people that I'm here surrounded by in terms of being able to filter."* [Participant 17, Critical Infrastructure, Victoria]

> *"I'm pretty practised at working out what is a priority and what needs to be said for a particular thing to occur or a particular action or whatever. I'm fairly used to that but it is really a skill that you need to have to sort out the forest from the trees and to be able to pick out, ok that was the key."* [Participant 7, Other Non-Emergency Agency, Victoria]

The skill of acquiring and analysing the necessary and pertinent information was intrinsically associated with the activity of resource coordinator.

Resource coordinator

Ancona & Caldwell (1992) identified the boundary spanners ability to lobby for and acquire resources for the team and this was also identified in this data. Participants identified the skills required in the coordination of agency resources. In addition, the participants often described the necessity

for this activity to assist with external agencies resourcing requirements to combat the threat. As emergency management often requires a multi-agency approach, it is not surprising that the activity of resourcing should take into account not only the stakeholders own agency requirements but those of the supra-organizations resourcing requests as explained by the following participant:

> "A liaison officer is required at a co-ordination centre to principally talk about the assets that we own or have control over within the disaster area. It's also to provide resources and maybe comment on the process that the co-ordination centre is taking with regard to the impact on our assets or the use of our assets." [Participant 28, Critical Infrastructure, Victoria]

The activity of resource coordinator emphasised not only the skill required to fulfil this activity but the knowledge requirements necessary for completing the activity.

Knowledge

Core-Task Analysis methodology (Norros 2004) hypothesises that *knowledge* and its processes facilitate coping in a complex environment and enable reflection on the inherent uncertainties in the environment. The final two activities of organizational expert and domain expert require the stakeholder to have knowledge of their own organization and the environment they are operating. However, these activities have no association with Ancona & Caldwell's (1992) typology.

Organizational expert

The importance of the stakeholder having knowledge of their own organization was the second most cited activity in this typology. This involved the stakeholder's ability to be a broad subject matter expert regarding their own organizations activities, capabilities and strategic aims. The functional purpose of this activity encompassed the stakeholder's ability to provide a rapid and succinct profile of their organizations abilities as defined by the following participants:

> "You have to be a subject matter expert for the whole agency and not just for the area that you might be involved in for day to day business." [Participant 19, Critical Infrastructure, Victoria]

> "You have to have an understanding, really of end to end, how your agency business works at a high level. So you don't have to be an expert, you don't have to have done everything but you need a good understanding." [Participant 17, Critical Infrastructure, Victoria]

However, synthesis of the data also identified the need for stakeholders to have knowledge of the external agencies respective roles within the emergency management structure and understanding their potential requirements.

Domain expert

The stakeholder requires knowledge of the multiple external agencies involved during the specified emergency event and an understanding of what those agencies can contribute to the event. The stakeholders do not necessarily need to know everything about every agency but they do require a broad understanding of how those agencies complement the emergency management structure as the following participants explain:

> "…where other agencies play into that mix and having that, you know, very strong understanding, not to the point where it's just superficial and what's in the book but actually practically understanding how other agencies roles and functions play into it and where you can draw on that strategic resource or where the, I guess, the expertise might lie for an unknown situation that comes about, which of the agencies can you go to actually provide that expertise and advice back into the mix." [Participant 9, Emergency Services, Victoria]

> "I would expect, and we put our people through training either externally and internally, to have an understanding of the roles and relationships of control agencies and how that works with the emergency services, between the police and SES (State Emergency Service) and all the responsible people because learning on the job in the middle of a crisis is not the ideal way to respond." [Participant 14, Critical Infrastructure, Victoria]

DISCUSSION

The aim of this research was to explore the boundary spanning activities of senior emergency management practitioner's from agencies that currently fulfil a boundary spanning capacity in strategic level multi-agency coordination. This typology represents a number of facets that resonate the boundary spanning activities described by Ancona & Caldwell's (1992) typology and have been documented in the recent associated literature exploring the concept of boundary spanning in

multiple disciplines (Drach-Zahavy, 2011; Johnson & Duxbury, 2010; Pilbeam & Jamieson, 2010; Weerts & Sandmann, 2010; Williams, 2012). However, the four activities described in Ancona & Caldwell (1992) typology would appear too simplistic for the complex and dynamic environment of emergency management. Consequently, to explore the activities in the emergency management domain features of the Core-Task Analysis methodology have been used. In particular the three different types of demands (*collaboration*, *skill* and *knowledge*) described in the Core-Task Analysis methodology that are placed on the workers actions are used as categories.

This research revealed a comprehensive typology of nine activities that are critical to the emergency management space. Four of these activities were aligned to Ancona & Caldwell's (1992) typology: representative; communicator; information conduit; and resource coordinator. However, five of these activities have not previously been analysed: networking; legitimate enabler; information analyst; organizational expert; and domain expert. This research explored these five activities to ascertain why there are elements of boundary spanning activities that are distinctive to the study setting.

Networking is an important activity of the boundary spanner in emergency management. Effective multi-agency coordination requires the synchronised efforts of multiple stakeholders (Van Scotter et al., 2012). These stakeholders require the ability to network with multiple agencies within a temporary supra-organization so that linkages can be established resulting in an interdependent decision-making team (Harrald, 2006; Salmon et al., 2011). The data identified the requirement of networking in the pre-event phase due to the temporal challenges associated with disasters and the subsequent challenges of establishing networks in the response phase.

Over a third of participants indicated that the activity of legitimate enabler was considered in the remit of the stakeholder's boundary spanning capacity. The data suggested stakeholders involved with strategic level emergency management multi-agency coordination arrangements were delegated the necessary authority and subsequently empowered to either commit to their agency's actions or have a direct link with the appropriate agency person who can make a decision. An issue reiterated among the participants was the requirement to do this expeditiously. The necessity to rely on rapid decision making reflects the temporal constraints of emergency management multi-agency coordination and is documented in the associated literature (e.g. Chen et al., 2008; Faraj & Xiao, 2006; Smith & Dowell, 2000). The temporal challenges in emergency management can also be associated with the remaining three activities described here.

The activity of information analyst was not described in Ancona & Caldwell's (1992) typology but is described in earlier boundary spanning literature. The concept of filtering and interpreting information to avoid information overload for the receiving organization is associated with the boundary spanner performing a gatekeeper activity (Aldrich & Herker, 1977; Ancona & Caldwell, 1988; Tushman, 1977). The participants in this study made frequent references for the obligation to provide succinct and pertinent information to multiple agencies in a timely manner. This is also identified in the associated literature (e.g. Comfort et al., 2004; Lindgren, Andersson, & Henfridsson, 2008) and reiterates not only the temporal challenges (Gryszkiewicz & Chen, 2012) but uncertainty (Farazmand, 2001) associated with emergency management. The advent of technology in disaster management information systems has increased the amount of information available to stakeholders (Janssen et al., 2010; Mishra et al., 2011; Vogt et al., 2011). However, due to the potential for information system incompatibility (Ley et al., 2012) between agencies, some stakeholders have to access information from multiple sources and analyse this according to their specific information requirements (Van de Walle & Turoff, 2008).

The final two activities of organizational expert and domain expert were identified as boundary spanning activities in emergency management that required organizational and domain knowledge. The complexities of emergency management require advanced knowledge beyond routine environments of governance (Farazmand, 2001, 2007). There was an expectation among the participants that stakeholders had expert knowledge of not only their own organizations but of other organizations operating within this environment and the obligations regarding the emergency management arrangements in this domain. Understanding the organizational requirements of multiple agencies can be challenging in multi-agency coordination when agencies may not have a history of

working together (Schraagen & Van de Ven, 2011). Again due to the temporal constraints stakeholders must be familiar with other agencies and emergency management arrangements in the pre-response phase and not rely on learning these factors in the actual event where time is often not a luxury. There are many similarities between the boundary spanning activities in emergency management and other domains. However, the dynamic, complex and uncertain nature of emergency management places demands on the boundary spanners work. These boundary spanners may have to adopt particular activities related to *collaboration*, *skill* and *knowledge* that will enhance their capability to manage their actions collectively in temporary supra-organizations and ultimately facilitate multi-agency coordination.

CONCLUSION

Fundamental to the success of spanning organizational boundaries and providing the linkages between these often disparate organizations is the boundary spanner. Stakeholders spanning organizational boundaries in emergency management may need to adopt unique activities to facilitate multi-agency coordination. This research aimed to identify the activities of boundary spanners operating at a strategic level in an emergency management context and ascertain if these differed to those activities identified in other environments. The findings indicate that the principal activities of the boundary spanner operating at a strategic level in the emergency management environment replicate some of the activities described by Ancona & Caldwell's (1992) typology and those that are subsequently documented in the boundary spanning literature. However, due to inadequate linkages, temporal constraints, and system incompatibility associated with operating in this dynamic and complex environment the participants had to embrace additional activities to those documented in the existing literature. The research identified that the activities of networking, legitimate enabler, information analyst, organizational expert and domain expert were fundamental to the success of boundary spanning in emergency management and ultimately in accomplishing successful collaboration between multiple organizations.

This research has made a theoretical contribution to the public administration and emergency management literature by proposing a typology of boundary spanning activities required by stakeholders operating at a strategic emergency management level. Nevertheless, despite this contribution the research was subject to a number of limitations. Firstly, the narrowness of the sample and specificity of the study setting yielded participants from a very unique field poses limitations. However, the reason for these choices was not to generalize the findings to other industries but to elaborate on existing theory and generate theory that can be applied to public administrators operating in an emergency management environment. It is anticipated that the rich data yielded from the research resulting in this typology may be applicable to emergency management operation centres in other regions within Australia and within the international emergency management community. A further limitation of this research is that the information from the participants was not observed and therefore the findings have not been corroborated. It was not this study's intent to observe the interaction between stakeholders that boundary span in an emergency management setting or ascertain if the stakeholders engage in overlapping boundary spanning activities and if this hinders or facilitates their task. Instead, the aim of the research was to explore the perceived activities of the boundary spanner from those personnel fulfilling this requirement. Subsequently, this qualitative research sought to allow themes to emerge from the participants and thus situate them at the core of the study (Gergen & Thatchenkery, 1996).

The implications for public administrators operating in the field of emergency management are evident. Public administrators are essential in the majority of emergency management events necessitating multi-agency coordination. These personnel are therefore instrumental in mitigating the risks of the disaster to the community. There is an obligation that these stakeholders adopt unique boundary spanning activities that may not be required in routine environments. We recommend that further research is necessary to build upon these findings and investigate if these boundary spanning activities overlap and how this affects the stakeholders work. Additional research is also required to understand the challenges faced by stakeholders undertaking boundary spanning in the complex and dynamic environment of emergency management. The boundary spanner in emergency management is pivotal to multi-agency coordination and is only going

to become more instrumental with the increased frequency of disasters demanding the formation of temporary supra-organizations.

ACKNOWLEDGMENTS

This project was supported with funding from the Australian Bushfire Cooperative Research Centre. The views presented in this paper are those of the authors and should not be taken to represent the position or policy of the funding body. We would like to thank all the emergency management liaison officers who have taken part in this research.

REFERENCES

Aldrich, H., & Herker, D. (1977). Boundary Spanning Roles Organization. *The Academy of Management Review*, *2*(2), 217–230.

Ancona, D. G., & Caldwell, D. F. (1988). Beyond Task and Maintenance Defining External Functions In Groups. *Group & Organization Studies*, *13*(4), 468–494.

Ancona, D. G., & Caldwell, D. F. (1992). Bridging the Boundary : External Activity and Performance in Teams Organizational. *Administrative Science Quarterly*, *37*(4), 634–665.

Baker, T. (1994). *Doing Social Research* (2nd ed.). New York: McGraw-Hill Inc.

Bharosa, N., Janssen, M., & Tan, Y. H. (2011). A research agenda for information quality assurance in public safety networks: information orchestration as the middle ground between hierarchical and netcentric approaches. *Cognition, Technology & Work*, *13*(3), 203–216.

Bharosa, N., Lee, J., & Janssen, M. (2010). Challenges and obstacles in sharing and coordinating information during multi-agency disaster response: Propositions from field exercises. *Information Systems Frontiers*, *12*(1), 49–65.

Bluhm, D., Harman, W., Lee, T., & Mitchell, T. (2011). Qualitative research in management: A decade of progress. *Journal of Management Studies*, *48*(8), 1866–1891.

Chen, R., Sharman, R., Rao, H. R., & Upadhyaya, S. J. (2008). An Exploration of Coordination in Emergency Response Management. *Communications of the ACM*, *51*(5), 66–73.

Comfort, L. (2007). Crisis Management in Hindsight: Cognition, Communication, Coordination, and Control. *Public Administration Review*, *67 (Supplement)*, 189–197.

Comfort, L., Dunn, M., Skertich, R., & Zagorecki, A. (2004). Coordination in complex systems: increasing efficiency in disaster mitigation and response. *International Journal of Emergency Management*, *2*(1-2), 62–80.

Creswell, J. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage.

Denzin, D. L., & Lincoln, Y. S. (2005). The discipline and practice of qualitative research. In D. L. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 1–32). Thousand Oaks, CA: SAGE Publications.

Drach-Zahavy, A. (2011). Interorganizational teams as boundary spanners : The role of team diversity , boundedness , and extrateam links. *European Journal of Work and Organizational Psychology*, *20*(1), 89–118.

Eisenhardt, K. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, *14*(4), 532–550.

Faraj, S., & Xiao, Y. (2006). Coordination in Fast-Response Organizations. *Management Science*, *52*(8), 1155–1169.

Farazmand, A. (2001). *Handbook of Crisis and Emergency Management.* (A. Farazmand, Ed.). New York, NY: Marcel Deker, Inc.

Farazmand, A. (2007). Learning from the Katrina crisis: A global and international perspective with implications for future crisis management. *Public Administration Review*, *67*(Supplement s1), 149–159.

Fleiss, J., Levin, B., & Paik, M. (2003). *Statistical methods for rates and proportions* (Third Edit.). Hoboken, NJ, USA: John Wiley & Sons.

Fontana, A., & Frey, J. H. (2005). The interview: From neutral stance to political involvement. In D. L. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 695–729). Thousand Oaks, CA: SAGE Publications.

Gergen, K., & Thatchenkery, T. (1996). Organization science as social construction: Postmodern potentials. *The Journal of Applied Behavioral Science*, *32*(4), 356–377.

Gryszkiewicz, A., & Chen, F. (2012). Temporal aspects in crisis management and its implications on interface design for situation awareness. *Cognition, Technology & Work*, *14*(2), 169–182.

Harrald, J. R. (2006). Agility and Discipline: Critical Success Factors for Disaster Response. *The ANNALS of the American Academy of Political and Social Science*, *604*(1), 256–272.

Hoover, R., & Koerber, A. (2011). Using NVivo to Answer the Challenges of Qualitative Research in Professional Communication: Benefits and Best

Practices Tutorial. In *Professional Communication, IEEE Transactions on 54.1* (pp. 68–82).

Hutchison, A. J., Johnston, L. H., & Breckon, J. D. (2010). Using QSR-NVivo to facilitate the development of a grounded theory project: an account of a worked example. *International Journal of Social Research Methodology*, *13*(4), 283–302.

Ipe, M., Raghu, T. S., & Vinze, A. (2009). Information intermediaries for emergency preparedness and response: A case study from public health. *Information Systems Frontiers*, *12*(1), 67–79.

Janssen, M., Lee, J., Bharosa, N., & Cresswell, A. (2010). Advances in multi-agency disaster management: Key elements in disaster research. *Information Systems Frontiers*, *12*(1), 1–7.

Jemison, D. B. (1984). The Importance of Boundary Spanning Roles in Strategic Decision-Making. *Journal of Management Studies*, *21*(2), 131–152.

Johnson, K., & Duxbury, L. (2010). The view from the field: A case study of the expatriate boundary-spanning role. *Journal of World Business*, *45*(1), 29–40.

Kapucu, N. (2006). Interagency Communication Networks During Emergencies: Boundary Spanners in Multiagency Coordination. *The American Review of Public Administration*, *36*(2), 207–225.

Kapucu, N. (2006b). The Evolving Role of the Public Sector in Managing Catastrophic Disasters: Lessons Learned. *Administration & Society*, *38*(3), 279–308.

Kapucu, N. (2011). Collaborative governance in international disasters: Nargis cyclone in Myanmar and Sichuan earthquake in China cases. *International Journal of Emergency Management*, *8*(1), 1–25.

Kapucu, N., Arslan, T., & Demiroz, F. (2010). Collaborative emergency management and national emergency management network. *Disaster Prevention and Management*, *19*(4), 452–468.

Katz, D., & Khan, R. (1966). *The social psychology of organizations*. New York: Wiley.

Khan, R. L., Wolfe, D. M., Quinn, R. P., & Snoek, J. D. (1964). *Organizational Stress: Studies in Role Conflict and Ambiguity*. New York: Wiley & Sons, Inc.

Klemola, U. M., & Norros, L. (1997). Analysis of the clinical behaviour of anaesthetists: recognition of uncertainty as a basis for practice. *Medical Education*, *31*(6), 449–56.

Landis, J., & Koch, G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174.

Lee, T., Mitchell, T. R., & Sablynski, C. J. (1999). Qualitative Research in Organizational and Vocational Psychology, 1979–1999. *Journal of Vocational Behavior*, *55*(2), 161–187.

Ley, B., Pipek, V., Reuter, C., & Wiedenhoefer, T. (2012). Supporting improvisation work in inter-organizational crisis management. In *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12* (pp. 1529–1538). New York, New York, USA: ACM Press.

Lindgren, R., Andersson, M., & Henfridsson, O. (2008). Multi-contextuality in boundary-spanning practices. *Information Systems Journal*, *18*(6), 641–661.

McEntire, D. A. (2002). Coordinating multi-organisational responses to disaster : Lessons from the March 28 , 2000 , Fort Worth Tornado. *Disaster Prevention and Management*, *11*(5), 369–379.

McEntire, D. A. (2004). The Status of Emergency Management Theory: Issues, Barriers, and Recommendations for Improved Scholarship. In *FEMA Higher Education Conference* (pp. 1–25). Emmitsburg, MD.

McGuire, M., & Silvia, C. (2010). The Effect of Problem Severity, Managerial and Organizational Capacity, and Agency Structure on Intergovernmental Collaboration: Evidence from Local Emergency Management. *Public Administration Review*, *March/Apri*, 279–288.

Miles, M. B., & Huberman, A. M. (1984). Drawing valid meaning from qualitative data: Toward a shared craft. *Educational Researcher*, *13*(5), 20–30.

Miles, R. (1976). Role requirements as sources of organizational stress. *Journal of Applied Psychology*, *61*(2), 172–179.

Militello, L., Patterson, E. S., Bowman, L., & Wears, R. L. (2007). Information flow during crisis management: challenges to coordination in the emergency operations center. *Cognition, Technology & Work*, *9*(1), 25–31.

Mishra, J. L., Allen, D. K., & Pearman, A. D. (2011). Information sharing during multi-agency major incidents. *Proceedings of the American Society for Information Science and Technology*, *48*(1), 1–10.

Morse, J. (1994). Designing funded qualitative research. In D. L. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 220–235). Thousand Oaks, CA: Sage Publications Ltd.

Morse, J., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, *1*(2), 13–22.

Norros, L. (2004). *Acting under uncertainty. The core-task analysis in ecological study of work*. VTT Publications, Espoo.

Nuutinen, M., & Norros, L. (2007). Core task analysis in accident investigation: analysis of maritime

accidents in piloting situations. *Cognition, Technology & Work*, *11*(2), 129–150.

Pilbeam, C., & Jamieson, I. (2010). Beyond Leadership and Management: The Boundary-spanning Role of the Pro-Vice Chancellor. *Educational Management Administration & Leadership*, *38*(6), 758–776.

Salmon, P., Stanton, N., Jenkins, D., & Walker, G. (2011). Coordination during multi-agency emergency response: issues and solutions. *Disaster Prevention and Management*, *20*(2), 140–158.

Schraagen, J. M., Huis, M., & Koning, L. De. (2010). Information Sharing During Crisis Management in Hierarchical vs . Network Teams. *Journal of Contingencies and Crisis Management*, *18*(2), 117–127.

Schraagen, J. M., & Van de Ven, J. (2008). Improving Decision Making in Crisis Response Through Critical Thinking Support. *Human Factors*, *2*(4), 311–327.

Schraagen, J. M., & Van de Ven, J. (2011). Human factors aspects of ICT for crisis management. *Cognition, Technology & Work*, *13*(3), 175–187.

Smith, W., & Dowell, J. (2000). A case study of co-ordinative decision-making in disaster management. *Ergonomics*, *43*(8), 1153–66.

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research*. Thousand Oaks, CA: Sage Publications Ltd.

Sturdy, A., & Wright, C. (2011). The active client: The boundary-spanning roles of internal consultants as gatekeepers, brokers and partners of their external counterparts. *Management Learning*, *42*(5), 485–503.

Teddlie, C., & Yu, F. (2007). Mixed Methods Sampling: A Typology With Examples. *Journal of Mixed Methods Research*, *1*(1), 77–100.

Thompson, J. D. (1967). *Organizations in action*. New York, McGraw-Hill book company.

Tushman, M. (1977). Special boundary roles in the innovation process. *Administrative Science Quarterly*, *22*(4), 587–605.

Van de Walle, B., & Turoff, M. (2008). Decision support for emergency situations. *Information Systems and E-Business Management*, *6*(3), 295–316.

Van Scotter, J., Pawlowski, S., & Cu, T. (2012). An examination of interdependencies among major barriers to coordination in disaster response. *International Journal of Emergency Management*, *8*(4), 281–307.

Veelen, B. Van, Storms, P., & Aart, C. van. (2006). Effective and efficient coordination strategies for agile crisis response organizations. *Proceedings of the 6th International ISCRAM Conference*, (May), 202–213.

Vogt, M., Hertweck, D., & Hales, K. (2011). Optimizing ICT Portfolios in Emergency Management : A Modular Alignment Approach. In *Proceedings of the 8th International ISCRAM Conference* (pp. 1–11).

Waugh, W. L. J., & Streib, G. (2006). Collaboration and leadership for effective emergency management. *Public Administration Review*, *66*(s1), 131–140.

Weerts, D. J., & Sandmann, L. R. (2010). Universities Community Engagement and Boundary- Spanning Roles at Research Universities. *The Journal of Higher Education*, *81*(6), 702–727.

Weick, K. (2001). *Making Sense of the Organization*. Maiden, MA: Blackwell Publishers.

Weick, K., & Sutcliffe, K. (2007). *Managing the Unexpected: Resilient Performance in an Age of Uncertainty*. San Francisco, CA: Jossey-Bass.

Weick, K., Sutcliffe, K., & Obstfeld, D. (1999). Organizing for high reliability: Processes of collective mindfulness. In R. Sutton & B. Staw (Eds.), *Research in Organizational Behavior* (pp. 81–123). Stanford, CT: JAI Press.

Wettenhall, R. (2009). Crises and Natural Disasters: a Review of Two Schools of Study Drawing on Australian Wildfire Experience. *Public Organization Review*, *9*(3), 247–261.

Williams, P. (2002). The Competent Boundary Spanner. *Public Administration*, *80*(1), 103–124.

Williams, P. (2011). The life and times of the boundary spanner. *Journal of Integrated Care*, *19*(3), 26–33.

Williams, P. (2012). *Collaboration In Public Policy And Practice: Perspectives On Boundary Spanners*. Bristol, UK: The Policy Press.

Appendix B: Paper II

ORIGINAL ARTICLE

Managing the constraints of boundary spanning in emergency management

Steven Curnin · Christine Owen · Cain Trist

Received: 29 August 2013 / Accepted: 18 June 2014

Abstract Stakeholders tasked with boundary spanning in emergency management are fundamental in facilitating multi-agency coordination. However, there is a scarcity of research investigating the characteristics of emergency management boundary spanners and how they achieve this function in the complex environment of emergency operation centres. An exploratory case study approach was adopted and applied in a strategic-level emergency operations centre. The study used three very different but interrelated qualitative research techniques based upon the Core-Task Analysis framework to categorize the work of stakeholders fulfilling a boundary spanning role in this setting. The data identified that stakeholders performing boundary spanning activities in a strategic-level emergency operations centre face a number of constraints. These can include unfamiliarity with the work domain, its personnel, and structure which can lead to temporal, cultural and information challenges. In order to manage these constraints, boundary spanners working in a strategic-level emergency operations centre need to adopt certain characteristics in order to accomplish their activities. A significant outcome from the data was the necessity to engage in these important undertakings in the pre-response phase in an effort to facilitate successful multi-agency coordination in an actual emergency event.

Keywords Boundary spanning · Emergency operations centre · Multi-agency coordination · Liaison officer · Emergency management · Disaster management

S. Curnin · C. Owen
Faculty of Education, Bushfire Cooperative Research Centre, University of Tasmania, Private Bag 66, Hobart, TAS 7001, Australia
e-mail: Steven.Curnin@utas.edu.au
C. Owen
e-mail: Christine.Owen@utas.edu.au
C. Trist
Fire Services Commissioner Victoria, Level 4, 8 Nicholson Street, Melbourne, VIC 3002, Australia
e-mail: Cain.Trist@firecommissioner.vic.gov.au

1 Introduction

Agencies involved in emergency management are faced with many challenges as society becomes increasingly vulnerable to disasters. Modern day disasters are characterized by complexity that frequently requires the coordination of multiple agencies (Schraagen and Van de Ven 2008; Van Scotter et al. 2012). Coordination in emergency management is the way in which different agencies or parts of the same organization work or act together in order to achieve a common objective (International Organization for Standardization 2011). This coordination necessitates the synchronized efforts of a diverse collection of public and private agencies (Van Scotter et al. 2012) to achieve a shared goal tailored to mitigate the consequences of risk to the community (Van Veelen et al. 2006). However, coordination in this environment is complex because of communication challenges (McEntire 2002; Comfort and Kapucu 2006; Manoj and Baker 2007; Aedo et al. 2010), temporal constraints (Janssen et al. 2010; Mishra et al. 2011), information system incompatibility (Baber et al. 2007; Ley et al. 2012), differing agency information

requirements (Van de Walle and Turoff 2008) and organizational linkages between multiple agencies that can be dysfunctional (Janssen et al. 2010; Salmon et al. 2011; Harrald 2006). These complexities require stakeholders involved in emergency management multi-agency coordination arrangements to overcome these constraints. In the Australian context, stakeholders tasked with fostering linkages between agencies can be called emergency management liaison officers. It is important to understand how emergency management liaison officers perform this role and how we can assist them to improve their capacity to undertake this function within emergency management multi-agency coordination arrangements.

One notion that is evident in the literature which may assist in understanding the work of the emergency management liaison officer is the concept of boundary spanning. Boundary spanning can be described as an individual from one agency who is located in an external organization and is tasked with bridging the boundaries between these agencies to facilitate a collective objective. However, the problem is that the concept of boundary spanning is not comprehensively articulated in the emergency management literature. To understand this concept in the context of the emergency management liaison officer was the requirement for a suitable theoretical framework to investigate the constraints they may encounter. Emergency management multi-agency coordination requires the temporary formation of multiple agencies into a supra-organization. Multiagency coordination within these supra-organizations is often multifaceted, unpredictable and often has temporal constraints. Core-Task Analysis identifies the core-task of a specific working practice. In particular, this concept identifies three interrelated dimensions that the workers must consider in order to achieve their activities in the work domain (Norros 2004). These dimensions are described as dynamism, complexity and uncertainty. These dimensions are evident in emergency management, and the concept has been applied in other complex working environments. However, there is limited research available describing the application of Core-Task Analysis in an emergency management setting. Core-Task Analysis would therefore appear an appropriate framework for this research. An interesting facet of this research was exploring how the analysis of the emergency management liaison officer's work is viewed through the concept of boundary spanning using the Core-Task Analysis framework.

Emergency management multi-agency coordination can occur at various levels. In the Australian context, states and territories are responsible for emergency management arrangements occurring within that jurisdiction. Within a state or territory, there can be three levels of multi-agency coordination at the local level (termed operational level), regional level (termed tactical level) and the state level (termed strategic level). This multi-agency coordination can take place informally in temporary locations at the incident site or in a structured environment such as an established emergency operations centre. The focus of this study is on the emergency management liaison officers tasked with performing a boundary spanning role in the complex environment of a state-level emergency operations centre.

1.1 Overview

This article is structured as follows: Sect. 2 provides the context of the study and a synopsis of the boundary spanning literature. Section 3 describes the aims of the study and introduces the research questions guiding the study. Section 4 presents the methodology and theoretical framework applied in the research. Section 5 offers the main results, and Sect. 6 provides some answers to the research questions guiding the article. Finally, Sect. 7 concludes with recommendations for future research.

2 Background

This study is part of the Australian Bushfire Cooperative Research Centre project Organizing for Effective Incident Management which is seeking to better understand how emergency management multi-agency coordination at a state level can be improved in order to reduce the consequences to communities of the emergency event. An important aspect of this project is how multiple agencies coordinate their activities during an emergency event. This is of importance because of the complexities involved with multi-agency coordination working together within a temporary supra-organization. A central feature of this is the various agency emergency management liaison officers who span organizational boundaries facilitating the linkages between agencies. These emergency management liaison officers performing boundary spanning activities at a state level in an emergency operation centre perform a complex role in a challenging environment. Despite the importance of this role, there is only a limited amount of research

concerning boundary spanning in emergency management.

To understand the concept of boundary spanning, we must draw on literature from the 1960s and its origins in open systems theory. Early accounts deemed a boundary spanner as a person from an individual organization who is located in a different external organizational system providing linkages between the organizations (Khan et al. 1964; Katz and Khan 1966; Thompson 1967). This initial view of boundary spanning from the open systems theory perspective led the way in the 1970s for empirical research in formal organizations and the research and design industry (Keller and Holland 1975; Miles 1976; Aldrich and Herker 1977; Tushman 1977). In the 1980s, research continued and investigated the importance of boundary spanning roles in the strategic decision-making process in fifteen organizations representing three industries, food industry, health industry and financial institutions (Jemison 1984). Further research was conducted in high-technology companies describing and classifying a set of fifteen attributes that link a group to its external environment (Ancona and Caldwell 1988). These fifteen activities included modelling, gathering information and resources, scanning, feedback seeking, opening up communication channels, information, coordinating, negotiating, moulding, allowing entry, translating, filtering, classifying, delivering and protecting (Ancona and Caldwell 1988). However, it is not until research is carried out in the 1990s that the individual role as opposed to the concept of team boundary spanning is theorized (Ancona and Caldwell 1992). This research produced a typology of four boundary spanning activities: ambassador, task coordinator, scout and guard. These four activities continue to influence current boundary spanning typologies in the literature two decades on. The synthesis of the typology of boundary spanning activities defined by Ancona and Caldwell (1992) is evident in contemporary empirical research that explores the boundary spanning roles in a multitude of disciplines (see for examples Drach- Zahavy 2011; Johnson and Duxbury 2010; Pilbeam and Jamieson 2010; Weerts and Sandmann 2010; Williams 2012). However, the majority of this research is confined to routine environments, and therefore, the findings may not be applicable to the complex and dynamic environment of emergency management.

The literature does make several references to the concept of boundary spanning in the context of emergency management. This is often in reference to the sharing and exchange of information between agencies, particularly with the notion of multi-agency coordination. However, the volume of literature investigating this in an emergency management context is limited. Kreps and Bosworth (1993) identify three dimensions of role enactment. These were status-role nexus, role links and role performance. These three dimensions were developed from archival materials from the Disaster Research Center featuring 257 participants in 196 organized responses during the emergency period of disasters. In particular, within the dimension of role links, the research makes reference to boundary spanning and individuals forming links with external agency representatives during an organized response (Kreps and Bosworth 1993). However, the article aims to describe role enactment in an emergency management context and does not go beyond this basic description of boundary spanning and the general association with providing links to other agencies in disasters. This research will further explore how emergency management liaison officers facilitate these linkages and constraints they face in fulfilling this role.

Chen et al. (2008) proposed a framework to analyse coordination patterns in the emergency response arena. This was based primarily on thirty-two interviews with emergency response personnel. One aspect of the framework explains that during emergency coordination the responder may fulfil a boundary spanning capability to fulfil coordination mechanism requirements (Chen et al. 2008). However, this is the only direct reference to boundary spanning in the entire article. Similarly, in his review of inter-organizational and cooperation that may be required during an emergency event, Granot (1997) makes a single reference to boundary spanning. In this research, he defines boundary spanning in the context of emergency management and how it may be useful for exchanging ideas and information among stakeholders with similar interests (Granot 1997). Contemporary research conducted by McGuire and Silva (2010) explored intergovernmental collaboration in emergency events. Using a data set of more than 400 county-level emergency management agencies in the USA, they investigate how public managers are required to work across organizational boundaries in collaborative networks during emergency events (McGuire and Silva 2010). The article only makes scant reference to the concept of boundary spanning but recognizes the importance of spanning organizational boundaries in an emergency management scenario.

It is perhaps Kapucu (2006, 2011) and Kapucu and Van Wart (2006) who makes most reference to the concept of emergency management boundary spanning in the literature. Kapucu (2006) firstly identifies the boundary spanner as someone who is associated with communication and information technologies among organizations in an effort to achieve effective decision-making in emergency events. Additionally, using empirical data from Hurricane Charley in 2004 and the world trade centre terrorist attacks in 2011, Kapucu and Van Wart (2006) analyse the role of the public sector in dealing with catastrophic disasters. In the article, the effectiveness of boundary spanning agencies was one of four areas identified as critical for high performance in emergency events (Kapucu and Van Wart 2006). However, this description of boundary spanning was in the context of team boundary spanning and not that of individual boundary spanning. Finally, following a comprehensive literature review, Kapucu (2011) analyses the current structure of international disaster relief organizations and identifies the main actors in the system. Exploring the work of the actors in this environment, he associates the concept of boundary spanning with developing relationships with other institutional members via networks (Kapucu 2011). However, it would appear that it was not the intention of these articles to comprehensively explore boundary spanning in emergency management. Despite making numerous references to boundary spanning in the context of interagency or collaborative networks, this research does not provide any comprehensive description on the roles of the boundary spanner in emergency management. It is perhaps Bharosa et al. (2011) who provide further explanation of the concept of boundary spanning in emergency management.

Based upon observations from field studies, Bharosa et al. (2011) identified the role of someone they termed an information orchestrator. An information orchestrator is someone who interacts with multiple agencies taking care of the information requirements that are beyond the boundary of a single agency (Bharosa et al. 2011). In this research, an information orchestrator requires ten necessary capabilities to assure information quality in public safety networks. These ten capabilities include: quality auditing; boundary spanning; information libraries; web-service composition; enrichment; anticipation; information categorization; expertise gathering and consultation; reach back; and information quality feedback (Bharosa et al. 2011). Despite the relevance of this article to boundary spanning in emergency management, it needs to be acknowledged that this research only investigates the concept of boundary spanning in the context of assuring information quality. Consequently, there is clearly a void in the literature that comprehensively investigates the multitude of boundary spanning roles in emergency management. Finally and in reference to the need for further research on this topic, Janssen et al. (2010), in an introduction to a special issue on advances in multi-agency disaster management, designate the importance of boundary spanning in emergency management. ‘‘In spite of their crucial role, little is known about how boundary spanners influence cross-agency coordination and their effectiveness for disaster management success’’ (Janssen et al. 2010, p. 4).

3 Study aims and research questions

A lack of empirical research on boundary spanning warrants further investigation of this topic. Therefore, this empirical research had to adopt an exploratory approach. The main aim of this study was to examine and illustrate the work of stakeholders fulfilling a boundary spanning role in emergency management. In emergency management operation centres in Australia, these stakeholders can be termed emergency management liaison officers. To study this topic empirically, we specifically focused upon state-level multi-agency coordination arrangements undertaken in an emergency operations centre. To accomplish this objective, we formulated the following three research questions:

1. What is the emergency management liaison officer’s role when working at a state-level emergency operations centre?
2. What are the challenges encountered by the emergency management liaison officers working in this domain?
3. How do emergency management liaison officers enact when faced with these demanding conditions?

4 Methods

An exploratory case study was undertaken to examine and report the content of the emergency management liaison officer’s work in a state-level emergency operations centre. This research is the culmination of over 12-months of work conducted in the study setting. This section will describe how this exploratory case study was conducted and how it is structured. Firstly, the methodological framework chosen for this study

Table 1 Participant demographics

Qualitative technique	Emergency services	Critical Infrastructure	Other agencies
Individual interviews (31 pax)	Police - 1 Fire - 6 SES - 4 Ambulance - 1	Water – 2 Energy – 2 Transport – 4 Communications – 2 Health – 1	Land management – 5 Military – 1 Non-Government Organization – 2
Observational studies (12 pax)	Police - 2 Fire - 1 Ambulance – 1	Water – 1 Energy – 2 Transport – 1 Communications – 2 Health – 1	Federal agency – 1
Focus group interviews (15 pax)	Police - 1 Fire - 2 SES - 2 Ambulance - 1	Water – 1 Energy – 1 Transport – 3 Communications – 1 Health – 1	Land management – 2

will be outlined. Secondly, an overview of the study setting will be presented. Next, the details of the three different but interrelated qualitative techniques used for the study will be discussed. Finally, the data analysis phase will be explained.

4.1 Core-Task Analysis

The approach of this exploratory case study was based upon the Core-Task Analysis (Norros 2004) framework. The aim of Core-Task Analysis is to identify the core-task of a specific working practice. The concept of the core-task indicates the objectives and the outcome of work that should be accounted for by the workers in everyday task performance. Core-Task Analysis adopts a systemic notion of human activity where the situated actions are conceived from an ecological, human–environment interaction perspective (Norros 2004). Core-Task Analysis was developed in studies conducted in several complex and dynamic working environments. These include nuclear power plant operations, anaesthesia and the navigation of large ships (Norros 2004). The methodology has continued to be applied in complex working environments involving automated train systems (Karvonen et al. 2011) and communication network operations (Norros et al. 2013).

Core-Task Analysis takes into account three interrelated dimensions that the workers must take into account to achieve their activities in the work domain, dynamism, complexity and uncertainty. In order to manage these dimensions, workers need *collaboration*, *skill* and *knowledge* (Norros 2004). When each of the dimensions is examined through these means the core-task demands of the work become apparent. The red dots with accompanying explanations in Fig. 2 represent the six generic core-task demands. In addition, Norros (2014) has recently further elaborated on the Core-Task Analysis framework so that the connections between the environmental constraints and the human resources are now explicitly addressed (Norros 2014). This research utilizes the framework described in Norros (2004) which hypothesizes that *collaboration* contributes to reducing the complexity in dynamic situations in an effort to enable proper functioning of a system. It also theorizes that *skill* is a process for coping with uncertainty in a situation that requires action to respond to the problem. Finally, Core-Task Analysis hypothesizes that *knowledge* and its processes facilitate coping in a complex environment and enable reflection on the inherent uncertainties in the environment (Norros 2004). Based on the applicability of these dimensions to emergency management, it would appear that this was an appropriate framework to apply in an emergency operations centre because of the multifaceted, unpredictable and often temporal challenges that are encountered in these temporary supra-organizations. Furthermore, investigating the boundary spanning working practices of the emergency management liaison officer in this environment draws upon various characteristics. Applying the dimensions of *collaboration, skill* and *knowledge* may also assist in exploring the mechanisms adopted by these stakeholders in overcoming the constraints they face in facilitating emergency management multiagency coordination.

4.2 Study setting

The study setting used for this research was the Victorian State Control Centre in Australia. This state-level emergency operations centre is the hub of eight regional and more than forty local incident control centres across the state that supports emergency services during major emergencies. The emergency operations centre has a multi-agency and multi-hazard approach to emergency events in the state. Upon the highest levels of activation, the emergency operations centre will routinely operate 24 h a day with up to ninety personnel at any one time representing more than twenty agencies. The emergency management liaison officers are co-located in the emergency operations centre. However, due to space limitations in the main operations room and the subsequent requirement for flexible seating arrangements, some emergency management liaison officers may be located in an adjacent room. This adaptability of seating arrangements ensures that emergency management liaison officers that are essential at that particular moment of the incident are located in the main room versus those that are located in the adjacent room that may not be as critical at that particular time. This adaptability of seating arrangements is dependent on the particular emergency event. The emergency management liaison officers working at the emergency operations centre represent, but are not limited to the following three groups of agencies. The emergency services such as fire agencies, police and ambulance. Critical infrastructure agencies such as water services, telecommunication and energy agencies. Finally, emergency management liaison officers may represent a multitude of other agencies such as non-for profit organizations, the military and land management agencies (Table 1).

4.3 Qualitative techniques

To triangulate the findings from the data, three qualitative techniques were adopted. These were individual interviews, observational studies and focus group interviews. In addition to these techniques, the study involved visiting the emergency operations centre in the planning stages. This preparatory phase allowed the researchers to familiarize and acquaint themselves with the work domain that the emergency management liaison officers would be expected to work. This aspect of the preparatory phase allowed for the immersion in the work domain and also enabled the research team to learn about information systems and specific terminology that would be used in the emergency operations centre.

4.3.1 Individual interviews

The first qualitative study involved thirty-one semi-structured interviews with emergency management liaison officers who undertake this role within a multi-agency approach at the emergency operations centre (see Table 1). As described previously, the emergency operations centre can accommodate more than ninety personnel at any one time representing more than twenty agencies. The purposive sampling of participants was deemed most appropriate as the interviews sought to generate a sample that would address the research questions (Teddlie and Yu 2007). The questions were first piloted to determine the suitability (Baker 1994). All the interviews were scheduled at times and places convenient to the participants. Twenty-six interviews were conducted face-to-face, and the remaining five were conducted by telephone. The names of the participants were de-identified to protect the confidentiality and maintain anonymity. However, the participant's agency remained visible and was grouped into one of three following categories: emergency services; critical infrastructure; and other agencies. This allowed the different services to be identified. The interviews were audio recorded and transcribed verbatim by a professional transcriber for data analysis. The interviews lasted between 24 and 61 min generating transcripts of between 3,600 and 11,200 words. This resulted in a total of 66 h and 31 min of individual interviews generating a total data set of 181,993 words. The interview transcripts were returned to the participants for checking and to ensure accuracy (Morse et al. 2002). Any alterations made by the participants were changed in the transcript prior to data analysis.

4.3.2 Observational studies

The second phase of the qualitative study was the observational component conducted under two different conditions in the study setting. The first was conducted over the course of a day during a state-level multi-agency coordination exercise where the in-depth observation of two emergency management liaison officers was carried out. This culminated in a total of 8 h of observations with the two participants. The second observational study was conducted during activation of the emergency operations centre during an actual

Fig. 1 Main operations room in the Victorian State Control Centre in Australia

large-scale emergency event. The latter observations were conducted over 2 days, and a total of ten emergency management liaison officers were observed. This second stage of the observational study concluded in a total of 16 h of real-time observations witnessing the emergency management liaison officers performing their role in a live incident. The observational study allowed for the observation of the emergency management liaison officers undertaking their normal work during operations requiring a multi-agency coordination approach. Due to privacy and security barriers, no video or audio recordings were conducted during the observational studies. However, comprehensive field notes together with a series of questions regarding the emergency management liaison officers work were posed to all the participants at scheduled times throughout the observational period. In conjunction with these data collection methods, opportunistic conversations with the participants were also completed and documented (Fig. 1).

4.3.3 Focus group interviews

The final qualitative technique used in this research was a series of focus group interviews. The rationale for conducting focus groups was twofold. Firstly, they were used to collect qualitative data from a small group of participants by informal group discussion that focused on a particular topic (Onwuegbuzie et al. 2009). Secondly, it was used as an opportunity to further explore the emergency management liaison officer's work in multi-agency coordination and elaborate on any associated constraints identified in the individual interviews and observational studies. Two focus groups were conducted with a total of fifteen participants. The focus group interviews were conducted at the study setting location. A member of the emergency operations centre's management team facilitated each focus group interview with one of the research team present to introduce the topic for discussion. The sample for the focus groups was drawn from previous participants in the study. Due to unforeseen circumstances, two participants had to withdraw but were replaced by a colleague who would also be expected to fulfil the emergency management liaison officer role. Both focus group interviews were audio recorded, and each participant was identified by a pseudonym. This maintained anonymity and confidentiality of the participants. The audio recordings were transcribed verbatim by a professional transcriber. The focus group interviews lasted 90 and 105 min, respectively, generating transcripts of 12,200 and 15,000 words.

4.4 Data analysis

The analytical technique used in this research was based upon the Core-Task Analysis framework (Norros 2004). The data were analysed using the data analysis software QSR-NVivo 10 that can facilitate the analysis of data and theoretical development (Hutchison et al. 2010; Hoover and Koerber 2011). The research was exploratory in nature, and the study design was derived from a pre-existing framework that guided the study (Bluhm et al. 2011). Using this grounded theory approach allowed for the interchange of inductive and deductive methods of analysis (Eisenhardt 1989).

The individual interviews asked the participants to identify the challenges they faced in their role and what they recognized as important tasks for the emergency management liaison officer working in a state-level emergency operations centre. The analysis of the individual interviews used the three dimensions workers have to consider when operating in the work domain as defined in the Core-Task Analysis theoretical framework. These were collaboration, skill and knowledge and were used when classifying the emergency management liaison officer's task in the work domain. Similarly, the dimensions defined as dynamism, complexity and uncertainty that the participants must take into account to achieve their activities in the work domain were used as a guide when identifying the constraints of operating in the emergency operations centre. The structure of Core-Task Analysis can lead to identification of the tasks and constraints encountered by emergency management liaison officers. This phase of data analysis therefore examined the tasks and constraints of the

participants and focused upon defining appropriate categories. Firstly, the individual interview data were examined and first-order descriptions of boundary spanning tasks and the constraints faced in the work domain was categorized in the language used by the participants. Collectively, these two themes identifying the tasks and constraints faced by the emergency management liaison officer initially yielded a total of thirty-five categories, eighteen pertaining to the tasks and seventeen concerning the constraints. The next stage involved systematically grouping similar data (Strauss and Corbin 1998) which reduced the tasks to nine categories and the constraints to seven categories. In conjunction with this stage, the data were examined in the light of the Core-Task Analysis framework. Data analysis was ceased when saturation was reached, and it became apparent that all the data had been assigned to one of the categories and no new categories emerged. To ensure validity and reliability a predefined coding framework was developed by the initial researcher. One of the other two authors reapplied the coding framework to the data and using Cohen's kappa coefficient statistical measurement achieved an inter-rater reliability of 87.5 % indicating a substantial level of agreement (Landis and Koch 1977; Fleiss et al. 2003).

Data yielded from the observational studies were used to consolidate the findings from the individual interviews and focus group interviews. The focus group interviews asked the participants to nominate the constraints encountered when working as an emergency management liaison officer in a state-level emergency operations centre. The data from the two focus group interviews were analysed and grouped into the categories that emerged from the individual interviews. If any data were did not match these categories, a new category was created. When all the data had been assigned to a category and no new categories emerged, then the data analysis was concluded. The data from the focus group interviews consolidated the findings in the individual interviews and presented some new areas of interest that are described in the findings section.

5 Results

The results section consists of three main segments that provide the findings to the research questions. These results are based on a combination of the three qualitative research techniques described earlier. First, the emergency management liaison officer's task in the work domain is presented. Second, an overview is given of the constraints associated with functioning in the work domain. Finally, the techniques used by the participants to address the challenges of operating in the work domain are explored.

5.1 Emergency management liaison officer's tasks

Based on the data collected from the studies, it was identified that the overarching task of the emergency management liaison was providing linkages between often disparate agencies. For the purposes of this paper, this task shall be called boundary spanning. The data indicated that this boundary spanning task encompassed nine different activities. These included representative, communicator, networker, legitimate enabler, information conduit, information analyst, resource coordinator, organizational expert and domain expert. Table 2 provides examples of actual participant's views from the data that were coded into the particular categories of the emergency management liaison officer activities. The table also groups the activities into one of the three dimensions, collaboration, skill and knowledge, as identified in the Core-Task Analysis framework that the participants have to consider when working in the emergency operations centre. In addition, the table indicates the percentage of descriptions that were similar in nature found from the interview data. However, as the data revealed, the boundary spanning task required by emergency management liaison officers in a state-level emergency level emergency operations centre has numerous constraints due to the dynamism, complexity and uncertainty that is associated with this type of work domain.

5.2 Domain constraints

As described previously in the methods section, the Core- Task Analysis framework acknowledges that the work domain is intrinsically characterized by demands related either to *dynamism, complexity* or to *uncertainty*. On the basis of the data, it was possible to identify and group the main categories identified by the participants as constraints into one of these three demands. The demand described as *dynamism* related to the actual emergency event and in particular the temporal challenges that are associated with working in this setting. The second demand of *complexity* highlighted the constraints encountered by emergency management liaison officers when functioning in a temporary supra-organization that comprised of multiple agencies. This included both cultural challenges and the

Table 2 Boundary spanning activities of the emergency management liaison officer

Dimension	Activity	Participants who described the activity (%)	Function	Participant description
Collaboration	Representative	74	Perform an ambassadorial role on behalf of their home organization	So they need to be able to represent our organization in a professional manner and understand what the other agencies are requiring. (Participant from non-government organization)
	Communicator	32	Enabling effective communication across organizational boundaries	…during disasters we have stakeholder bridges and we'll communicate information so we're getting the latest intelligence on a disaster impacted area. (Participant from a communications agency)
	Networker	48	Foster effective relationships with external organizations	…our job is to form relationships with people and other agencies in the emergency management field and maintain those relationships so we're a better able to deal with them…in the event of an incident. (Participant from the military)
	Legitimate Enabler	42	Authority and empowerment to commit to their agency's actions or direct link with a decision-maker	…they may not be the most senior person that can make a decision but they have to be someone that's senior enough to be able to talk to decision makers. (Participant from the state emergency services)
Skill	Information conduit	74	Two-way exchange of information across organizational boundaries	The core would be…ensuring effective information flow that's relevant to your agency and providing information out to the agency you're working with… (Participant from a fire service agency)
	Information analyst	58	Interpret information into meaningful facts for the home organization	Emergency management liaison officers need to make a judgement about what information is essential to their agency that enables good decision-making… (Participant from a land management agency)
	Resource coordinator	42	Coordinate resourcing requests from the supra-organization	The key aspects are probably understanding and communicating the resources at your disposal that may actually assist the control agency. (Participant from a fire service agency)
Knowledge	Organizational expert	65	Able to provide advice on their own organizations activities, capabilities are strategic aims	So you need to be around the organization long enough and understand its structure, its capability, its capacity, especially from a tactical perspective. (Participant from a fire service agency)
	Domain expert	48	Provide expertise to home organization regarding the emergency management framework	…so a knowledge of the organization structure they're using to respond to that particular incident at a State level I think is important. (Participant from a water agency)

participant's unfamiliarity of working in a multi-agency environment. The final demand of *uncertainty* acknowledged the multiple information challenges associated with working in a state-level emergency operations centre. The constraints identified in the individual interviews were corroborated with the findings from the observational studies and focus group interviews.

5.2.1 Dynamism

Findings from the data indicated that due to the *dynamism* associated with emergency management events and subsequent fast-action requirements, these lead to the participants encountering temporal constraints. This was characterized by the expectation from the lead agencies that emergency management liaison officers could provide information promptly and also stipulated the requirement to make a decision quickly. In this dynamic environment, there was an expectation among the participants that if they were asked to make a decision regarding their own agency's intent, then they should be able to access a decision quickly as described by the following participant:

> So if police or the fire agency want some information, we would have someone to say, yes, our agency can do that or no we can't do it now but we'll be able to provide you an update in whatever time frame they stipulate. (Participant from a non-government organization)

The fast-action requirements necessary to work in this environment were compounded by the complexity of working in a multi-agency environment.

5.2.2 Complexity

The creation of multiple agencies into a temporary supraorganizations is complex and consequently presented numerous constraints for emergency management liaison officers operating in this environment. A constraint identified in this study was the cultural challenges of working in the emergency operations centre. Elements of the data revealed that some agencies integrated into the temporary supra-organization with less challenges than other agencies. The social identity of the emergency management liaison officer was designated as a limiting factor by participants fulfilling this role. Rank and file agencies that predominantly wear a uniform often with their rank displayed such as the emergency services are instantly recognizable to anyone working in the environment. This can assist in legitimizing their role and presence in the emergency operations centre. This was explained by the following participant:

> … you turn up with a shirt and tie, people haven't got a clue how long you've been in, what you know or what courses you've done…whereas if you're wearing a uniform, it's already inferred. (Participant from a transport agency)

Emergency services agencies that may have a history of working together in emergency events can also have similar working practices compared to those agencies that may be requested to assist in emergency events less frequently.

The data highlighted the silo mentality of some agencies that do not have an understanding of other agencies functions and requirements. Emergency services are virtually always present in an emergency operations centre during an emergency event, often with a 24-h presence. This is in contrast with some non-emergency agencies that may only be required in the emergency operations centre for a limited duration as requested. The data highlighted that there was an expectation by some emergency services that nonemergency agencies would send a stakeholder when requested. However, this was not always possible in the time frame expected by the emergency services due to the human resourcing challenges faced by non-emergency agencies that often do not have a designated emergency management team. Additionally, the physical location and in particular the seating arrangements within the emergency operations centre could pose some constraints. Participants representing non-emergency services who were occasionally located outside of the main operations room, which historically and culturally was considered the territory of the emergency services, identified not been located in the main room as a potential challenge as described by the following participant.

> …you could be quite resented (when working in an emergency operations centre) and that's why we were not on the main floor…however, the challenge wasn't being in the back room, the challenge was getting them (the emergency services) to understand what we can offer. (Participant from a communications agency)

A lack of physical presence in the main operations room led to some participants feeling

that their presence in the emergency operations centre was undervalued compared to other agencies such as the emergency services. Some of the cultural challenges identified with working in a temporary supra-organization could also be associated with an unfamiliarity with the work domain and subsequent uncertainty of certain operational requirements.

5.2.3 Uncertainty

An unfamiliarity with working in a multi-agency environment and infrequency of some emergency management liaison officers to participate in temporary supra-organizations at a state-level emergency operations centre presented challenges. The most identified constraint associated with unfamiliarity of the operating environment was associated with information uncertainty. Due to the relative infrequency of activation, the presence of emergency management liaison officers required to participate in the multi-agency coordination efforts may be sporadic depending on the type and duration of the emergency event. The emergency services will invariably have more exposure to the emergency operations centre than other non-emergency agencies. However, prolonged events over days and weeks can require the continuous attendance of stakeholders at the emergency operations centre. These emergency management liaison officers may be unaccustomed to this work domain and multi-agency coordination structures, and in particular, the information systems used in the emergency operations centre.

The multiple constraints identified in the data concerning information often led to information *uncertainty* for some emergency management liaison officers. The triangulation of findings from the data identified that a lack of familiarity with information technology systems within the working environment was constraining and led to uncertainty regarding the information requirements of some participants. The emergency operations centre in this case study uses multiple information technology systems to collate and disseminate information. A lack of interoperability of information system among the various agencies resulted in some participants suffering information insufficiency. This was also documented in the observations in the study setting conducted during the real-life emergency event. Various participants in the individual interviews identified a lack of familiarity with information technology, and in particular, a lack of interoperability as a constraining as defined by the following participant:

> Information technology is a challenge because there's no interoperability between the agencies at all really… we don't know how to operate the sites properly so you see a limited amount (of data) but you can't have a finite number of screens operating at the same time. (Participant from the police service)

In contrast to information insufficiency, the data also highlighted the problem of information overload. This could be attributed to a lack of understanding of the various emergency management liaison officers' specific information requirements with some participants describing that much of the information they received was not relevant to their needs. Information available from the emergency operations centre and information disseminated by the emergency management liaison officers' back into their own agency's information systems are crucial. Any information uncertainty can impede the emergency management liaison officer from successfully fulfilling their tasks.

5.3 Mastery

Adopting the expertise necessary to address the Core- Task Analysis features of *dynamism, complexity* and *uncertainty* in the work domain required the stakeholders to incorporate collaboration, skill and knowledge into their working practices (Norros 2004). Stakeholders required a combination of *collaboration* and *skill* to overcome the dynamism associated with working in the emergency operations centre (see Fig. 2). The data identified that the temporal challenges of multi-agency coordination required the partnership of numerous agencies that could make decisions quickly. These fast action requirements often necessitated that the emergency management liaison officer located within the emergency operations centre had the authority and empowerment to access a decision to commit to their agency's actions. Working in a dynamic environment also entailed that the emergency management liaison officers could work under time pressure, a *skill* that is essential when operating in emergency events that are often unpredictable and subject to change without warning.

Emergency management liaison officers required *collaboration* to address the *complexity* that was associated with multi-agency

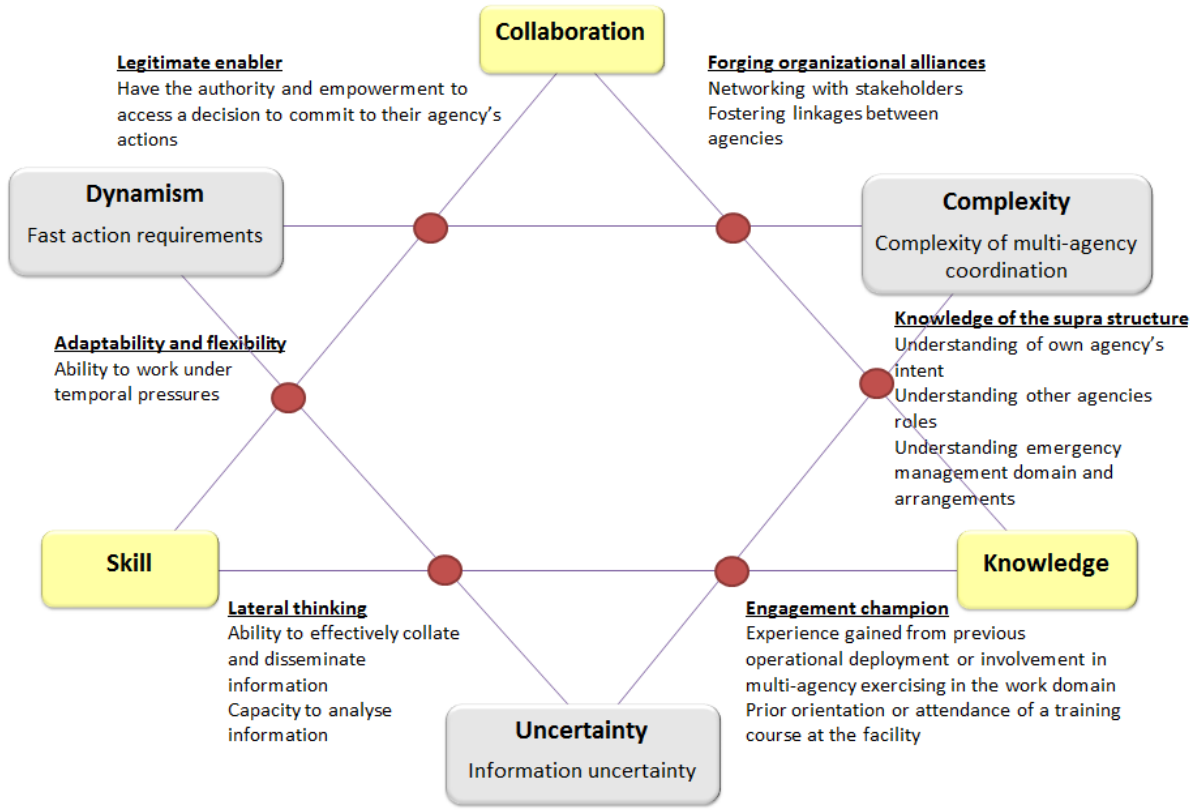


Fig. 2 Managing the core-task demands of an emergency management liaison officer

coordination in the work domain. By networking in the pre-response phase and establishing linkages with the other agencies and particularly other stakeholders involved in the multi-agency coordination efforts, the participants addressed some of the cultural challenges associated with functioning in the work domain. In combination with *collaboration*, emergency management liaison officers required specific *knowledge* in an effort to address the knowledge of other agencies roles that are located in the emergency operations centre, and finally *knowledge* of the emergency management structure and arrangements in the specified emergency operations centre.

Addressing the constraint of information *uncertainty* required the emergency management liaison officers to draw upon certain *knowledge* and *skill*. Having previous exposure to the emergency operations centre reduced some of the information uncertainties. *Knowledge* of information systems gained from prior deployment, involvement in multi-agency exercising, or prior orientation to the emergency operations centre enabled some participants to overcome some of the *uncertainty* related to information challenges due to familiarity with the information systems. Acquiring the *skills* of collating, disseminating and analysing information assisted in addressing the challenges of information overload and consistency of information. The emergency management liaison officer's ability to analyse information allowed them to not only disseminate pertinent information to their own agency but to that of other agencies requiring the information in the emergency operations centre.

6 Discussion

The aim of this research was to investigate the work of emergency management liaison officers fulfilling a boundary spanning role in emergency management. The study explored this from the context of emergency management liaison officers working in a state-level emergency operations centre. The results presented previously provide some explanation to the questions that were proposed in section three of the article.

Emergency management multi-agency coordination necessitates the collaboration of numerous agencies to mitigate the consequences of risk to the community. In a state-level emergency operations centre, numerous emergency management liaison officers from

multiple agencies provide linkages to other agencies. However, performing the task of an emergency management liaison officer in a state-level emergency operations centre is demanding and the role is multifaceted. The concept of boundary spanning in an emergency management context is related to the first research question concerning the emergency management liaison officers work in a state-level emergency operations centre.

In an effort to provide an answer the first research question, the analysis revealed nine activities that are associated with spanning the boundaries of multiple agencies in emergency management. Some of these activities, such as representative, communicator, information conduit, networker, information analyst and resource coordinator activities, have been described in previous boundary spanning research (see for examples Aldrich and Herker 1977; Tushman 1977; Ancona and Caldwell 1992; Weerts and Sandmann 2010; Johnson and Duxbury 2010; Pilbeam and Jamieson 2010; Sturdy and Wright 2011; Williams 2012). However, due to the complexity, dynamism and uncertainty associated with emergency management, not all of these explanations of the activities were directly transferable to this environment. Therefore, the description of boundary spanning activities in this research experienced some modifications to previous definitions that were often only applicable to stable working environments. In particular, the emerging activities of legitimate enabler, organizational expert and domain expert highlighted some of the unique requirements required by boundary spanners working in this state-level emergency operations centre. Emergency management liaison officers fulfilling a boundary spanning role in emergency management are crucial in influencing cross-agency coordination (Janssen et al. 2010). However, fulfilling this role within a multiagency coordination approach in an emergency operations centre has numerous constraints.

The individual interviews, observational studies and focus group interviews revealed some of the answers to the second research question regarding the constraints encountered by the emergency management liaison officers working in a state-level emergency operations centre. In particular, the temporal constraints of emergency management and subsequent fast-action requirements of the participants working in this domain were considered particularly challenging. These findings are aligned to contemporary research describing the temporal challenges of emergency management multi-agency coordination (Faraj and Xiao 2006; Janssen et al. 2010; Mishra et al. 2011; Gryszkiewicz and Chen 2012). A further constraint was that cultural barriers between agencies can complicate matters when functioning in the emergency operations centre. Multi-agency coordination is reliant on a disparate group of agencies that are often hastily gathered to address the emergency event (Schraagen and Van de Ven 2011). Some of the emergency management liaison officers representing these agencies may not have worked with each other or in the emergency operations centre previously. Some non-emergency agencies that may be requested to attend the emergency operations centre in an emergency event may not operate along the lines of a command and control structure as some of the emergency services. However, despite the co-location of the emergency services and non-emergency agencies the silo mentality of some participants from the emergency services still impeded boundary spanning activities. The organizational silos of some agencies were also identified as a problem to information sharing and coordination in an emergency management context as described by Bharosa et al. (2011). These constraints can create cultural barriers when operating in this environment. Additionally, a lack of working together, especially in the operating environment, can be associated with unfamiliarity with the applicable multiagency coordination arrangements.

Unfamiliarity of multi-agency coordination arrangements in the emergency operations centre presented a number of constraints for the participants. A lack of familiarity with the emergency operations centre led to challenges with actually functioning in the physical structure of the work domain. Furthermore, a lack of familiarity with the work domain led to challenges with operating the emergency operations centres information systems. The data identified that numerous information challenges in the work domain included a lack of information system interoperability between agencies, inconsistency of information, potential information overload and finally a lack of understanding regarding other agencies information requirements. These findings are consistent with research investigating information technology incompatibility (Ley et al. 2012), information overload (Gryszkiewicz and Chen 2012), differing information requirements of stakeholders (Van de Walle and Turoff 2008), and a lack of familiarity with information systems used in the emergency management domain (Paton and Flin 1999; Saoud et al. 2006; Coates et al. 2011). Analysis of the data also revealed that compounding these constraints was some

emergency management liaison officer's lack of participation in multiagency exercising at the emergency operation centre. This could be attributed to cultural barriers between emergency and non-emergency agencies and the subsequent lack of involvement of some emergency management liaison officers in exercising. A lack of involvement in multiagency exercising could be attributed to a lack of familiarity with the work domain and in particular the information systems. This finding is consistent with other research that suggests in order to address some of the technological challenges associated with emergency management, simulation training with the information technology needs to occur in the pre-event phase enabling increased familiarity not only with information systems but with other agencies goals and objectives (Paton and Flin 1999; Turoff et al. 2004a, b).

Finally, important insights regarding the third research question corresponding to how do emergency management liaison officers prevail over the constraints described previously were identified. Using the Core-Task Analysis framework resulted in a description of the emergency management liaison officer's core-task demands. This supported an understanding of how the constraints of the work domain were interpreted by the participants and how they consequently addressed the challenges by means of their collaboration, skill and knowledge. Many of the core task demands were drawn from the activities described in answering the first research question. However, an aspect that was described explicitly in the focus group interview data and corroborated in the observational data that consequently underlined the majority of the core-tasks was the necessity to accomplish these in the pre-response phase. The concept of forging agency alliances and acquiring knowledge of the supra-structure prior to an emergency event exemplifies the temporal challenges associated with emergency management events. This highlights the requirement to establish practices in pre-response training and exercising that facilitate completing the core-tasks in the work domain during an actual emergency event.

Emergency management liaison officers working in a state-level emergency operation centres are expected to overcome an array of constraints associated with functioning in this domain. The triangulation of the data from the three qualitative research methods identified that emergency management liaison officers can mitigate these constraints. Addressing the challenges of operating in this type of environment requires a concerted effort by emergency management liaison officers performing a boundary spanning role to engage in some important undertakings in the pre-response phase of an emergency event. Personnel fulfilling this role need to actively participate in multiagency exercising in the emergency operations centre that they may be expected to operate. The benefits of this are numerous. Firstly, functioning in an exercise environment can enable the network and fostering of relationships with numerous agency stakeholders. This relationship building in the multi-agency environment can increase their familiarity with other agencies involved in multi-agency coordination arrangements including their roles, requirements and expectations during an actual emergency event. This may assist in breaking down any cultural barriers between agencies and thus overcoming some of the complexities associated with operating in a multi-agency environment. In addition, having a comprehensive understanding of the potential decision-making expectations that the emergency management liaison officers would be expected to provide on behalf of their agency in an emergency event is important. This may assist the emergency management liaison officer in dealing with the dynamic setting of a state-level emergency operations centre that necessitates fast-action requirements. Secondly, regular multi-agency exercising can also increase the emergency management liaison officer's familiarity with the actual multiagency coordination structure and operating procedures. Using the specific emergency operations centres particular information systems in an exercise situation can increase the emergency management liaison officer's familiarity with these information technologies that can facilitate their use in an actual emergency event and could potentially reduce information uncertainty.

This exploratory research aimed at understanding the boundary spanning task of emergency management liaison officer's involved in state-level multi-agency coordination. It is envisaged that adopting certain boundary spanning strategies in the pre-response phase may facilitate multiagency coordination within a state-level emergency operations centre during an actual emergency event. This could ultimately contribute to mitigating the consequences of the risk to the affected communities. Although these findings are restricted to one case study, it is anticipated that the results may be important to boundary spanning in other strategic emergency management contexts.

7 Conclusion

This case study has explored and described the work of emergency management liaison officer's fulfilling a boundary spanning role in emergency management. However, research on this topic in the area of emergency management is limited, and therefore, this study adopted an exploratory approach. Core-Task Analysis methodology was a successful means to understand the task of boundary spanning in a complex work domain. From a research perspective, this case study contributes to an improved understanding of boundary spanning in the context of state-level emergency operation centres. Although sharing similarities to boundary spanning in other domains, the activities required for boundary spanning in emergency management has highlighted a number of facets that are unique to working in this *complex, dynamic* and *uncertain* environment. However, performing a boundary spanning function in a state-level emergency operations centre presents many constraints to the emergency management liaison officer's fulfilling this role. The constraints of operating in this work domain means that emergency management liaison officers have to adopt certain characteristics to achieve their activities in the emergency operations centre. According to the data, emergency management liaison officers should engage in some of these important undertakings in the pre-response phase of an emergency event in an effort to facilitate multi-agency coordination in the emergency operations centre during an actual emergency event. The main contribution of this research is identifying the core task principles required by emergency management liaison officer's performing a boundary spanning role in a state-level emergency operations centre to successfully function in this environment.

It is envisaged that facets of this research can form the basis for specific training intended for state-level emergency management liaison officers. The suggested core task principles of boundary spanning in a state-level emergency operations centre would benefit from further validation using multiple similar case study settings. In addition, it may be of benefit to explore the boundary spanning activities of emergency management liaison officers at the operational and tactical levels of emergency management to investigate whether these roles differ from those at emergency management arrangements at the strategic level. It is acknowledged that this research is confined to the study setting used in the case study. Nevertheless, it is envisaged that the fundamental principles of boundary spanning in this particular environment and mechanisms incorporated to address the challenges could be applied in other complex, dynamic and uncertain work domains. Irrespective of the working environment, collaboration between human factors researchers and practitioners is critical (Nemeth et al. 2011) in developing a new knowledge base to shape the physical, technological, and informational and social structures of the chosen work domain (Norros 2014).

Acknowledgments This project was supported with funding from the Australian Bushfire Cooperative Research Centre. The views presented in this paper are those of the authors and should not be taken to represent the position or policy of the funding body. We would like to thank all the emergency management liaison officers and staff at the Victorian State Control Centre who have taken part in this research and in particular Peter Norman for facilitating the focus group interviews. We would also like to thank the two reviewers of this paper for their helpful and constructive feedback which has helped improve the paper.

References

Aedo I, Dı´az P, Carroll JM et al (2010) End-user oriented strategies to facilitate multi-organizational adoption of emergency management information systems. Inf Process Manag 46:11–21. doi:10. 1016/j.ipm.2009.07.002

Aldrich H, Herker D (1977) Boundary spanning roles organization. Acad Manag Rev 2:217–230

Ancona DG, Caldwell DF (1988) Beyond task and maintenance defining external functions in groups. Gr Organ Stud 13:468–494

Ancona DG, Caldwell DF (1992) Bridging the boundary: external Activity and Performance in Teams Organizational. Adm Sci Q
37:634–665

Baber C, Cross J, Smith P, Robinson D (2007) Supporting implicit coordination between teams in disaster management. In: Loffler
J, Klann M (eds) Mobile response. Springer, Berlin, pp 39–50

Baker T (1994) Doing social research, 2nd edn. McGraw-Hill, New York

Bharosa N, Janssen M, Tan YH (2011) A research agenda for information quality assurance in public safety networks: information orchestration as the middle ground between hierarchical and netcentric approaches. Cogn Technol Work 13(3):203–216. doi:10.1007/s10111-011-0172-9

Bluhm D, Harman W, Lee T, Mitchell T (2011) Qualitative research in management: a decade of progress. J Manag Stud 48:1866–1891

Chen R, Sharman R, Rao HR, Upadhyaya SJ (2008) An exploration of coordination in emergency response management. Commun ACM 51:66–73

Coates G, Wilson DT, Hawe GI, Crouch RS (2011) Adaptive coordinated emergency response to rapidly evolving large-scale unprecedented events (REScUE). 8th international ISCRAM conference, pp 1–5

Comfort L, Kapucu N (2006) Inter-organizational coordination in extreme events: The World Trade Center attacks, September 11, 2001. Nat Hazards 39:309–327. doi:10.1007/s11069-006-0030-x

Drach-Zahavy A (2011) Interorganizational teams as boundary spanners: the role of team diversity, boundedness, and extrateam links. Eur J Work Organ Psychol 20:89–118

Eisenhardt KM (1989) Building theories from case study research. Acad Manag Rev 14:532. doi:10.2307/258557

Faraj S, Xiao Y (2006) Coordination in fast-response organizations. Manag Sci 52:1155–1169

Fleiss J, Levin B, Paik M (2003) Statistical methods for rates and proportions, 3rd edn. Wiley, Hoboken

Granot H (1997) Emergency inter-organizational relationships. Disaster Prev Manag 6:305–310

Gryszkiewicz A, Chen F (2012) Temporal aspects in crisis management and its implications on interface design for situation awareness. Cogn Technol Work 14:169–182. doi:10.1007/ s10111-011-0199-y

Harrald JR (2006) Agility and discipline: critical success factors for disaster response. Ann Am Acad Pol Soc Sci 604:256–272. doi:10.1177/0002716205285404

Hoover R, Koerber A (2011) Using NVivo to answer the challenges of qualitative research in professional communication: benefits and best practices tutorial. Prof Commun IEEE Trans 54(1):68–82

Hutchison AJ, Johnston LH, Breckon JD (2010) Using QSR-NVivo to facilitate the development of a grounded theory project: an
account of a worked example. Int J Soc Res Methodol 13:283–302. doi:10.1080/13645570902996301

International Organization for Standardization (2011) Societal security— emergency management—requirements for incident response. ISO 22320:2011

Janssen M, Lee J, Bharosa N, Cresswell A (2010) Advances in multiagency disaster management: key elements in disaster research. Inf Syst Front 12:1–7. doi:10.1007/s10796-009-9176-x

Jemison DB (1984) The importance of boundary spanning roles in strategic decision-making. J Manag Stud 21:131–152

Johnson K, Duxbury L (2010) The view from the field: a case study of the expatriate boundary-spanning role. J World Bus 45:29–40. doi:10.1016/j.jwb.2009.04.002

Kapucu N (2006) Interagency communication networks during emergencies boundary spanners in multiagency coordination. Am Rev Public Adm 36(2):207–225

Kapucu N (2011) Collaborative governance in international disasters: Nargis cyclone in Myanmar and Sichuan earthquake in China cases. Int J Emerg Manag 8:1. doi:10.1504/IJEM.2011.040395

Kapucu N, Van Wart M (2006) The evolving role of the public sector in managing catastrophic disasters: lessons learned. Adm Soc 38:279–308

Karvonen H, Aaltonen I, Wahlstro¨m M et al (2011) Hidden roles of the train driver: a challenge for metro automation. Interact Comput 23:289–298. doi:10.1016/j.intcom.2011.04.008

Katz D, Khan R (1966) The social psychology of organizations. Wiley, New York

Keller R, Holland W (1975) Boundary-spanning roles in a research and development organization: an empirical investigation. Acad Manag J 18:388–393

Khan RL, Wolfe DM, Quinn RP, Snoek JD (1964) Organizational stress: studies in role conflict and ambiguity. Wiley, New York

Kreps GA, Bosworth SL (1993) Disaster, organizing, and role enactment: a structural approach. Am J Sociol 99:428–463

Landis J, Koch G (1977) The measurement of observer agreement for categorical data. Biometrics 33:159–174

Ley B, Pipek V, Reuter C, Wiedenhoefer T (2012) Supporting improvisation work in inter-organizational crisis management.
In: Proceedings of the 2012 ACM annual conference human factors computing systems. CHI '12. ACM Press, New York, NY, USA, pp 1529–1538

Manoj BS, Baker AH (2007) Communication challenges in emergency response. Commun ACM 50:51. doi:10.1145/1226736. 1226765

McEntire DA (2002) Coordinating multi-organizationorganizationorganization responses to disaster: lessons from the March 28, 2000, Fort Worth Tornado. Disaster Prev Manag 11:369–379

McGuire M, Silva C (2010) The effect of problem severity, managerial and organizational capacity, and agency structure on intergovernmental collaboration: evidence from local emergency management. Pub Adm Rev 70(2):279–288

Miles RH (1976) Role requirements as sources of organizational stress. J Appl Psychol 61:172–179. doi:10.1037//0021-9010.61. 2.172

Mishra JL, Allen DK, Pearman AD (2011) Information sharing during multi-agency major incidents. Proc Am Soc Inf Sci Technol 48:1–10. doi:10.1002/meet.2011.14504801039

Morse J, Barrett M, Mayan M et al (2002) Verification strategies for establishing reliability and validity in qualitative research. Int J Qual Methods 1:13–22

Nemeth C, Wears RL, Patel S et al (2011) Resilience is not control: healthcare, crisis management, and ICT. Cogn Technol Work 13:189–202. doi:10.1007/s10111-011-0174-7

Norros L (2004) Acting under uncertainty. The core-task analysis in ecological study of work. VTT Publications, Espoo

Norros L (2014) Developing human factors/ergonomics as a design discipline. Appl Ergon 45:61–71. doi:10.1016/j.apergo.2013.04. 024

Norros L, Norros I, Liinasuo M, Seppanen K (2013) Impact of human operators on communication network dependability. Cogn Technol Work 15(4):363–372

Onwuegbuzie A, Dickinson W, Leech NL, Zoran AG (2009) A qualitative framework for collecting and analyzing data in focus group research. Int J Qual Methods 8:1–21

Paton D, Flin R (1999) Disaster stress: an emergency management perspective. Disaster Prev Manag 8:261–267

Pilbeam C, Jamieson I (2010) Beyond leadership and management: the boundary-spanning role of the pro-vice chancellor. Educ Manag Adm Leadersh 38:758–776. doi:10.1177/17411432 10379058

Salmon P, Stanton N, Jenkins D, Walker G (2011) Coordination during multi-agency emergency response: issues and solutions. Disaster Prev Manag 20:140–158. doi:10.1108/096535611 11126085

Saoud NB, Mena TB, J Dugdale et al (2006) Assessing large scale emergency rescue plans: an agent based approach. Int J Intell Control Syst 11:260–271

Schraagen JM, Van de Ven J (2008) Improving decision making in crisis response through critical thinking support. Hum Factors 2:311–327. doi:10.1518/155534308X377801

Schraagen JM, Van de Ven J (2011) Human factors aspects of ICT for crisis management. Cogn Technol Work 13:175–187. doi:10. 1007/s10111-011-0175-6

Strauss A, Corbin J (1998) Basics of qualitative research. Sage, Thousand Oaks

Sturdy A, Wright C (2011) The active client: the boundary-spanning roles of internal consultants as gatekeepers, brokers and partners of their external counterparts. Manag Learn 42:485–503. doi:10. 1177/1350507611401536

Teddlie C, Yu F (2007) Mixed methods sampling: a typology with examples. J Mix Methods Res 1:77–100. doi:10.1177/2345678 906292430

Thompson JD (1967) Organizations in action. McGraw-Hill, New York

Turoff M, Chumer M, Hiltz R, Klashner R (2004a) Assuring homeland security: continuous monitoring, control & assurance of emergency preparedness. J Inf 6:1–24

Turoff M, Chumer M, Van de Walle B, Yao X (2004b) The design of a dynamic emergency response management information system. J Inf Technol Theory Appl 5:1–36

Tushman M (1977) Special boundary roles in the innovation process. Adm Sci Q 22:587–605

Van de Walle B, Turoff M (2008) Decision support for emergency situations. Inf Syst E-bus Manag 6:295–316. doi:10.1007/ s10257-008-0087-z

Van Scotter J, Pawlowski S, Cu T (2012) An examination of interdependencies among major barriers to coordination in disaster response. Int J Emerg Manag 8:281–307

Van Veelen B, Storms P, van Aart C (2006) Effective and efficient coordination strategies for agile crisis response organizations. Proceedings of the 6th international ISCRAM conference, pp 202–213

Weerts DJ, Sandmann LR (2010) Universities community engagement and boundary-spanning roles at research universities. J Higher Educ 81:702–727. doi:10.1353/jhe.2010.0011

Williams P (2012) Collaboration in public policy and practice: perspectives on boundary spanners. The Policy Press, Bristol,
UK

Appendix C: Paper III

Obtaining information in emergency management: a case study from an Australian emergency operations centre

Steven Curnin* and Christine Owen

Faculty of Education,
University of Tasmania,
Private Bag 66, Hobart, Tasmania 7001, Australia
E-mail: Steven.Curnin@utas.edu.au
E-mail: Christine.Owen@utas.edu.au
*Corresponding author

Abstract: Stakeholders involved in emergency management multi-agency coordination require information to inform their situation awareness to plan and coordinate their response and mitigation strategies. This study investigates the perceived information requirements of senior strategic level emergency management personnel and how they obtain this information. The results are based on empirical data from two sources: an organizational survey and observational study during an emergency event. The findings indicate that the most influential cognitive artefacts used to obtain information are in person communication and use of specialised application software. However, challenges associated with using the latter can result in an increased use of in person communication which can limit the exchange of information throughout the system of actors. Understanding the strengths and limitations of how these stakeholders obtain information in this Australian emergency operations centre to inform their situation awareness is essential in facilitating multi-agency coordination in this environment.

Keywords: situation awareness; emergency management; emergency operations centre; multi-agency coordination; cognitive artefacts.

Reference to this paper should be made as follows: Curnin, S. and Owen, C. (2013) 'Obtaining information in emergency management: a case study from an Australian emergency operations centre', *Int. J. Human Factors and Ergonomics*, Vol. 2, Nos. 2/3, pp.131–158.

Biographical notes: Steven Curnin is a PhD candidate at the University of Tasmania and an Australian Bushfire Cooperative Research Centre scholarship holder. He received his Masters of Emergency Management from Charles Sturt University in 2011. His interest is investigating how stakeholders in emergency management use boundary spanning activities in temporary supra organizations to facilitate multi-agency coordination.

Christine Owen is a researcher with a focus on organizational behaviour and learning. She has extensive experience in researching and consulting in a number of high reliability domains, including the aviation field, emergency medicine and more recently in the fire and emergency services industry. She has been involved in the Australian Bushfire Cooperative Research Centre since 2006 and currently she leads a multi-disciplinary team examining coordination effectiveness at regional, state and national levels of emergency management.

1 Introduction

As society becomes increasingly susceptible to disasters, emergency management practitioners are faced with multiple challenges. Modern day disasters are characterised by complexity and uncertainty that frequently require the coordination of multiple stakeholders (Schraagen & Van de Ven, 2008). This complexity can be attributed to multiple elements including, but not limited to, temporal constraints (Janssen et al., 2010; Mishra et al., 2011), communication challenges (Aedo et al., 2010; Comfort & Kapucu, 2006; Manoj & Baker, 2007; McEntire, 2002) dysfunctional organizational linkages between multiple agencies (Janssen et al. 2010; Salmon et al. 2011; Harrald 2006) and information challenges. Information challenges can include system incompatibility (Baber et al. 2007; Ley et al. 2012), differing agency information requirements (Van de Walle & Turoff, 2008) and a lack of familiarity with different agency information systems (Coates et al., 2011; Paton & Flin, 1999; Saoud et al., 2006).

The international standard for emergency management defines coordination as "the way in which different organizations (public or private) or parts of the same organization work or act together in order to achieve a common objective" (International Organization for Standardization, 2011). Effective coordination necessitates the synchronised efforts of a diverse collection of public and private agencies with specialised skills and knowledge (Van Scotter et al., 2012). In order to facilitate such synchronised efforts, individual agencies (or personnel from different parts of the same agency) have to transition from being autonomous entities (in non-crisis situations) into interdependent decision-making teams (Janssen et al., 2010). The temporary supra-organization collaborations that are formed will then comprise of stakeholders from multiple agencies who span the boundaries between agencies and facilitate linkages so that actions to mitigate the disaster and to facilitate community recovery can be efficiently coordinated (Pasquero, 1991). Boundary spanning is critically important in these situations to explore the ways in which multiple stakeholders share their information (Kapucu, 2006a). Fundamental to the success of boundary spanning is the requirement for stakeholders to obtain adequate information to inform their situation awareness of the event (Salmon et al. 2011); engage in team decision-making (Salas et al., 2007) and effectively coordinate their activities.

In order to improve emergency management coordination it is important to understand the challenges of operators in developing and maintaining situation awareness so that decision making and coordinating activities may be effective. The problem of how disparate stakeholders come together to achieve this is not well understood and certainly not well theorised.

The importance of coordination in emergency events is, more often than not, highlighted by coordination failure (Comfort & Kapucu, 2006; Lutz & Lindell, 2008; Moynihan, 2007; Reid, 2006; Teague et al., 2010; Wise, 2006). In the literature it has been found that there is frequently a deterioration of quality information in large scale emergency events (Bharosa et al., 2011) that can lead to impaired understanding. In addition, the demands for interagency communication increases significantly (Kapucu & Van Wart, 2006) requiring more information exchange in ways that are time-critical (Schraagen et al., 2010). However, some literature questions the necessity of coordination, particularly in the response phase of an emergency event where collaboration occurs infrequently and may even be unachievable (Berlin & Carlström, 2008; Helsloot, 2008; Scholtens, 2008).

Situation awareness is a term given to an individual's level of awareness of a situation, an operators understanding of 'what is going on' (Endsley, 1995) and is an indicator of safety in highly complex socio-technical systems. Some theorists have represented situation awareness as a static snapshot (Endsley, 1995) and others have represented it as a process (Smith & Hancock 1995). The view preferred here is that of Sarter and Woods (1991, p. 52) where situation awareness is the "accessibility of a comprehensive and coherent situation representation which is continuously being updated in accordance with the results of the recurrent assessments". Maintaining situation awareness in dynamic, complex and collaborative environments is reliant on the timely transmission of accurate and pertinent information (Salmon et al. 2011; Militello et al. 2007; Bharosa et al. 2011; Mishra et al. 2011). However, the flow of information (in terms of its quantity and quality) needed to provide continuous situation awareness can cause increases in cognitive workload which can be problematic (Tsang & Wilson 1997; Raj et al. 2011). It is also

important to note that situation awareness is based on sensation perception and differs from situation understanding which results from a sense-making process (Raj et al., 2011). Through team processes, both situation assessment and sense-making feed into the development of shared mental models, an important construct in teamwork coordination (Burke, Stagl, Salas, Pierce, & Kendall, 2006; Owen et al., 2013). For the purposes of this paper, situation awareness involves not only an understanding of the current emergency incident but also forecasting how it could evolve to provide advance warning of impending threats and to facilitate the planning of response and mitigation strategies (D. Johnson et al., 2011). In this respect it involves perception, sense-making and sense-giving.

In contemporary organizations distributed situation awareness is supported through a range of information systems that act as cognitive artefacts to aid or enhance people's cognitive abilities (Norman, 1991). The use of cognitive artefacts allows information to be available in the system in its entirety rather than just to selected human actors within this environment (Salmon et al. 2011). The use of artefacts to store and represent information, to support reflection and reinterpretation, to cue activity and to communicate action, provides a mechanism by which distributed groups may be aware of an unfolding situation and the activities of others to achieve their outcomes in a coordinated way (McMaster, Baber, & Duffy, 2012). The exploration of cognitive artefacts is well documented in the literature investigating complex environments such as the health sector (Wilson et al. 2007; Wears et al. 2006; Laxmisan et al. 2006; Xiao 2005), and may be an important enabler in the development and maintenance of situation awareness in the emergency management environment.

However, the research examining the use of cognitive artefacts to support emergency management coordination is limited (see Lutz & Lindell 2008, Salmon et al. 2011 for some exceptions). Moreover, given the complexity of the environment and the multiple challenges associated with this it is unlikely that insights gained from similarly complex domains will be directly transferrable. What is needed is a deeper understanding of how personnel working at a strategic coordination level in emergency management use existing cognitive artefacts to support their needs.

Knowing what activities emergency management personnel are engaged with in order to ascertain how cognitive artefacts may support their distributed situation awareness is therefore critical. This led to the following questions to guide this research:

- What problem-solving activities are emergency management personnel engaged with that require coordination?
- What artefacts do they currently use when engaged in those problem solving activities?
- What are the information requirements to inform their situation awareness and how might artefacts better support these in an emergency management event?

1.1 Analysing situation awareness and the use of cognitive artefacts

There are a number of different models that can be applied to analyse the role of cognitive artefacts and their implications for distributed situation awareness and emergency management coordination. There are, for example, formal models of articulating human-machine interaction and operator needs through the processes of hierarchical task analysis (Kirwan & Ainsworth, 1992); others that consider the socio-technical system as a joint cognitive system between human and no-human agents in terms of cognitive process engineering (Hollnagel, 2001), work domain analysis (Vicente, 1999) and cognitive work analysis (Stanton et al., 2009).

Hollnagel (2011) makes the point that these models have been historically based on a number of assumptions that, due to complexity and interdependency, are becoming increasingly irrelevant. These assumptions are that (1) system boundaries can be well defined; (2) internal and external interactions of the system are similar; and (3) that humans and machines operating within these systems are reactive to stable inputs from their external environments. He goes on to argue that

these are reasonable assumptions for systems that are tractable and which are relatively independent and only loosely coupled to their environment. However, they are not tenable for systems that are more open-loop and are more tightly coupled to their environment. Increasingly, human-machine systems are interdependently complex and needing to adjust to changes in their environments. It is this type of domain that emergency management coordination best represents. According to Hollnagel (2011) the design (and here – the analysis of) such systems needs to be more global in perspective; because the goals change from maintaining local stability to one of persistence – defined as the ability to absorb change and disturbance and still maintain an effective relationship with the external environment.

In keeping with Hollnagel's (2011) critique therefore, the approach taken here is to investigate the problem solving activities undertaken by emergency management personnel to better understand the challenges they face and how various cognitive artefacts are used to acquire the information they need to better support their emergency management coordination goals. This approach acknowledges the argument made by scholars working within the Naturalistic Decision-Making frameworks (see for example Klein et al. 1993; Zsambok & Klein 1997; Todd & Gigerenzer 2001): that activities associated with sense-making and situational awareness should be studied in their real-life domains rather than in a laboratory. In keeping with this premise it was important to try to understand the challenges faced from the point of view of the practitioners as they go about their activities. While there were a number of potential conceptual frameworks that could be chosen to guide the study (see for example Flin & Arbuthnot 2002; Salas & Klein 2001; Vicente 1999), the one employed here was developed by Rasmussen (as cited by Boy 2011, page 3). Rasmussen's framework has been used to analyse a range of complex environments because of its focus on dynamic and highly interdependent work activities in managing unpredictable events and in particular the role of the design of information systems such as those reported here. It has been further developed by Hoc (1996) and others (Millot, Debernard, & Vanderhaegan, 2011). According to Rasmussen (as cited by Boy 2011) the stages involved in managing unpredictable events includes tasks associated with:

1. Abnormal event detection, which includes searching for information;
2. Engaging in risk and situation assessment;
3. Task execution including goal and target definition and enacting, and procedures to complete execution;
4. Predicting and assessing consequences, planning for the future.

Hoc (1996) added a fifth stage, which involved activities associated with evaluating the progress of the goals and making adjustments. Given the emphasis on the need for system review and monitoring discussed in post emergency event inquiries such as the Victorian Bushfire Royal Commission (Teague et al., 2010) in Australia, evaluation will also be included here.

1.2 Study setting

State governments in Australia are responsible for managing emergency events. The activation of a state emergency operations centre occurs if there is an emergency event that has the potential to affect multiple communities or is so significant that it requires a state level response. In the Australian state of Victoria, the State Control Centre fulfils this obligation. The role of the Centre is to act as the hub of eight regional and more than forty-seven local incident control centres across the state that supports emergency services during major emergencies. The Centre is a multi-agency and a multi hazard state level emergency operations centre. The Centre is staffed every day of the year with a core skeleton of staff but increases depending on the activation level (i.e., depending on the seriousness of the event). During the highest level of activation which is described as Tier 3

activation, the Centre will routinely operate 24 hours a day with up to ninety personnel at any one time representing multiple agencies co-located in the Centre. Agencies involved include, for example, fire services, police, ambulance, primary industry and critical infrastructure (e.g., water and energy). Stakeholders representing these agencies are required to span organizational boundaries providing linkages between the agencies. These linkages facilitate the stakeholder's ability to obtain information to inform their situation awareness that is been continuously reassessed specific to their agencies requirements. It also allows the stakeholder to assist with the needs of collaborating agencies situation awareness in an effort to assist in the planning of response and mitigation strategies for the emergency event.

The Centre currently has two areas where stakeholders may be located: in the operations room of the Centre with the command and control (e.g., fire and police) agencies, centre support staff and some stakeholder agency representatives; and in a designated room adjacent to the operations room (see Figure 1). There is a range of data applications available in the Centre that provides information about the event (See Table 1). This information is available from numerous sources in the operations room including several visual display units and permanent computers located at each work station that the stakeholders can access. As the operations room can only accommodate a limited number of stakeholders, additional stakeholders are located in the adjacent room. Due to the geographical location of the adjacent room there is no direct view of the operations room. In this room stakeholders are expected to provide their own laptops which mean they are currently unable to access all the data applications in use at the Centre. There is one visual display unit in the room.

Figure 1 Participants location in the emergency operations centre

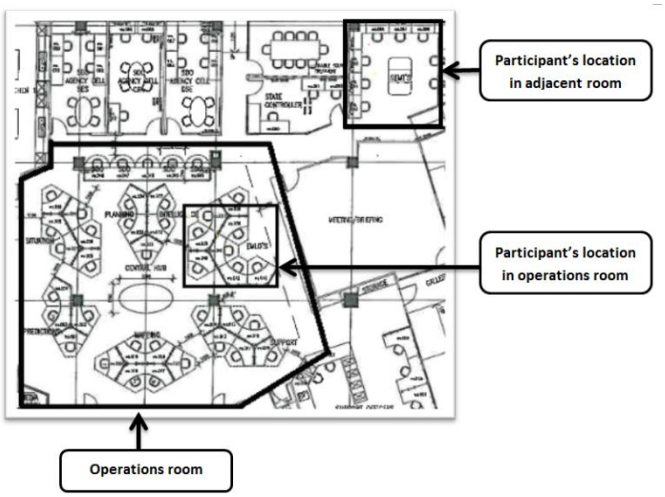


Table 1 Artefacts available for emergency management personnel

Verbal	*Data*	*Map*	*Video*	*Photos*	*Text*
In person	PC application	Printed	Camera	MMS (via phone)	SMS / pager
Telephone	Agency (intranet) web site	Map book	Live streaming (e.g. CCTV or Web)	camera (PC)	PDF / DOC
Agency radio Broadcast radio	Website / social media	Agency application/intranet Public website	TV	Online	

2 Methodology

This study is based on empirical data from two sources, an organizational survey and an observation conducted during an actual emergency event. Both forms of data collection received ethics approval from the Tasmanian Social Sciences Human Research Ethics Committee in Australia and followed the protocols for provision of information and consent.

2.1 Organizational survey

The organizational survey was distributed under the auspices of the Victorian Office for the Fire Services Commissioner in Australia. The aim of the survey was to investigate the information needs of the various stakeholders working in this multi-jurisdictional centre. Humans would often prefer too much information rather than too little information when constructing a comprehensive picture (O'Reilly, 1980; Russo, 1974). However, in emergency management the abundance of information might not actually be required for the functions the stakeholders have to perform. Therefore it has to be acknowledged that the findings from the survey may only give an insight into what information the participants would like to have and not necessarily what information they require to perform their role. This is why undertaking a second phase in this study was important; and forms the rationale for making it an observational study. Nevertheless, a survey was considered the most appropriate way to efficiently gain some overall insights into the work being undertaken.

Table 2 Sample for survey and observations

Functional areas in Centre	*Personnel*	*Survey N (%)*	*Observation*
Centre management support staff	31	16 (52%)	
Command and Control agencies (includes urban fire services, rural fire services, police land management)	43	29 (67%)	Yes
State Emergency Service	21	14 (67%)	Yes
Health /Ambulance	14	8 (57%)	Yes
Critical infrastructure (e.g., Water, communications utilities, electricity, Gas)	28	17 (61%)	Yes
Other state government	15	8 (53%)	Yes
Total	152	92 (61%)	

The study was piloted with three subject matter experts in the industry and adjustments made to clarify the wording of some questions. The organizational survey was distributed toward the end of 2011 to 104 fire and emergency services personnel who had recently worked in the Centre. A stratified sample was used to ensure good coverage of the main roles performed in the Centre (see Table 2). Ninety-two surveys were returned yielding a response rate of 61% which is above the typical response rate for organizational surveys (Baruch & Holtom, 2008). Part of the survey requested that participants nominate the role they most commonly performed in an incident and to list the most important decisions and/or actions they made when in that role. In the survey 92 participants responded to this question and provided 160 separate comments. These comments were then coded against the problem-solving framework outlined earlier by Rasmussen (as cited by Boy 2011) and Hoc (1996). This framework was employed as a departure point for the analysis of the various demands and challenges discussed and because it has previously been employed to build a formative picture of decisions undertaken, and information needs in the context of systems design (see for example Jenkins, Stanton Salmon, Walker and Rafferty 2010). The framework provided a useful way of grouping the data, however thematic modifications were needed to represent the emergency management domain. Sub-categories were then developed inductively. Once the coding framework had been developed by the initial researcher the second researcher

reapplied the coding framework to the data. An inter-rater reliability Kappa of 75% was achieved indicating a substantial or good level of inter-rater agreement (Fleiss et al., 2003; Landis & Koch, 1977). The modified problem-solving activities and examples from the data are presented in Table 3.

Table 3 Problem solving model including activities and examples from the data

Problem solving activity	*Examples from the data*
Problem detection including situation assessment, size up – current assessment of risk	Assessing incident criticality Ascertaining correct and up to date information on the incident Identifying & managing risk
Execution of tasks, includes resource management	Dispatch and deployment of aircraft to fires and emergencies Where your resources are established on the scene Deployment of resources
Anticipation/planning/prediction	Assessment of likely flood impacts Exposures - Strategies to protect life and property What is the likely fire behaviour
Interpretation and sense-making – consequences for system goals - development of strategy	Information to the community - website/warnings Which information to pass on to the public and how might it be communicated to ensure a clear message What is the extent of damage and implications?
Evaluation in relation to system constraints - quality assurance measures	Making sure statutory obligations are being met and compliance with procedures Processes of transfer of Control from the field are followed Ensuring Commander / Controllers Intent at all levels are implemented

2.2 Observational study

The second source of data reported in this paper is an observation study conducted when the Centre was at tier 3 activation during a series of large complex bushfires early in 2013. Tier 3 activation is the highest level of activation in the Centre. Direct observation of individuals in their natural setting is a highly valued and effective research method (Caldwell & Atwal, 2005; Carlson & Morrison, 2009) and provided the opportunity to triangulate the kinds of challenges discussed in the survey and to identify the artefacts in use. The researcher adopted an observational stance where the group under observation was aware of the researcher's observational activities (Gold, 1958). This allowed for the researcher's participation in the group activities as desired thus generating a more complete understanding of the participant's activities (Kawulich, 2005).

We recognised that the observation needed to be non-intrusive and did not impose upon the participants or the organization's response efforts. Under these circumstances it was decided with the Centre management that only one researcher would be present to undertake the observational studies. The authors recognised that this may introduce an aspect of observer bias but felt that it was necessary during these conditions (Kawulich, 2005). Field notes, recording and self-reports from those observed were the primary forms of data collection as audio and video recording was considered too intrusive in this sensitive environment. An observation protocol had been previously developed and piloted in two state bushfire simulation exercises with modifications made to the protocol based on feedback (see Table 4).

Table 4 Observational study protocol guidelines

Question	*Time of observation* 0800	1000	1200	1400
Having ascertained their perception of the situation awareness they needed: how would you rate your current situational awareness of the event?	0 – none 1 – poor 2 – average 3 – good 4 – excellent	0 – none 1 – poor 2 – average 3 – good 4 – excellent	0 – none 1 – poor 2 – average 3 – good 4 – excellent	0 – none 1 – poor 2 – average 3 – good 4 – excellent
Do you feel the information you receive for your agencies decision making process is…?	0 – none 1 – poor 2 – average 3 – good 4 – excellent	0 – none 1 – poor 2 – average 3 – good 4 – excellent	0 – none 1 – poor 2 – average 3 – good 4 – excellent	0 – none 1 – poor 2 – average 3 – good 4 – excellent
Descriptors	*Comments*	*Comments*	*Comments*	*Comments*
Receiving information: (Describe how the participant is receiving information: briefings, data applications, visual displays, informal communication, using telecommunications, etc. Are there any challenges related to performing this task)				
Disseminating information: (Describe how the participant is disseminating information: briefings data applications, informal face communication, using telecommunications, etc. Are there any challenges related to performing this task)				
Modality of information: (Describe what modes of communication the participant is using and identify if there are there any challenges related to performing this task)				

For the observation of a real-time emergency event ten stakeholder personnel were selected for observing. These represented the key agencies involved (see Table 5). A summary of the personnel involved and some of their demographic information is presented in Table 6. The names of the participants in the observational study were de-identified to maintain anonymity and confidentiality. The majority of the participants were from critical infrastructure and there was an even distribution of participants located in the operations room and the adjacent room. All participants had considerable industry experience. Two of the participants had not performed this role in a previous emergency event and three participants had not performed the role specifically at this emergency operations centre. In terms of experience within their existing role at a senior state level, two participants had undertaken the role for more than five years and six had between one and five years' experience. There was an even distribution of participants who had received formal training for the role and those who had received no training (see Table 6). For the remainder of the findings, the details of the specific agencies represented are de-identified to protect the confidentiality of the participants.

Due to the predicted workload of the participants it was determined by the researcher and the Centre management team to observe a maximum of five participants per day with a combination of participants located in the operations room and the adjacent room. Each participant was asked the questions included in Table 4, every two hours over the period of the shift. Two consecutive day shifts were observed. If the participant was not at their location during this observation period they were recorded as absent. The questions commenced with the first participant on the hour with

a fifteen minute interval between each subsequent participant. This fifteen minute time allocation allowed the researcher to note the predominant activity occurring and the modalities in use, and provided the opportunity for discussion with the participant. This protocol also meant that the researcher could participate in the scheduled briefings and observe the participants at these briefings. During the time between asking questions the researcher also wrote up field notes and partook in opportunistic conversations with other participants. Immediately following each day the researcher completed detailed field notes.

Table 5 Participants agency and location in emergency operations centre

Agency	*Tranche*	*Location in the centre*
Police	Emergency Services	Main room
Federal Government	Other	Main room
Telecommunications	Critical Infrastructure	Side room
Energy	Critical Infrastructure	Side room
Transport	Critical Infrastructure	Side room
Telecommunications	Critical Infrastructure	Main room
Health	Critical Infrastructure	Main room
Ambulance	Emergency Services	Main room
Energy	Critical Infrastructure	Side room
Water Services	Critical Infrastructure	Side room

Table 6 Participants experience in the role

Participant	*Performed role previously in an emergency event?*	*Performed role previously in this emergency operations centre?*	*How many years have they been performing the role?*	*Have they received any formal training to perform the role?*
1	Yes	Yes	>5	Yes
2	Yes	Yes	<1	No
3	Yes	Yes	<1	No
4	No	No	1-5	Yes
5	Yes	No	1-5	Yes
6	Yes	Yes	1-5	Yes
7	Yes	Yes	>5	No
8	Yes	Yes	1-5	No
9	No	No	1-5	Yes
10	Yes	Yes	1-5	No

2.2.1 Limitations of the observation study

The study has some limitations. One limitation is the prospect of introducing observer bias as previously noted, particularly as only one researcher physically performed the observations. As the observational study was performed in a real-time emergency event this placed caveats on the research which was in no way to obstruct the operations. Hence, the research team decided a sole researcher conducting the observations would be less imposing in this environment. Another limitation is that the study is restricted to one emergency operations centre thus restricting the generalisation of the findings. Nevertheless, no emergency operation centre can be characterised as typical (Sommer & Njå, 2012), therefore how stakeholders obtain information to inform their situation awareness in this research may also be relevant for other practitioners operating in alternative emergency operation centres.

Bushfires, together with earthquakes, landslides, avalanches, storms, floods, volcanic eruptions and tsunamis, can be categorized as rapid onset natural hazards (Bernard et al., 1988; Omelicheva, 2011). Bushfires can evolve over an extended timeframe or can be fast moving as seen in the Black Saturday Bushfires in Australia (Cruza et al., 2012). However, this can be in contrast to

other natural disasters such as flash flooding or earthquakes that often provide no warning. In these disasters time pressures can be perceived as more challenging. Therefore, as the observational studies were conducted during a bushfire event it should be acknowledged that any findings from this data may be difficult to generalise specifically to other types of disasters.

3 Findings

The findings are based upon the organizational survey and the observational study and endeavour to inform the reader how emergency management personnel perceive their need for information and how they access this information to inform their situation awareness. The findings are divided into three sections based upon the three questions guiding this research as described in the introduction. The first section will draw upon the survey data and provide an outline and description of the five problem solving activities that emergency management personnel are engaged with. The next section will utilise the survey data to describe what artefacts the emergency management personnel used when engaging in the nominated problem solving activity. The final section will use data collected from the observational study and identify the two most commonly used cognitive artefacts used to gain information amongst stakeholders in the centre during an actual emergency event.

3.1 Problem solving activities of emergency management

To address the first research question, *what problem-solving activities are emergency management personnel engaged with that require coordination*, the survey data were coded into different problem solving activities that were analysed. Table 7 outlines the survey comments coded at each of the categories as well as providing an outline of the sub-categories emerging from the data.

Table 7 Problem solving activities

Problem solving activity	*SCC case study*
Problem detection including situation assessment, size up – current assessment of risk. Included sub-categories of: • Establishing communication flows • Situation assessment • Intelligence gathering	34 (18%)
Execution of tasks includes resource management. Included sub-categories of: • Managing resources • Managing competing priorities • Managing systems	43 (27%)
Anticipation/planning/prediction. Included sub-categories of: • Scenario building and testing • Determining potential impacts • Developing strategic plans	25 (16%)
Interpretation and sense-making – including issuing warnings and development of strategy. Included sub-categories of: • Developing a mitigation strategy • Providing meaning for different stakeholder groups	45 (28%)
Evaluation in relation to system constraints- quality assurance measures. Included sub-categories of: • Monitoring safety health and enactment of goals • Quality assurance	13 (8%)
Total	160

3.1.1 Problem detection

Activities associated with problem detection comprised the second largest volume of decisions and/or actions reported, and gaining an appreciation of the incident was the most common concern. This was reported as being challenging in events that were rapidly developing and dynamic in their changes. In the Centre it is important for personnel to gain an initial assessment of the impacted areas and an assessment of the level of damage so that they may begin a process of risk assessment and consequence management. However, personnel on the incident ground are sometimes not easily able to provide this information if they are in the midst of an emerging situation due to temporal constraints. This can create challenges for both situation assessment and gathering intelligence to feed into further strategic incident management processes.

3.1.2 Task execution

The activities related to the execution of tasks focused on decisions and/or actions involving resource management. Personnel reported being engaged in procuring and managing logistical issues. In some cases this was particularly challenging for those agencies needing to procure and roster additional volunteers. It is when engaged in these activities that difficulties in the interfaces of Computer Aided Dispatch systems with both dispatch and deployment responsibilities become visible and add to the complexity of task execution. In addition, participants reported that the duplication of processes requiring repeated manual handling of the same information slows down the capability for action.

3.1.3 Anticipation

Within the anticipation, planning and prediction category personnel operating in the Centre used their emerging situation awareness to determine potential impacts and develop strategy. Part of the challenge here related to the frequently reported problem of accessing resources to be able to perform certain tasks, as well as the need to develop predictions with incomplete or inconsistent information.

3.1.4 Sense-making

A number of participants were focused on ensuring that warnings were appropriately conveyed to different groups, including affected communities. Others were involved in ensuring that key stakeholder groups were engaged and had a clear understanding of the issues and their potential consequences. Participants needed to make sense of the implications for their agency and frequently manage political and community expectations. In this respect, boundary spanning roles are particularly important as are other mechanisms to bridge different positions, intentions, needs and interests, including aligning strategic intent with existing and sometimes contradictory government policy goals. Providing updates and meaning with situational advice for stakeholder groups was reported as particularly important.

3.1.5 Evaluation

There were also reported decisions/actions associated with assessing and evaluating the safety health of the emergency management arrangements. This included for example, assessing information collated to ascertain if statutory obligations were being met and that there was compliance with procedures.

3.2 Artefacts in use for situation awareness

To address the second research question, *what artefacts do stakeholders currently use when engaged in problem solving activities*, participants in the organizational survey were asked about what artefacts they used when engaging the nominated decisions and actions. The cognitive

artefacts available in the Centre are summarised in Table 1. These results were cross tabulated against the reported various problem solving categories developed to ascertain the preference for cognitive artefacts (see Table 8).

Table 8 Problem solving activity and information systems interfaces used

Problem solving activity	*Most important*	*Second most important*	*Third most important*
Problem detection including situation assessment, size up - current assessment of risk	Data - PC application	Map - agency application / intranet	Verbal - in person
Execution of tasks, including resource management	Verbal - in person	Verbal - telephone	Data - agency (intranet) website
Anticipation / planning / prediction	Data - PC application	Verbal - in person	Map - printed
Interpretation and sense-making - consequences for system goals - development of strategy	Verbal - telephone	Map - agency application / intranet	Data - agency (intranet) website
Evaluation in relation to system constraints - quality assurance measures	Data - PC application	Verbal - telephone	Verbal - in person

For problem detection activities the most important cognitive artefact was found to be specialised application software. For task execution and resource management activities the most important cognitive artefact reported was verbal communication in person. For anticipation, prediction and planning activities the most important cognitive artefact is application software, particularly for modelling purposes and/or for examining the models emailed from specialists. For interpreting and sense-making activities the most important form of cognitive artefact used is verbal communication by telephone. This may demonstrate the external orientation of much of this type of work in needing to coordinate with other agencies. Lastly, evaluation and quality assurance activities are most commonly supported by application software.

3.3 Situation awareness and artefact used in a real-time event

To address the third research question, *what are the information requirements to inform their situation awareness and how might artefacts better support these in an emergency management event*, an observational study was conducted at an emergency operations centre during the 2012/2013 Australian bushfire season. During the two days of observation in the state of Victoria, the centre was at the highest activation level and operating 24 hours a day. The weather outlook over the observational period was for hot, mostly dry, freshening winds with ratings of severe fire danger potential on both days. There were two large fires already active in the state: the first was over 2,500 ha in size and the second over 65,000 ha. The public fire rating was considered very high for the entire state and total fire bans was in force for over seventy-five per cent of the state. These severe conditions warranted the attendance of stakeholders from multiple agencies at the emergency operations centre.

Stakeholders require situation awareness in emergency management multi-agency coordination so they can collectively mitigate the consequences of risk to the community. In the Australian context some bushfires are deemed too dangerous to risk fire-fighter's lives and are left to burn. The flow of information within an emergency operations centre and how stakeholders within this environment access this information is important. If an uncontrollable fire was to impact a critical infrastructure asset (such as electricity, water or telecommunications etc.) that may result in a loss of this utility to a community, then access to crucial information could help the agencies mitigate

against the risk of loss or damage to ensure the continuity of these services to the community. Similarly, for example, if an elderly residential care facility was in the path of an uncontrollable fire, ambulance, police and road traffic agencies would require vital information to plan for the safest and most expeditious evacuation of the facility. As the observational study was conducted in a state level emergency operations centre, the emphasis is on strategic emergency management arrangements and the information requirements of stakeholders to acquire information to inform their distributed situation awareness.

Table 9 Participants definition of situation awareness

Participant	*Definition of situational awareness*
1	"Current overview of significant fire events and from this information identifying the significant issues concerning my agency. Also ensure correct information is disseminated both ways from my agency's operations centre to the here and to other agencies as deemed appropriate."
2	"What is happening in the state right now and what issues are affecting Victoria and are there any major concerns that are upcoming that may affect my agency."
3	"Knowing where the fires are going and if it affects my agencies assets and disseminating this information to my agency."
4	"What the scope of operations is and where the issues are and how significant they are to my agency overall and if these will impact towns and the general public."
5	"Learning and understanding what is going on in the event that is relevant to my agency".
6	"It's a case of finding out what is happening and where it's happening and the impacts of any predictions that is out there".
7	"What is currently happening in the event and what is the projection for the event and how does it impact our agency".
8	"Current awareness of the incidents occurring across the state, the current plan and strategic outlook for the state".
9	"Understanding where the fires are and how they might impact our assets and letting the appropriate agencies know and disseminate information back here as to what assets may be affected and the potential consequences".
10	"Linked into what is happening in here and what information is pertinent to my agency and what is pertinent from my agency to this centre".

At the commencement of the observation period the participants were asked to define situation awareness and their situation awareness needs (see Table 9). This was important in order to understand the participants' perceptions and to use their own definition as a benchmark for the ratings they provided for the questions asked during the observations. It can be seen from the table that there is an overall consistency in the purposes for which situation awareness is needed. The definitions all include a need for information about what is happening now (e.g., "what is happening right now" #2) as well as a need to project these to better understand the implications for the future (e.g., "how this might impact on our assets" #9). These definitions represent perception as well as sense-making. Only one participant reported a definition that included sense-giving (e.g., "what is pertinent from my agency to this centre" #10).

Table 10 offers some illustrations of how the observation data were recorded from the participants own definition of situation awareness and the observer's field notes during the observation period.

Table 10 Example of observational data collection

Participant	*Time*	*Answers to situation awareness questions*		*Observational Descriptors*		
		Question 1	*Question 2*	*Received Information*	*Disseminated Information*	*Modality of Information*
2	1015	Absent	Absent	Not applicable	Not applicable	Not applicable
	1215	Excellent	Good	Speaking with intelligence & planning sections	Not at present	Verbal in person
	1415	Good	Good	Speaking with Fire Commissioner & Military regarding need for Federal assistance	Updating own agency	Verbal in person, data applications
	1615	Good	Good	Stated that briefing provided clear information	Not observed	Verbal in person
4	1045	Average	Average	Struggling with unfamiliarity with intranet email	Not observed	Data applications
	1245	Average	Average	Unsuccessful attempt to access mapping	Not observed	Data applications
	1445	Good	Good	Using intranet email, states briefing was informative	Liaising with media section	Data applications, verbal in person
	1645	Good	Good	Now successfully accessing mapping application	Using agency email to update own agency	Data applications
5	1100	Poor	Poor	Struggling with unfamiliarity with intranet email	Not observed	Data applications
	1230	Average	Average	Stated briefing was good	Not observed	Verbal in person
	1500	Average	Average	Liaising with stakeholders in other locations	Using agency email to provide update to own agency	Verbal in person, data applications
	1700	Good	Good	Received mapping advice and information from stakeholder in another location	Informing own agency of potential impacts to agency assets	Verbal in person and telephone, data applications

The observation data were analysed across the two days of observation for collective themes. Our analysis revealed a number of cognitive artefacts that facilitated information sharing and contributed to stakeholders informing their distributed situation awareness of the unfolding events. The most frequently observed cognitive artefacts employed for this included gleaning pertinent information from scheduled briefings, opportunistic informal conversations, access of the intranet email system, and specialised application software such as fire mapping programs. This is consistent with the survey data. The two most commonly used cognitive artefacts were people communication and use of information technology systems.

3.3.1 People communication

People communication involved one-to-many briefings as well as one-to-one and face-to-face conversations. During tier 3 activation, there will be, on average, four scheduled briefings per day. In addition there may also be unscheduled briefings at any time, however none of these were observed by the researcher. Briefings take place in the operations room. The daily morning briefing, for example, was approximately 30 minutes in duration. It involved a formal presentation of the day's outlook by the Centre's duty manager, resident meteorologist and fire behaviour analyst. Information presented was displayed on multiple visual display units throughout the room, complimenting the audio commentary. Throughout the day were a number of shorter briefings (e.g., 10 minutes) providing updates to all personnel in the Centre. All the participants in the observational study attended the briefings with many taking paper notes. The Centre's management team encouraged comments from all agencies present but during the observation period only one participant made a comment and requested information that was pertinent to their agency's needs. All participants reported that they valued the briefings for obtaining information of the event.

The most frequently observed form of sharing information relied on one-to-one and face-to-face communication. This was regardless of their location in the Centre. Informal one-to-one conversations to share information were observed on multiple occasions and by all participants over the two days. One example of this was from a participant located in the adjacent room who regularly networked with multiple personnel from various agencies in the entire complex sourcing information relevant to their agency's needs. However, it was also noted during the observations that the participants located in the operations room were privy to casual information that circulated around this room by word of mouth. One example of this involved someone informing the participants in the operations room by giving them a verbal heads up about a fire situation change. The researcher did not observe this person passing on the same information to the participants located in the adjacent room. When the researcher asked if any of the participants in the adjacent room were aware of this information, all specified they had not been informed. This may be a simple case of merely passing on information that would soon be uploaded and disseminated to all participants via the internal email system. However, those located in the main room had received an earlier warning.

In addition, the operations room is the main thoroughfare for personnel operating in the Centre. Therefore the participants located in this area are on view and easily accessible to other stakeholders as well as Centre management staff. Thus, for participants present in the operations room it was observed that a higher amount of opportunistic information was conveyed during the emergency event. This is confirmed by one of the participants located in this area who commented that it was beneficial to have other stakeholders in close proximity as information could freely be exchanged in an ad hoc and relaxed manner. Another participant located in this area stated that they often listened out for any extra information that might be useful for their agency. Indeed, the observation of participants 'overhearing' information and subsequently receiving this information was evident on multiple occasions by the researcher, involving all the participants in the operations room. During the emergency event it was observed that the clustering of stakeholders into smaller groups promoted the exchange of information between other stakeholders. The exchange of information between the participants located in the operations room and those in the adjacent room was less frequent. It seems likely that this physical separation of the participants

into two distinct areas could contribute to a reduced synergy between the groups of collective stakeholders located in the Centre. Nevertheless, it must be acknowledged that an increase in the exchange of information does not necessarily lead to effective multi-agency coordination. Not all information is relevant for all stakeholders. Stakeholders must therefore access information that is pertinent to their specific requirements which can then enhance their distributed situation awareness.

These findings indicate that stakeholders may have an overreliance on face-to-face communication, rather than using data applications, which was also consistent with the findings of the survey. This raises two problems. First, it may indicate that the time taken to share information is potentially prolonged. Second, it indicates that information may not be available to others who may also find it pertinent.

The above also highlight the reliance that stakeholders have on extracting information from the Centre to send it out to other stakeholder agencies. The way in which stakeholders might be able to push information into the Centre and to inform its own operations was also limited. It was observed by the researcher that the management team provided clear explanations to the participants that if they felt they had any agency information that may be potentially relevant to the event they could inform a member of the Centre's staff at any time. Once again this may result in prolonged information sharing times as well as a loss of intelligence that the Centre may gain from information available to its stakeholders.

Informal sharing of information between stakeholders was also observed. An example of this was when a participant in the adjacent room provided information to a member of the mapping section as requested. A further example involved a participant located in the operations room visiting another participant who was located in the adjacent room to pass on some information that they deemed may be advantageous for that participant's agency. Both these examples meant that the participants had to walk to another location in the Centre to share this information. Although this is labour-intensive it did provide confirmation of receipt of the information for the participants involved.

3.3.2 Information technologies

For operational emails the Centre utilises a single intranet email system used by all agencies working in the Centre. During an emergency event this email system also disseminates regular situation reports about the event to all agency representatives located in the Centre. The system is based upon a standard email format used by many data applications and is thus relatively straightforward to function. It was observed that this method provides invaluable information to the stakeholders that can be accessed and analysed accordingly. The observations revealed that once the information was analysed, the participant typically forwarded a brief synopsis of the information relevant to the agency's needs to their parent organization. This allowed stakeholders operating outside of the Centre to develop their own situation awareness of the event. All participants stated that this approach provided them with some element of the information required to inform their situation awareness of the event. For example, two of the participants found that the predictive mapping information attached in the emails contributed to their situation awareness. In particular this information allowed them to identify if any of their agency's assets were at risk so they could respond accordingly in an effort to mitigate any further risks to the community. Nevertheless, contributing to the participants' sense making activities involved a familiarity with the application software. Three participants had never performed the role in the centre prior to the event and thus had no experience operating the intranet email system (see Table 6). This contributed to a reduced understanding of the events as evidenced by the self-reported *poor* or *average* initial rating for the participants' situation awareness. Nevertheless, at the end of the observational period these three participants perceived that this had improved to a rating of *average* or *good*. This would suggest that familiarity with this particular application software contributed to an increased situation awareness of the event.

Again during the observations many of the participants commented they were not specifically required (or invited) to feed any information into the Centre's intranet email system. Therefore, how this application software may be used to share information from the agency representatives with each other or with Centre staff was not apparent to the researcher.

Despite the positive unified nature of a single internet-based email system and the ability to share information, the observations identified that there were challenges utilising application software. In order for stakeholders to acquire information to inform their distributed situation awareness of an event it is important that the application software used in the Centre is accessible. It was observed that a number of the participants located in the adjacent room had unsuccessful attempts at accessing particular application software. For example, none of the participants in the adjacent room could access the fire predictive mapping application software. All these participants felt that this application software would be important in identifying the fires proximity to their agencies assets and would thus improve their distributed situation awareness. During the observation period this was rectified by the Centre management team who provided temporary computer access on a visual display unit situated within the room. An impromptu overview of the software and its capabilities together with a rudimentary teaching session was given to all participants collectively if interested. Prior to this, participants in the adjacent room had to physically relocate to the operations room to view this information on one of the numerous visual display units.

4 Discussion

Our findings indicate how stakeholders involved in an emergency operations centre perceive their information requirements and how they acquire this information to inform their distributed situation awareness. However, this can be complex for these stakeholders working in a temporary supra-organization during an emergency event in a strategic-level state emergency operations centre. The most common problem-solving activities involved interpretation and sense-making about the implications of the event for stakeholder agencies and their assets. The second most common activities involved procuring and managing resources. Yet for these and all other problem solving activities, the most predominant artefact in use emphasised personal communication.

For problem-solving activities such as task execution and managing resources this seems both labour-intensive and possibly inefficient. Moreover, the full gamut of potentially available artefacts such as fire predictive mapping application software was not employed; with reliance mostly on the intranet service. These findings in the survey were triangulated in the observations and raised issues of how and why these artefacts were being used in a real emergency event

Verbal communication in person is not uncommon in emergency events. In the immediate aftermath of the 2001 United States World Trade Centre attacks, over forty per cent of communications between agencies was conducted in person (Kapucu, 2006a). The survey results indicated that only task execution in the problem solving activities in emergency management specified that verbal communication in person was the most important interface. However, findings from the observations revealed an increased reliance on verbal communication in person during the emergency event. This could be attributed to data applications not having the ability to reduce the operator's workload and stakeholder unfamiliarity with certain application software. However, findings from the observational study also identified that formal briefings were seen as important artefacts in acquiring information to inform stakeholder situation awareness. The observations identified that all participants attended every formal briefing with many stating the importance they associated with this artefact. Nevertheless, formal briefings were not the only method of personal communication that was identified in the observations. Informal conversations amongst personnel in the centre elicited information that may not be immediately available at formal briefings or on application software. The observations identified numerous occasions when information was either picked up or given to the participants casually in a passing comment.

The use of cognitive artefacts in facilitating stakeholder's ability to acquire information to inform their situation awareness in an emergency event is not only dependent on the type of artefact used but on the stakeholder's physical location in the emergency operations centre. There is a necessity to ensure that all stakeholders in an emergency operations centre have access to the full complement of cognitive artefacts crucial in providing information about the event (Militello et al., 2007). However, findings from the observations indicate that the participant's location within the Centre often contributed to their capacity to access data applications. Within the study setting participants not located in the operations room often had difficulties accessing data applications and missed out on information from informal conversations.

There are a number of challenges that can inhibit emergency management personnel to acquire information to inform their distributed situation awareness in the emergency operations centre. The use of application software was highlighted as the most important interface used in three of the problem solving activities and was deemed the most appropriate for modelling purposes such as fire predictive mapping application software. However, the stakeholder's lack of familiarity with the software is a perpetual challenge in emergency management. Subsequently, there is a requirement for disaster management information systems to be incorporated into simulation training to increase familiarity with the system (Turoff, Chumer, Hiltz, et al., 2004; Turoff, Chumer, Van de Walle, et al., 2004). The observational study identified challenges with the unfamiliarity of data applications. This was apparent in the first few hours of observations when stakeholders unfamiliar with the intranet email software cited this as a reason for their poor or average situation awareness. According to our findings, stakeholders had difficulty accessing some of the application software required in the acquisition of information. Other than the intranet email systems, selected data applications were not available to stakeholders using non-emergency operations centre information technology structures. A further challenge regarding the use of data applications is a lack of financial resources and deficiency in collaboration between agencies, particularly regarding privacy and security barriers. These have been identified as obstacles to the adoption of a collaborative approach to data applications in emergency management (Kruchten et al., 2008; Ley et al., 2012; Reddick, 2011). Finally, data applications need the capability to reduce the operator's workload. Any artefact providing information needs to be sufficiently flexible and able to ensure that relevant information reaches the appropriate agencies in a valid format and in a timely manner to facilitate effective action (Comfort et al., 2004). Findings from the observations indicated that because the Centre intranet email system had limited capability to input information from stakeholders, the participants used verbal communication in person to fulfil this task.

5 Conclusion

Acquiring adequate information in an emergency management event is challenging for those involved due to the uncertain and dynamic characteristics of emergencies. The formation of a temporary supra-organization in emergency management to address meta-problems is faced with multiple complications. The findings indicate how stakeholders perceive their need of information using cognitive artefacts and how this is actually achieved. The data reveals a reliance on verbal face to face communications in these circumstances. This has inherent risks and limitations for stakeholders obtaining information to inform their distributed situation awareness. There is a need to understand why certain cognitive artefacts are not exploited. The problem solving activities identified as task execution and sense-making emphasise a dependence on verbal face to face communications. Supporting these activities with specialised cognitive artefacts such as designated disaster management information systems may be beneficial. These cognitive artefacts are designed to specifically increase the efficient and timely exchange of information (Comfort et al., 2004). This would allow more time to be devoted to other problem solving activities such as strategic planning. A further challenge with relying on verbal face to face communications is that information flow is predominantly one way and taken from the Centre and not fed into the Centre from the stakeholders. The data suggest there is an assumption that the purpose of the Centre is to disseminate information outwards towards the organizational boundary. However, the core Centre

management team, which consists of units such as planning and intelligence, are reliant on information that is systematically fed from the organizational boundary into the Centre. Cognitive artefacts that solely rely on users to store the information, such as verbal face to face communications, face the risk of information remaining with that particular user and not available on a shared systems platform. This can result in delayed information and a potential deterioration of distributed situation awareness. We recommend that further research is necessary to understand why some cognitive artefacts such as data applications are not utilised more frequently in emergency operation centres. Exploring how such artefacts may be better aligned with user needs to obtain information for stakeholders involved with emergency management multi-agency coordination are also required. These issues are important to the future of emergency management with disasters often requiring the involvement and coordination of multiple agency stakeholders in temporary supra-organizations.

References

Aedo, I. et al. (2010) 'End-user oriented strategies to facilitate multi-organizational adoption of emergency management information systems', *Information Processing & Management*, Vol. 46, No. 1, pp.11–21.

Baber, C. et al. (2007) 'Supporting implicit coordination between teams in disaster management', in J. Loffler and M. Klann (Eds.) *Mobile Response*, pp.39–50, Springer-Verlag, Berlin Heidelberg.

Baruch, Y. and Holtom, B.C. (2008) 'Survey response rate levels and trends in organizational research', *Human Relations*, Vol. 61, No. 8, pp.1139–1160.

Berlin, J. and Carlström, E. (2008) 'The 90 second collaboration: a critical study of collaboration exercises at extensive accident sites', Journal of Contingencies and Crisis Management, Vol. 16, No. 4, pp.177–185.

Bernard, E.N. et al. (1988) 'On mitigating rapid onset natural disasters: project THRUST (Tsunami Hazards Reduction Utilizing Systems Technology)', *Eos, Transactions American Geophysical Union*, Vol. 69, No. 24, pp.649, 651, 659–661.

Bharosa, N., Janssen, M. and Tan, Y.H. (2011) 'A research agenda for information quality assurance in public safety networks: information orchestration as the middle ground between hierarchical and netcentric approaches', *Cognition, Technology & Work*, Vol. 13, No. 3, pp.203–216.

Boy, G. (2011) *The Handbook of Human-Machine Interaction: A Human-Centered Design Approach*, Ashgate Publishing Ltd., Farnham, Surrey.

Burke, C. et al. (2006) Understanding team adaption: a conceptual analysis and model. Journal of Applied Psychology, Vol. 91, No. 6, pp.1189–1207.

Caldwell, K. and Atwal, A. (2005) Non-participant observation: using video tapes to collect data in nursing research', *Nurse Researcher*, Vol. 13, No. 2, pp.42–54.

Carlson, M.D. and Morrison, R.S. (2009) 'Study design, precision, and validity in observational studies', *Journal of Palliative Medicine*, Vol. 12, No. 1, pp.77–82.

Coates, G. et al. (2011) 'Adaptive co-ordinated emergency response to rapidly evolving large-scale unprecedented events (REScUE)', in *8th International ISCRAM Conference*, pp.1–5.

Comfort, L. and Kapucu, N. (2006) 'Inter-organizational coordination in extreme events: the World Trade Center attacks, September 11, 2001', *Natural Hazards*, Vol. 39, No. 2, pp.309–327.

Comfort, L. et al. (2004) 'Coordination in complex systems: increasing efficiency in disaster mitigation and response', *International Journal of Emergency Management*, Vol. 2, Nos. 1–2, pp.62–80.

Cruz, M.G. et al. (2012) 'Anatomy of a catastrophic wildfire: the Black Saturday Kilmore East fire in Victoria, Australia', *Forest Ecology and Management*, Vol. 284, pp.269–285.

Endsley, M.R. (1995) 'Toward a theory of situation awareness in dynamic systems', *Human Factors*, Vol. 37, No. 1, pp.32–64.

Fleiss, J., Levin, B. and Paik, M. (2003) *Statistical Methods for Rates and Proportions*, 3rd ed., John Wiley and Sons, Hoboken, NJ, USA.

Flin, R. and Arbuthnot, K. (2002) *Incident Command: Tales from the Hot Seat*, Ashgate Publishing Ltd., Aldershot.

Gold, R.L. (1958) 'Roles in sociological field observations', *Social Forces*, Vol. 36, No. 3, pp.217–223.

Harrald, J.R. (2006) 'Agility and discipline: critical success factors for disaster response', *The ANNALS of the American Academy of Political and Social Science*, Vol. 604, No. 1, pp.256–272.

Helsloot, I. (2008) 'Coordination is a prerequisite for good collaboration, isn't it?', *Journal of Contingencies and Crisis Management*, Vol. 16, No. 4, pp.173–176.

Hoc, J.M. (1996) *Supervision et Controle de Processus: La Cognition en Situation Dynamique*, Presse Universitaire de Grenoble, Grenoble.

Hollnagel, E. (2001) 'Extended cognition and the future of ergonomics', *Theoretical Issues in Ergonomics Science*, Vol. 2, No. 3, pp.309–315.

International Organization for Standardization (2011) *Societal Security – Emergency Management – Requirements for Incident Response*, ISO 22320:2011.

Janssen, M. et al. (2010) 'Advances in multi-agency disaster management: key elements in disaster research', *Information Systems Frontiers*, Vol. 12, No. 1, pp.1–7.

Jenkins, D.P., Salmon, P.M., Stanton, N.a, and Walker, G.H. (2010) 'A new approach for designing cognitive artefacts to support disaster management', *Ergonomics*, Vol. 53, No. 5, pp.617–35.

Johnson, D. et al. (2011) 'Improved situational awareness in emergency management through automated data analysis and modeling', *Journal of Homeland Security and Emergency Management*, Vol. 8, No. 1, Article 40.

Kapucu, N. (2006) 'Interagency communication networks during emergencies: boundary spanners in multiagency coordination', *The American Review of Public Administration*, Vol. 36, No. 2, pp.207–225.

Kapucu, N. and Van Wart, M. (2006) 'The evolving role of the public sector in managing catastrophic disasters: lessons learned', *Administration & Society*, Vol. 38, No. 3, pp.279–308.

Kawulich, B. (2005) 'Participant observation as a data collection method', *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, Vol. 6, No. 2, Article 43.

Kirwan, B. and Ainsworth, L. (1992) *A Guide to Task Analysis*, Taylor and Francis, London.

Klein, G. et al. (1993) *Decision Making in Action: Models and Methods*, Ablex Publishing Co., Norwood, NJ.

Kruchten, P. et al. (2008) 'A conceptual model of disasters encompassing multiple stakeholder domains', *International Journal of Emergency Management*, Vol. 5, Nos. 1/2, pp.25–56.

Landis, J. and Koch, G. (1977) 'The measurement of observer agreement for categorical data', *Biometrics*, Vol. 33, No. 1, pp.159–174.

Laxmisan, A. et al. (2006) 'The multitasking clinician: decision-making and cognitive demand during and after team handoffs in emergency care', *International Journal of Medical Informatics*, Vol. 76, Nos. 11–12, pp.801–11.

Ley, B. et al. (2012) 'Supporting improvisation work in inter-organizational crisis management', in *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems – CHI '12*, ACM Press, New York, New York, USA, pp.1529–1538.

Lutz, L.D. and Lindell, M.K. (2008) 'Incident command system as a response model within emergency operation centers during hurricane Rita', *Journal of Contingencies and Crisis Management*, Vol. 16, No. 3, pp.122–134.

Manoj, B.S. and Baker, A.H. (2007) 'Communication challenges in emergency response', *Communications of the ACM*, Vol. 50, No. 3, p.51.

McEntire, D.A. (2002) 'Coordinating multi-organizational responses to disaster: lessons from the March 28, 2000, Fort Worth Tornado', *Disaster Prevention and Management*, Vol. 11, No. 5, pp.369–379.

McMaster, R., Baber, Chris and Duffy, T. (2012) 'The role of artefacts in Police emergency response sense making', in *Peoceedings of the 9th International ISCRAM Conference*, Vancouver, Canada, April, pp.1–10.

Militello, L.G. et al. (2007) 'Information flow during crisis management: challenges to coordination in the emergency operations center', *Cognition, Technology & Work*, Vol. 9, No. 1, pp.25–31.

Millot, P., Debernard, S. and Vanderhaegan, F. (2011) 'Authority and cooperation between humans and machines', in GA Boy (Ed.) *The Handbook of Human-machine Interaction: A Human-Centred Approach*, pp.207–234, Ashgate Publishing Ltd., Farnham, Surrey.

Mishra, J.L., Allen, D.K. and Pearman, A.D. (2011) 'Information sharing during multi-agency major incidents', *Proceedings of the American Society for Information Science and Technology*, Vol. 48, No. 1, pp.1–10.

Moynihan, D.P. (2007) *From Forest Fires to Hurricane Katrina: Case Studies of Incident Command Systems*, Washington DC.

Norman, D.A. (1991) 'Cognitive artifacts', in J. Carroll (Ed.) *Designing Interaction: Psychology at The Human-computer Interface*, pp.17–38, Cambridge University Press, New York.

O'Reilly, C. (1980) 'Individuals and information overload in organizations: is more necessarily better?', *Academy of Management Journal*, Vol. 23, No. 4, pp.684–696.

Omelicheva, M.Y. (2011) 'Natural disasters: triggers of political instability?', *International Interactions: Empirical and Theoretical Research in International Relations*, Vol. 37, No. 4, pp.441–465.

Owen, C. et al. (2013) 'Developing a theoretical model of complex multi-team coordination in emergency management', *International Journal of Emergency Management*, Vol. 9, No. 1, pp.1–17.

Pasquero, J. (1991) 'Supraorganizational collaboration: the Canadian environmental experiment', *Journal of Applied Behavioral Scienceral Science*, Vol. 27, No. 1, pp.38–64.

Paton, D. and Flin, R. (1999) 'Disaster stress: an emergency management perspective', *Disaster Prevention and Management*, Vol. 8, No. 4, pp.261–267.

Raj, A.K., Doyle, M.J. and Cameron, J.D. (2011) 'Psychphysiology and performance: considerations for human-centered design', in *The Handbook of Human-Machine Interaction: A Human-Centred Approach*, pp.53–74, Ashgate, Farnham.

Reddick, C. (2011) 'Information technology and emergency management: preparedness and planning in US states', *Disasters*, Vol. 35, No. 1, pp.45–61.

Reid, J. (2006) *Addressing Lessons from the Emergency Response to the 7 July 2005 London Bombings: What We Learned and What We are Doing About It*, London.

Russo, J. (1974) 'More information is better: a reevaluation of Jacoby, Speller and Kohn', *Journal of Consumer Research*, Vol. 1, No. 3, pp.68–72.

Salas, E. and Klein, G. (Eds.) (2001) *Linking Expertise and Naturalistic Decision Making*, Lawrence Erlbaum Associates, Mahwah, New Jersey.

Salas, E. et al. (2007) 'Markers for enhancing team cognition in complex environments: the power of team performance', *Aviation, Space and Environmental Medicine*, Vol. 78, No. 5, pp.77–85.

Salmon, P. et al. (2011) 'Coordination during multi-agency emergency response: issues and solutions', *Disaster Prevention and Management*, Vol. 20, No. 2, pp.140–158.

Saoud, N.B. et al. (2006) 'Assessing large scale emergency rescue plans: an agent based approach', *International Journal of Intelligent Control Systems*, Vol. 11, No. 4, pp.260–271.

Sarter, N. and Woods, D. (1991) 'Situation awareness: a critical but ill-defined phenomenon', *International Journal of Aviation Psychology*, Vol. 1, No. 1, pp.45–57.

Scholtens, A. (2008) 'Controlled collaboration in disaster and crisis management in the Netherlands, history and practice of an overestimated and underestimated concept', *Journal of Contingencies and Crisis Management*, Vol. 16, No. 4, pp.195–207.

Schraagen, J.M. and Van de Ven, J. (2008) 'Improving decision making in crisis response through critical thinking support', *Human Factors*, Vol. 2, No. 4, pp.311–327.

Schraagen, J.M., Huis, M. and De Koning, L. (2010) 'Information sharing during crisis management in hierarchical vs. network teams', *Journal of Contingencies and Crisis Management*, Vol. 18, No. 2, pp.117–127.

Smith, K. and Hancock, P. (1995) 'Situation awareness is adaptive, externally directed consciousness', *Human Factors*, Vol. 37, No. 1, pp.137–148.

Sommer, M. and Njå, O. (2012) 'Dominant learning processes in emergency response organizations: a case study of a joint rescue coordination centre', *Journal of Contingencies and Crisis Management*, Vol. 20, No. 4, pp.219–230.

Stanton, N. et al. (2009) *Digitalising Command and Control: A Human Factors and Ergonomics Analysis of Mission Planning and Battlespace Management*, Ashgate Publishing Ltd., Farnham, Surrey.

Teague, B., McLeod, R. and Pascoe, S. (2010) *2009 Victorian Bushfires Royal Commission Final Report*, Melbourne.

Todd, P. and Gigerenzer, G. (2001) 'Putting naturalistic decision making into the adaptive toolbox', *Journal of Behavioral Decision Making*, Vol. 14, No. 5, pp.381–383.

Tsang, P. and Wilson, G. (1997) 'Mental workload', in Salvendy, G. (Ed.): *Handbook of Human Factors and Ergonomics*, pp.417–449, Plenum, New York.

Turoff, M., Chumer, M., Hiltz, R. et al. (2004a) 'Assuring homeland security: continuous monitoring, control & assurance of emergency preparedness', *Journal of Information*, Vol. 6, No. 3, pp.1–24.

Turoff, M., Chumer, M., Van de Walle, B. et al. (2004b) 'The design of a dynamic emergency response management information system', *Journal of Information Technology Theory and Application*, Vol. 5, No. 4, pp.1–36.

Van de Walle, B. and Turoff, M. (2008) 'Decision support for emergency situations', *Information Systems and e-Business Management*, Vol. 6, No. 3, pp.295–316.

Van Scotter, J., Pawlowski, S. and Cu, T. (2012) 'An examination of interdependencies among major barriers to coordination in disaster response', *International Journal of Emergency Management*, Vol. 8, No. 4, pp.281–307.

Vicente, K. (1999) *Cognitive Work Analysis: Toward Safe, Productive, and Healthy Computer-based Work*, Lawrence Erlbaum Associates, Mahwah, New Jersey.

Wears, R.L. et al. (2006) 'Emergency department status boards: user-evolved artefacts for inter and intra-group coordination', *Cognition, Technology & Work*, Vol. 9, No. 3, pp.163–170.

Wilson, S., Galliers, S. and Fone, J. (2007) 'Cognitive artifacts in support of medical shift handover: an in use, in situ evaluation', *International Journal of Human-Computer Interaction*, Vol. 22, Nos. 1–2, pp.59–80.

Wise, C.R. (2006) 'Organizing for homeland security after Katrina: is adaptive management what's missing?', *Public Administration Review*, Vol. 66, No. 3, pp.302–318.

156 Xiao, Y. (2005) 'Artifacts and collaborative work in healthcare: methodological, theoretical, and technological implications of the tangible', *Journal of Biomedical Informatics*, Vol. 38, No. 1, pp.26–33.

Zsambok, C. and Klein, G. (1997) *Naturalistic Decision Making*, Lawrence Erlbaum Associates, Mahwah, NJ.

Appendix

Organizational survey questions

Demographics

1 Please tell us about yourself

- Name:
- Organization:
- Position:
- Location:
- State:
- E-mail:

Your role

2 What sector or group do you most represent?
3 What is the type of incident or emergency is your main responsibility?
4 What is your most senior role during an incident?
5 What incident management team section do you work in? (Pick your most senior role here)

- Controller
- Operations
- Public information
- Planning
- Logistics
- Other

6 For how many years have you been in this role?

Information for decisions

7 What are the most important decisions/actions you make in your role as [Q4]
8 What is the key information you use for making these decisions?

Obtaining information in emergency management 157
9 Where do you get this key information from?

(Here we are asking you what information you need to enable you to make the decisions you make and where you get it from. Please select the top three answers to each question)

Information formats

10 In what form, and how important, is the key information you currently use in your [Q3] activities? PART I

- Verbal in person
- Verbal telephone
- Verbal agency radio
- Verbal broadcast radio
- Text SMS/pager
- Text PDF/DOC

11 In what form, and how important, is the key information you currently use in your [Q3] activities? PART II

- Data PC application
- Data agency (intranet) website
- Data website/social media
- Map printed
- Map book
- Map agency application/intranet
- Map public website

12 In what form, and how important, is the key information you currently use in your [Q3] activities? PART III

- Photos MMS (via phone)
- Photos camera (PC)
- Photos online
- Video Camera
- Video Live streaming (e.g. CCTV or Web)
- Video TV

(For the above three questions please rate as: not important; slightly important; somewhat important; very important; and extremely important)

Information sharing

13 What is the most important information do you share with others during an incident?

(Here we are asking how much you share data with others and the issues associated with sharing. Please list the top three answers)

14 How do you currently share data and information with others during an incident and how important is it?

- Voice in person
- Voice telephone
- Voice teleconference
- Voice agency
- Voice broadcast radio
- Video broadcast TV
- Video conference

(For the above question please rate as: not important; slightly important; somewhat important; very important; and extremely important)

Appendix D: Paper IV

Title

Role clarity, swift trust and multi-agency coordination

Abstract

The purpose of this paper is to further the understanding of swift trust in temporary organizations by examining the role swift trust plays in emergency management coordination and how role clarity acts as an enabler within temporary organisational configurations A qualitative interview study was conducted with 32 liaison officers working in 3 strategic level emergency operations centres in Australia. Role clarity was identified as an important factor in the successful formation of emergency management temporary organizations by emergency services and critical infrastructure liaison officers working in multi-agency arrangements. By providing role clarity, liaison officers may enable collaborative working practices between organizations involved in emergency management and thus facilitate multi-agency coordination. The function of role clarity in the context of swift trust is largely overlooked in emergency management. Therefore this study has contributed to the knowledge of swift trust by empirically verifying the impact of role clarity by liaison officers working in the research setting.

Keywords - Swift trust, Emergency management, Liaison officer, Emergency operations centre, Role clarity

1. Introduction

Disasters of any magnitude will require government to mount a response that will invariably require an emergency management multi-agency approach involving not only the traditional emergency services but also non-emergency organizations including critical infrastructure agencies, the military and non-for profit organizations (Scholtens, 2008; Schraagen & Van de Ven, 2008; Van Scotter, Pawlowski, & Cu, 2012). Stakeholders representing their organization are often called liaison officers (Wolbers & Boersma, 2013). In the absence of prior inter-agency development, liaison officers involved with emergency management multi-agency arrangements can encounter increased conflict and confusion (Paton & Auld, 2006; Paton, Johnston, Houghton, & Smith, 1998; Paton & Owen, 2013). This can be particularly challenging for organizations that are not emergency services, such as critical infrastructure organizations, which may not regularly work in an emergency management environment and are often culturally different from their emergency services counterparts. Trust is often vital in securing sustainable relationships among these disparate organizations and is especially evident in ambiguous situations characterized by uncertainty as experienced in emergency management. However, developing and maintaining trust between culturally dissimilar organizations is a formidable challenge.

Liaison officers from different organizations can bring conflicting cultural beliefs, behaviours and assumptions which can prevent successful interaction and collaboration (Dietz, Gillespie, & Chao, 2010). The emergency services often have similar command structures and work together in routine operations as well as collaborating in crises. Consequently, the familiarity that is gained over time between emergency services, that can include the crucial factor of understanding other agencies roles, can foster a sense of trust among these different personnel (Dirks & Ferrin, 2001). In contrast, liaison officers from non-emergency services such as those from critical infrastructure organizations may not have the luxury of building relationships over time and thus do not have the opportunity to learn and understand each other's roles. Consequently, this could lead to these liaison officers facing challenges associated with gaining trust in emergency management arrangements. The importance of considering trust derives from its function in determining understanding and performance in circumstances characterised by high uncertainty in which people become highly reliant on others for information and for decision making (Siegrist & Cvetkovich, 2000). This makes it an important construct when developing multi-agency relationships and makes its consideration crucial when opportunities to develop it prior to events. Without trust, teams focus on task demands, not teamwork, reducing their effectiveness to meet the emerging needs during a disaster (Pollock, Paton, Smith, & Violanti, 2003). Due to the dynamic and temporal nature of emergency management, liaison officers not from the emergency services may need to adopt alternative ways of developing trust.

A different method that may be suited to emergency management is the concept of swift trust. Swift trust has less emphasis on the traditional form of trust building that often develops and strengthens over time which is based primarily on personalities and interpersonal relationships (Kramer, 1999). In contrast, swift trust is characterised by actions that are not necessarily constrained by time and are driven by the generic features of the setting rather than personalities. In these settings trust in temporary teams is enhanced by role clarity and by people dealing with each other more as roles than as individuals (Meyerson, Weick, & Kramer, 1996). Consequently when there is no time to engage in the usual forms of confidence-building activities that contribute to the development and maintenance of trust, providing clarity of the individuals specific role as identified in swift trust, may be an alternative form of trust building suited to temporary organizations (Meyerson et al., 1996) such as those typically found in emergency management multi-agency coordination.

Therefore, the aim of this article is to further the understanding of swift trust in emergency management temporary organizations by exploring if role clarity acts as a means to improving multi-agency coordination.

2. Swift trust

A significant amount of research has been conducted by a diverse range of disciplines exploring the definition of trust (see for example Dirks & Ferrin, 2001; Lewicki & Bunker, 1995; Pollock et al., 2003; Siegrist & Cvetkovich, 2000; Sitkin & Roth, 1993). In organizational science trust has been described as an expectancy held by an individual that the advice offered by another individual or organization can be relied upon (Rotter, 1980). Other definitions describe trust as a set of expectations shared by all individuals involved in an exchange (Zucker, 1986) or as an agent-principal relationship (Shapiro,

1987). However, there appears to be a consensus that trust is highly beneficial to the functioning of organizations (Dirks & Ferrin, 2001). This understanding of trust in organizations is often regarded as something that develops and strengthens over time (Kramer, 1999; Mayer, Davis, & Schhorman, 1995). However this may not always be possible in temporary groups that comprise of a set of diversely skilled people who are expected to work collaboratively on a complex task often under time constraints (Goodman & Goodman, 1976).

In emergency management events, liaison officers from multiple organizations who do not often work together are expected to operate synergistically. Nevertheless, due to the often cultural differences between these organizations, the configuration of temporary supra-organizations in time critical environments such as emergency operations centres is challenging. Research conducted by Goodman and Goodman (1976) identified that some temporary groups that do not have a history of trust development display behaviours that presuppose trust. This was an important finding as trust has been identified to influence an organizations intention to collaborate (Mohr & Spekman, 1994). The fast action requirements of many temporary collaborative working organizations (Faraj & Xiao, 2006) means there is often little time to develop trust in the traditional ways (Hyllengren et al., 2011). This led to a new form of trust described by Meyerson, Weick and Kramer (1996), as swift trust. This concept may be more suited to temporary organizations such as those that operate in emergency management.

Swift trust has been defined as a practice that involves the collective perception and ability to relate matters that are capable of addressing topics pertaining to vulnerability, uncertainty, risk and expectations in short-lived temporary organizations (Meyerson et al., 1996). Embedded in swift trust are systems and temporary organizational configurations that are evident in emergency management multi-agency coordination. The requirements for swift trust to occur in temporary organizations necessitate that the individual involved apply specific roles. In their pivotal research describing the concept of swift trust, Meyerson et al (1996) posited that what was important in temporary organizations is the requirement to 'get things done' influenced by the ability to develop shared understanding of (evolving) situations and the respective roles of the different stakeholders involved. This highlights the avoidance of personal disclosure strategies that are evident in traditional forms of trust building over a prolonged period of time, in favour of a reliance and absorption in the task driven by the generic features of the setting (Meyerson et al., 1996). Therefore, we are including the concept of trust in this context and particularly the dimension of providing role clarity, as it has been found to be a valuable idea in temporary organizations such as the short term supra-organizations found in strategic level emergency management arrangements.

Research regarding swift trust is limited in the emergency management literature. However, the concept of swift trust has been applied extensively to the working practices of global virtual teams that epitomize the temporary organizations and requirements for adopting this concept (see for examples, Coppola, Hiltz, & Rotter, 2004; Crisp & Jarvenpaa, 2013; Robert, Denis, & Hung, 2009; White, Plotnick, Addams-Moring, Turoff, & Hiltz, 2008). But for this study we drew upon literature that acknowledges the importance of swift trust in a military context. Military combat units and emergency response teams are often formed of complete strangers from different branches and organizations that must perform immediately, frequently in life or death situations (Wildman, Fiore, Burke, & Salas, 2011). Therefore due to the similarities between the

military and emergency management, we explored emergent literature in this domain to further explore the dimension of role clarity in swift trust.

In the military, professional competency is built upon role clarity (Paparone, 2002). In a review of the literature exploring the development of interpersonal trust, Adams and Webb (2002), explored its application within small military teams. They posited that in a military context, competence and in particular expert knowledge of the soldiers role, were important factors influencing person-based trust (Adams & Webb, 2002). In addition, providing clarity of a soldier's role capability could promote trust in small military teams. The importance of role clarity is further explored in the following research projects conducted with soldiers involved in temporary military groups.

Hyllengren et al (2011) conducted a questionnaire with 591 Norwegian and Swedish military leaders that were at differing stages of their careers that sought to illuminate factors that benefited or inhibited the development of swift trust in the leaders of temporary military groups. In a model of factors contributing to swift trust, individual-related characteristics based on experience and competency, highlighted that specialist knowledge was a contributing factor to developing swift trust. It appears that clarification of the persons specialist knowledge and therefore subsequent role in the team resulted in an acceptance of that persons competency and ultimately the formation of trust building (Hyllengren et al., 2011). Lester and Vogelgesang (2012) also examined the concept of swift trust in military leaders. Among the factors identified in initiating swift trust was the officers expertise and knowledge in their role (Lester & Vogelgesang, 2012). The importance of understanding other people's knowledge and capabilities in small military teams was also identified by Ben-Shalom, Lehrer and Ben-Ari (2005). A qualitative anthropological study that was conducted in the Israeli Defence Force during the Al-Aqsa-Intifada between 2000 and 2001, sought to study the importance of swift trust in temporary military groups. Data from interviews conducted with 130 combat soldiers revealed that troops often interacted with "roles" rather than personalities. Consequently, during the first meeting role clarity was crucial in terms of developing swift trust as the soldiers had to trust that the other soldiers they worked with had a clear understanding how to perform their own job (Ben-Shalom, Lehrer, & Ben-Ari, 2005).

The importance of role clarity is also identified in research investigating the challenges of forming trusting relationships in multinational military forces. In a theoretical analysis of previous findings investigating United Nations peace keeping operations, Elron, Shamir and Ben-Ari (1999), identified the value of swift trust including the importance of role clarity. The authors found that soldiers of multinational forces have repeatedly had to learn to work together "on the job" as there was often little time for the development of integrated force culture. Therefore contributing to swift trust in this setting was the shared professionalism of the soldiers that involved a clear understanding between parties of their particular tasks and roles (Elron, Shamir, & Ben-Ari, 1999). Similarly, using survey data collected from a European Union military mission in Bosnia-Herzegovia, Maniscalco, Aubry and Rosato (2008) revealed some of the contributing factors associated with the dynamics of cooperation in multicultural and multinational forces. A survey conducted with 551 soldiers based in Mostar representing the countries of Spain, France, Italy and Germany, revealed that in large scale multinational work units, role clarity was one of the fundamental elements for the success of complex military organizations (Maniscalco, Aubry, & Rosato, 2008). The literature investigating the concept of swift trust in the military is still in its infancy (Hyllengren et

al., 2011), nevertheless, preliminary research conducted in this environment has clearly indicated the importance of role clarity.

3. Methodology

The participants in this study were part of a larger interview schedule that was aligned to a project investigating how liaison officers in emergency management use boundary spanning activities in temporary supra-organizations to facilitate multi-agency coordination. The findings from the aforementioned research project are published in four papers (names deleted to maintain the integrity of the review process). The interview data used in this article was collected from thirty-two participants that were from two groups, the emergency services and critical infrastructure organizations. All participants work within multi-agency arrangements in one of three strategic level emergency operations centres in the Australian states of New South Wales, Victoria or Tasmania. Ethics approval was received from the Tasmanian Social Sciences Human Research Ethics Committee in Australia (Ethics Ref No: H0008810) and followed the protocols for provision of information and consent.

The interviews were all audio recorded and transcribed verbatim by a professional transcriber prior to data analysis. The interviews lasted approximately 30 to 45 minutes generating transcripts of between 3,500 and 11,000 words. The interview transcripts were returned to the participants for checking and to ensure accuracy with any alterations made by the participants changed in the transcript prior to data analysis. Underpinning the analysis of the data for the entire research project was an inductive approach (Charmaz, 2006; Glaser & Strauss, 1967). This phase was completed with the aid of the data analysis software QSR-NVivo 10. The data for the entire research project yielded a total of six major themes: (1) *attitude towards others*; (2) *challenges*; (3) *contributes to success*; (4) *attributes*; (5) *purpose*; and (6) *roles*. For the purpose of this study the data was re-examined in relation to the issue of interest which were the participant's reference to the topic of role clarity. This ensuing data was linked to two of the major themes, *challenges* and *contributes to success*. Two sub themes for this study were subsequently generated. Firstly, how role clarity was associated with the challenges of facilitating multi-agency coordination. Secondly, how role clarity could be used as a mechanism to facilitate successful multi-agency coordination. To ensure validity and reliability a predefined coding framework was developed by the initial researcher. Two of the co-authors reapplied the coding framework to the data and using Cohen's Kappa coefficient statistical measurement achieved an aggregate inter-rater reliability of 72.5% indicating a substantial level of agreement (Fleiss, Levin, & Paik, 2003).

Table I. Participant demographics

Group	Specific agency (number of participants)
Critical infrastructure (16 pax)	Energy (5) Water (3) Transport (5) Communications (2) Health (1)
Emergency services (16 pax)	Police (2) Fire (7) Ambulance (2) State Emergency Service[2] (5)

4. Findings

Interestingly, the two sub themes pertaining to role clarity that emerged from the data could be sub-divided into two groups. Firstly, in their experiences the critical infrastructure liaison officers all associated role clarity in a negative context and as a barrier or challenge to facilitating multi-agency coordination. The second group consisted of liaison officers from the emergency services who deemed that role clarity was imperative to the success of multi-agency coordination efforts.

Role ambiguity

Data from the interviews indicated that critical infrastructure liaison officers perceived that personnel from the emergency services did not fully understand their role within the emergency operations centre. This role ambiguity was perceived as a challenge to fostering trusting relationships and ultimately facilitating multi-agency coordination. This is echoed by the following participants:

> 'So we're right alongside the emergency services right from the very start. We have a really good understanding of what they do. However, they don't necessarily have a good understanding of our role.' Health liaison officer

> 'Quite often some of the emergency services don't really understand our business or role. For example, we can't just open a road after clearing debris following a landslide, we also have to make sure it's structurally safe, sometimes they don't understand that'. Transport liaison officer 1

> 'I suppose it's an issue across people who work in emergency operations centres that they need to have a common understanding of roles and responsibilities (of other organizations), so they can contribute to the emergency outcomes and also the decision making process.' Transport liaison officer 3

> 'One of my experiences was that clarity of who we were, why we were there, and what we were there for (our role). This wasn't clear to everybody so I must have

[2] The State Emergency Service (SES) is a predominantly volunteer organization responsible for responding to flood and storm hazardous events.

> re-explained myself to fifty different people during the event.' Energy liaison officer1
>
> 'Three times I had our liaison officer say to their (emergency services) controller, "*just sit down, where are you going, how can we help you, we don't want anything from you, we want to help you*". It was a big difference in culture, they're obviously of the opinion that everyone always comes in and they always want something from them. So I guess the point is that different organizations have different maturities of understanding what our role is.' Communications liaison officer 2
>
> "I think it works both ways, we are aware of the information they (the emergency services) want but we need to ensure that the emergency services understand the seriousness (of our information) and ultimately our role because we might see a situation that we think threatens the community." Water liaison officer 2

Data from the critical infrastructure participants revealed a deficit of interagency knowledge by the emergency services. This lack of understanding by the emergency services of the critical infrastructure liaison officer's role in the research setting often led to a lack of recognition. Given the complexity of the emergency services, personnel within these organizations often rely on a pre-existing knowledge base and the requirements of the other emergency services workers, a concept referred to as interpositional knowledge (Ford & Schmidt, 2000). However, critical infrastructure liaison officers might not frequently interact with the emergency services and therefore may not have the opportunity to profit from interpositional knowledge. The participants from critical infrastructure organizations identified that a deficit in role clarification by emergency services personnel was a constraint when working in emergency management arrangements.

Role clarity as an enabler

Corroborating the importance of role clarity in the research setting was data from the emergency services liaison officers. The following examples from the raw data indicated that the emergency services personnel believed that liaison officer's required clarity of their own role and also the roles of liaison officers from other agencies. This was considered as an important contributing factor to the success of multi-agency coordination when working in a strategic level emergency operations centre. This is described by the following emergency services participants:

> 'So to ensure that you get the job done you actually need people (liaison officers) to know the facility, understand what the other organizations have to offer and they have to know their roles.' Police liaison officer 1
>
> 'At the moment what can happen, and we've had it in the past with energy personnel, liaison officers sit at the computer and they didn't really know their roles.' Fire services liaison officer 2
>
> 'It is a work in progress to understand how each of the organizations work…they (other organizations) need to understand what they do and then form those relationships which make it easier to actually manage an emergency to a successful conclusion.' Fire services liaison officer 4

> ‘So they (the liaison officers) really need an in-depth knowledge of the types of roles that they can play, what they can do, what they can’t do, the equipment that they’ve got, and all those sorts of things’. State Emergency Services liaison officer 2

The importance of role clarification is evident in the data and expressed by participants from critical infrastructure organizations and those representing the emergency services. Nevertheless, based on this data there is an obvious disconnect between the two groups with one group perceiving role clarity as a barrier and the second group identifying role clarity as an enabler in facilitating multi-agency coordination. However, the findings did not disclose how role clarity should be clarified between liaison officers.

5. Discussion

The evidence presented from the participants in this study suggests that role clarity is an important mechanism in facilitating multi-agency coordination in a strategic level emergency operations centre. It is noteworthy that participants from the emergency services specified that role clarification was a contributing factor to the success of liaison officers working in strategic emergency operations centres. In contrast, liaison officers from critical infrastructure organizations identified that a knowledge deficiency or lack of understanding regarding their role by emergency services personnel was deemed a constraint when working in a strategic level emergency operations centre.

The contrasting negative and positive views of role clarity elicited from participants representing both groups would indicate that there is a disconnect between the two. The data found that both groups understood the importance of role clarity in the formation of temporary organizations. However, there was an expectation from the critical infrastructure liaison officers that the emergency services personnel should have an existing understanding of their role. The view from the emergency services participants was that other organizations should clearly understood their own role as this would contribute to the success of working within multi-agency coordination arrangements. Clearly there is an expectation by all the participants in this study that role clarity is imperative in strategic level emergency operations centres, but it was unclear whose responsibility it was for attaining clarity of the role.

Liaison officers working within temporary organizations that are often formed in strategic level emergency operations centres require complete comprehension of their role. We posit that it is essential that this is explained to personnel from all organizations succinctly upon first contact, particularly in the response phase of a disaster. The importance of rapid role clarification between personnel from different organizations has been acknowledged in the literature investigating swift trust in a military context (Ben-Shalom et al., 2005; Hyllengren et al., 2011; Lester & Vogelgesang, 2012; Paparone, 2002). Furthermore, this also raises the possibility that scenario planning could be used by the emergency services and critical infrastructure organizations to more clearly articulate non-routine operating parameters and relationships. Even if the respective organizations do not have the scope to work together, scenario planning/concept mapping could increase recognition of the potential roles and relationships that are required and so help create a context in which swift trust could occur (Anderson et al., 2006; Schoemaker, 1995).

This study has confirmed the importance of role clarity in the rapid formation of temporary organizations. Other research on swift trust seems to imply this but to the best of our knowledge it has yet to examine this in the complex and dynamic environment of emergency management. Therefore this study has contributed to the knowledge of swift trust in an emergency management context by empirically verifying the impact and importance of role clarity from liaison officers working in three Australian strategic level emergency operations centres.

6. Potential limitations

We acknowledge the limitations of the small sample size and the fact that the participants represented only three strategic level emergency operations centres in Australia. Nevertheless, despite the relatively small sample size, we believe that specifically using data from participants that are not traditionally the focus of emergency management research (which is predominantly dominated by the emergency services) provided us with the opportunity to focus on not only the emergency services liaison officers but also the unique requirements of critical infrastructure liaison officers involved in multi-agency coordination arrangements.

7. Implications for industry

The concept of swift trust has substantial implications for practice. Emergency management multi-agency coordination is characterised by the rapid formation of a temporary supra-organization requiring liaison officers from an often disparate group of organizations each with their own organizational cultures. The collaboration required for the success of these temporary supra-organizations often requires differing organizational liaison officers involved to have a trusting inter-personal relationship. De-personalising the working relationship and providing role clarification can mean that the trustor can make a judgement on other colleagues ability based on the fact that they have specialised knowledge required to fulfil a particular role (Kramer, 1999). Enacting a dimension of swift trust termed role clarity may enable collaborative working practices between organizations thus facilitating emergency management multi-agency coordination.

8. Conclusion

We suggest that there is clear potential for role clarity in the context of swift trust to be embraced by liaison officers involved in emergency management multi-agency coordination arrangements. Clearly, further research regarding the concept of swift trust in an emergency management context needs to be performed. Nevertheless, while emergency management arrangements continue to necessitate a multi-agency approach, liaison officers involved in these arrangements will be required to build trusting relationships swiftly.

References

Adams, B., & Webb, R. (2002). Trust in small military teams. In *7th International command and control technology symposium* (pp. 1–20).

Anderson, L., Gwaltney, M., Sundra, D., Brownson, R., Kane, M., Cross, A., … White, C. (2006). Using concept mapping to develop a logic model for the Prevention Research Centers Program. *Preventing Chronic Disease: Public Health Research, Practice and Policy*, *3*(1), 1–9.

Ben-Shalom, U., Lehrer, Z., & Ben-Ari, E. (2005). Cohesion during military operations: a field study on combat units in the al-Aqsa intifada. *Armed Forces and Society*, *32*(1), 63–79.

Charmaz, K. (2006). *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. Thousand Oaks, CA: Sage Publications Ltd.

Coppola, N. W., Hiltz, S. R., & Rotter, N. G. (2004). Building Trust in Virtual Teams. *IEEE Transactions on Professional Communication*, *47*(2), 95–104.

Crisp, C. B., & Jarvenpaa, S. L. (2013). Swift Trust in Global Virtual Teams. *Journal of Personnel Psychology*, *12*(1), 45–56.

Dietz, G., Gillespie, N., & Chao, G. (2010). Unravelling the complexities of trust and culture. In M. Saunders, D. Skinner, G. Dietz, N. Gillespie, & R. Lewicki (Eds.), *Organizational Trust: A Cultural Perspective* (pp. 3–41). Cambridge,UK: Cambridge University Press.

Dirks, K., & Ferrin, D. (2001). The Role of Trust in Organizational Settings. *Organization Science*, *12*(4), 450–467.

Elron, E., Shamir, B., & Ben-Ari, E. (1999). Why don't they fight each other? Cultural diversity and operational unity in multinational forces. *Armed Forces & Society*, *26*(1), 73–97.

Faraj, S., & Xiao, Y. (2006). Coordination in Fast-Response Organizations. *Management Science*, *52*(8), 1155–1169.

Fleiss, J., Levin, B., & Paik, M. (2003). *Statistical methods for rates and proportions* (Third Edit.). Hoboken, NJ, USA: John Wiley & Sons.

Ford, J., & Schmidt, A. (2000). Emergency response training: strategies for enhancing real-world performance. *Journal of Hazardous Materials*, *75*(2), 195–215.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for Qualitative Research*. Transcaction publishers.

Goodman, R., & Goodman, L. (1976). Some management issues in temporary systems: A study of professional development and manpower-the theater case. *Administrative Science Quarterly*, *21*(3), 494–501.

Hosmer, L. (1995). Trust: The connecting link between organizational theory and philosophical ethics. *Academy of Management Review*, *20*(2), 379–403.

Hyllengren, P., Larsson, G., Fors, M., Sjöberg, M., Eid, J., & Olsen, O. K. (2011). Swift trust in leaders in temporary military groups. *Team Performance Management*, *17*(7/8), 354–368.

Kramer, R. (1999). Trust and Distrust in Organizations: Emerging Perspectives, Enduring Questions. *Annual Review of Psychology*, *50*(1), 569–598.

Lester, P., & Vogelgesang, G. (2012). Swift Trust in Ad Hoc Military Organizations. In J. Laurence & M. Michael (Eds.), *The Oxford Handbook of Military Psychology* (pp. 176–186). New York: Oxford University Press.

Lewicki, R., & Bunker, B. (1995). Developing and maintaining trust in work relatiosnhips. In R. Kramer & T. Tyler (Eds.), *Trust in Organizations: Frontiers of Theory and Research* (pp. 114–139). Thousand Oaks, CA: Thousand Oaks, CA: Sage.

Maniscalco, M., Aubry, G., & Rosato, V. (2008). Working Together. In N. Leonhard, G. Aubry, M. Santero, & B. Jankowski (Eds.), *Military Co-operation in Multinational Missions: The Case of EUFOR in Bosnia and Herzegovina* (pp. 89–122). Strausberg: Sozialwissenschaftliches Institut der Bundeswehr.

Mayer, R., Davis, J., & Schhorman, F. (1995). An Integrative Model of Organizational Trust. *Acaademy of Management Review*, *20*(3), 709–734.

Meyerson, D., Weick, K., & Kramer, R. (1996). Swift Trust in Temporary Groups. In R. Kramer & T. Tyler (Eds.), *Trust in Organizations: Frontiers of Theory and Research* (pp. 166–195). Thousand Oaks, CA: Sage Publications Ltd.

Mohr, J., & Spekman, R. (1994). Characteristics of partnership success: partnership attributes, communication behavior, and conflict resolution techniques. *Strategic Management Journal*, *15*(2), 135–152.

Paparone, C. (2002). The nature of soldierly trust. *Military Review*, *82*(6), 45–53.

Paton, D., & Auld, T. (2006). Resilience in Emergency Management: Managing the flood. In *Disaster Resilience: An integrated approach* (pp. 268–288). Springfield, Ill: Charles C. Thomas.

Paton, D., Johnston, D., Houghton, B., & Smith, L. (1998). Managing the effects of a volcanic eruption: Psychological perspectives on integrated emergency management. *Journal of the American Society of Professional Emergency Managers*, *5*, 59–69.

Paton, D., & Owen, C. (2013). Incident management. In K. Bradley Penuel, M. Statler, & R. Hagen (Eds.), *Encyclopedia of Crisis Management* (pp. 502–506). Thousand Oaks, CA: Sage Publications Ltd.

Pollock, C., Paton, D., Smith, D., & Violanti, J. (2003). Team Resilience. In D. Paton, J. Violanti, & L. Smith (Eds.), *Promoting Capabilities to Manage posttraumatic stress: Perspectives on resilience* (pp. 74–88). Springfield, Ill: Charles C. Thomas.

Robert, L. P., Denis, A. R., & Hung, Y.-T. C. (2009). Individual Swift Trust and Knowledge-Based Trust in Face-to-Face and Virtual Team Members. *Journal of Management Information Systems*, *26*(2), 241–279.

Rotter, J. (1980). Interpersonal trust, trustworthiness, and gullibility. *American Psychologist*, *35*(1), 1–7.

Schoemaker, P. (1995). Scenario Planning: A Tool for Strategic Thinking. *Sloan Management Review*, *36*, 25–40.

Scholtens, A. (2008). Controlled Collaboration in Disaster and Crisis Management in the Netherlands , History and Practice of an Overestimated and Underestimated Concept. *Journal of Contingencies and Crisis Management*, *16*(4), 195-207.

Schraagen, J. M., & Van de Ven, J. (2008). Improving Decision Making in Crisis Response Through Critical Thinking Support. *Human Factors*, *2*(4), 311–327. doi:10.1518/155534308X377801.

Shapiro, S. (1987). The social control of impersonal trust. *American Journal of Sociology*, *93*(3), 623–658.

Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: The role of social trust and knowledge. *Risk Analysis*, *20*(5), 713–719.

Sitkin, S., & Roth, N. (1993). Explaining the limited effectiveness of legalistic "remedies" for trust/distrust. *Organization Science*, *4*(3), 367–392.

Van Scotter, J., Pawlowski, S., & Cu, T. (2012). An examination of interdependencies among major barriers to coordination in disaster response. *International Journal of Emergency Management*, *8*(4), 281–307.

White, C., Plotnick, L., Addams-Moring, R., Turoff, M., & Hiltz, S. R. (2008). Leveraging A Wiki To Enhance Virtual Collaboration In The Emergency Domain. In *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS 2008)* (pp. 1–10).

Wildman, J., Fiore, S., Burke, C., & Salas, E. (2011). Trust in Swift Starting Action Teams: Critical Considerations. In N. Stanton (Ed.), *Trust in Military Teams* (pp. 71–88). Farnham, Surrey: Ashgate Publishing Ltd.

Wolbers, J., & Boersma, K. (2013). The Common Operational Picture as Collective Sensemaking. *Journal of Contingencies and Crisis Management*, *21*(4), 186–199.

Zucker, L. (1986). Production of trust: Institutional sources of economic structure, 1840-1920. In B. Staw & L. Cummings (Eds.), *Research in organizational behavior* (pp. 53–111). Greenwich, CT: JAI Press.

Appendix E: Paper V

A theoretical framework for negotiating the path of emergency management multi-agency coordination

Steven Curnin [a, d, *], Christine Owen [a, d], Douglas Paton [b, d], Benjamin Brooks [c, d]

[a] *Faculty of Education, University of Tasmania, Private Bag 66, Hobart, TAS 7001, Australia*
[b] *School of Medicine (Psychology), University of Tasmania, Locked Bag 1342, Launceston, TAS 7250, Australia*
[c] *National Centre for Ports and Shipping, Australian Maritime College, University of Tasmania, Maritime Way, Newnham, TAS 7248, Australia*
[d] *Bushfire Cooperative Research Centre, 340 Albert St, East Melbourne, VIC 3002, Australia*

ARTICLE INFO

Article history:
Received 7 April 2014
Accepted 20 October 2014
Available online

Keywords:
Emergency management
Multi-organizational core-task analysis
Boundary spanning

ABSTRACT

Multi-agency coordination represents a significant challenge in emergency management. The need for liaison officers working in strategic level emergency operations centres to play organizational boundary spanning roles within multi-agency coordination arrangements that are enacted in complex and dynamic emergency response scenarios creates significant research and practical challenges. The aim of the paper is to address a gap in the literature regarding the concept of multi-agency coordination from a human environment interaction perspective. We present a theoretical framework for facilitating multiagency coordination in emergency management that is grounded in human factors and ergonomics using the methodology of core-task analysis. As a result we believe the framework will enable liaison officers to cope more efficiently within the work domain. In addition, we provide suggestions for extending the theory of core-task analysis to an alternate high reliability environment.

1. Introduction

Managing disasters in the context of environmental change represents an increasing global challenge (Comfort and Kapucu, 2006; Van Scotter et al., 2012). Disasters are becoming increasingly regular occurrences that, if not managed well will continue to disrupt and threaten individual lives, communities, organizations and indeed economies. Modern day disasters require agencies to transition from independent agencies and assemble into temporary supra-organizations (in which their "routine" expertise evolves to encompass a multi-agency management capability and in which routine and emergency actions need to be combined and applied appropriately to respond to situational demands that change over time) that collectively address problems that are beyond the capacity of any single agency (Janssen et al., 2010; Meyerson et al., 1996). These temporary supra-organizations operate in an environment that is inherently complex and dynamic (Walker et al., 2014). This supra-organization typically includes members drawn from many tens of public and private agencies who never or very rarely interact together. This involves not only the traditional emergency services but also non-emergency agencies including the military, non-government organizations and those form critical infrastructure such as energy, water, communications and transport agencies (Scholtens, 2008; Schraagen and Van de Ven, 2008). Not only must members of these diverse agencies interact with people, roles and areas of expertise that they are unfamiliar with, they have to do so (i.e., when disaster strikes) under high risk, high stress conditions. The crucial role these emergent supra-organizational agencies play in facilitating effective and expedient disaster recovery highlights the importance of systematically researching the factors that influence the development of effective multi-agency actions and using this to inform the creation of effective comprehensive emergency management. This issue takes on even greater significance when key organizational contributions are made by agencies not typically regarded as emergency response agencies (e.g., critical infrastructure agencies).

These agencies with differing social histories, organizational cultures, operating practices, crisis management experience and areas of expertise come to have a role in

disaster response because the demands of the situation require their expertise (e.g., lifeline companies and building contractors collaborate with emergency management agencies to support response and recovery). However, relationships of this nature are not the norm and if a disaster brings together diverse agencies this means that, in the absence of prior development activities, they are likely to act in an autonomous manner. This increases the likelihood that their interaction will be characterized by frequent conflict (e.g., as cultures and operating practices collide) regarding objectives because organizations act based upon their particular needs and ways of operating and not the collective management of complex multi-faceted needs (e.g., Paton and Auld, 2006).

To counter this dysfunctional outcome and achieve effective coordination (that will be required over weeks or months) agencies have to span several organizational boundaries to provide linkages that facilitate information sharing, cooperation and decision making (Harrald, 2006; Janssen et al., 2010). Information sharing is a necessity to satisfy the information requirements of the multiple agencies involved in the relief efforts in a struggle to inform the situation awareness essential for agency interpretation of information from diverse sources (Curnin and Owen, 2013) in order to develop the shared situational awareness required to facilitate inter-agency cooperation in complex, multi-faceted environments. Particular agency stakeholders are fundamental to the success of agencies informing their situation awareness and facilitating the linkages across organizational boundaries. These stakeholders working at the boundaries of organizations are often deemed to be practicing 'boundary spanning' activities. In emergency management these stakeholders are habitually called liaison officers (Helsloot, 2005; Perry, 2003; Wolbers and Boersma, 2013). However, multi-agency coordination in emergency management and specifically the role of liaison officers is problematic due to a myriad of social, organizational and technological complexities (McMaster and Baber, 2012).

Globally, both natural and man-made disasters such as the World Trade Centre attacks in 2001, the European heat wave in 2003, Hurricane Katrina in 2005, the Haiti earthquake in 2010 and the Fukishima nuclear incident in 2011 give prominence to the vulnerability of society to suddenly-occurring events whose scale, complexity and duration transcend the management capability of any one organization. In an Australian context and as one of the most bushfire prone areas in the world, Australia has also been affected by recent disasters such as the 2009 Black Saturday bushfires in the state of Victoria. Being able to manage the devastating impact of these complex, multi-faceted long-duration disasters is of paramount importance due to the increased susceptibility of societies to experiencing such events (Comfort et al., 1999). Crucial to this process are the lifelines (e.g., utilities, roads etc.) that can be disrupted or damaged by hazard events.

Communities have an increasing reliance on the effective functioning of public services to maintain a quality of life and encourage economic growth (Boin and McConnell, 2007). However, this dependence is impacted during disasters when significant damage to critical infrastructures (e.g., loss of power, water, sewerage, telecommunications, etc.) deprives citizens of basic services, and thus their capacity to recover normal functioning, often for considerable periods of time. In an effort to mitigate the impact of these disruptions on affected communities, and facilitate societal response and recovery form hazard consequences, agencies involved in emergency management arrangements require a coordinated approach to facilitate recovery from events that have created widespread loss of utilities, infrastructure and services. However, the problem of multi-agency coordination in emergency management is not well understood and certainly not well theorised. The lack of rigorous, systematically developed theory has meant that response management has tended to be ad hoc.

A consequence of the ad hoc nature of response has been that the importance of coordination in emergency events is more often highlighted by coordination failure. Several articles (see Comfort & Kapucu, 2006; Wise, 2006) and post-event inquiries (e.g. Moynihan, 2007; Teague, McLeod, & Pascoe, 2010) have highlighted these problems and identified the need for improvements to multi-agency coordination in emergency management.

1.1 Multi-agency coordination

Emergency management multi-agency coordination can occur concurrently at several hierarchical levels within organizations to address operational, tactical and strategic demands (Paton and Owen, 2013). Australian emergency management arrangements follow similar concepts used in other countries such as the National Incident Management System (Walsh et al., 2011) used in the US and the gold–silver–bronze command structure (Pearce and Fortune, 2006) adopted in the UK. In an Australian context the operational level typically occurs locally and activation ensues at the onset of an incident. The tactical level will result at a regional level and is often invoked for multiple incidents within the same locality. Finally, strategic arrangements transpire at a state or national level for multiple incidents over numerous jurisdictions and offer critical direction to the overall emergency events. Multi-agency and multi-jurisdictional issues arise at all these levels.

Multi-agency coordination in emergency management can take place informally in temporary locations at the incident site (e.g., between fire, police and critical infrastructure representatives) or in a structured environment such as an established emergency operations centre. At a strategic level temporary supra-organizations invariably assemble at a designated emergency operations centre. This theoretical framework has focused on strategic level emergency operations centres as a deficiency in the situation awareness of agencies at this strategic level can filter down and affect a decision making capability which can impact actions at the tactical and operational level. Ultimately strategic emergency management arrangements are instrumental in facilitating and safeguarding community welfare and mitigating the consequences of risk to the affected citizens (over the whole recovery and reconstruction phases of disaster response). Mitigation strategies can only succeed with effective multi-agency coordination among the diverse agencies involved. Because effective coordination requires a comprehensive overview of what has happened and what will happen and that will need to be responded to, liaison officers at a strategic level are therefore crucial in facilitating the prescribed multi-agency coordination efforts and sustained them over time against a backdrop of changing demands and organizational involvement.

Liaison officers are a key enabler in fostering functional linkages between organizations that are required to gain situation awareness of complex, multi-faceted events (Harrald, 2006; McGuire and Silvia, 2010). In spite of this crucial role little is known about how liaison officers are selected, trained or how they influence inter-agency coordination or what factors and capabilities they contribute to the effectiveness of disaster management (Janssen et al., 2010).

In fostering linkages across organizational boundaries liaison officers are confronted with a conglomerate of constraints in the multi-agency environment. These include but are not limited to role clarity and cultural differences between agencies (Marcus et al., 2006), information uncertainty (Doyle et al., 2014; Van de Walle and Turoff, 2008), fast action requirements (Janssen et al., 2010), and inter-organizational (Harrald, 2006) and inter-jurisdictional complexities (Paton and Auld, 2006). These challenges can be associated with the dynamic, complex and often uncertain domain where multi-agency arrangements are undertaken in a strategic level emergency operations centre. Therefore exploration of this phenomenon required an appropriate methodological framework suited to high reliability environments.

1.2 Core-task analysis

Core-task analysis adopts a systemic notion of human activity where the situated actions are conceived from an ecological, human-environment interaction perspective with the aim of identifying the core-task of a specific working practice (Norros, 2004). Core-task analysis takes into account three interrelated dimensions that the workers must take into account to achieve their activities in the work domain: (1) dynamism; (2) complexity and (3) uncertainty. In order to manage these dimensions workers require collaboration, skill and knowledge. The core-task analysis framework described by Norros (2004) has six core-task work demands as a result of the interaction of collaboration, knowledge or skill with any two of the three dimensions.

This methodological framework has been applied in other high reliability domains such as nuclear power plant operations and the piloting of large vessels. Consequently, for this theoretical framework it was deemed a suitable methodology to apply the activities of liaison officers in emergency management multi-agency arrangements. The development of this theoretical framework specifically drew upon the three types of resources that human actors can respond with to manage the environmental constraints. These resources are illustrated in the core-task analysis methodology as collaboration, skill and knowledge. The activities suggested in this theoretical framework were aligned to one of these three resources in respect to how the activity was associated with collaboration, skill or knowledge.

This paper will propose a theoretical framework based on earlier empirical data collection and analysis that will be briefly outlined next. The following section will also provide the rationale behind our framework and describe the individual activities, their interdependencies and rationale why they may facilitate multi-agency coordination. Finally the paper will comment on the recent elaboration of the core-task analysis methodology and in particular a new issue that was characterized as dialogical communication (Norros, 2014). The paper will define how this may be adapted to emergency management and particularly hastily formed groups involving multiple agencies with differing objectives.

2. A theoretical framework for facilitating multi-agency coordination

Our earlier empirical research was conducted over a two year period within three strategic level emergency operations centres in Australia and is documented in four other papers (Curnin and Owen, 2014, 2013; Curnin et al., 2014a, 2014b). The empirical data collected included forty-three individual interviews, thirty-nine hours of observational studies and three focus group interviews across three states. Significantly twenty-two hours of observations were conducted during real-time catastrophic bushfire conditions that required the activation of a strategic level emergency operation centre. This collection of 'live' data that is often extremely difficult to collect during large scale emergency events (McMaster and Baber, 2012) provided a rare insight into liaison officers work in the emergency operations centre. The aforementioned four papers each contain a detailed methodology section encompassing comprehensive explanations of the specific samples chosen, analytical techniques performed and inter-rater reliability testing as to ensure validity of the results. A synopsis of the four papers is provided in Table 1.

2.1 Preparedness phase activities

In the preparedness phase of an emergency management event liaison officers may have the opportunity to be involved in multi-agency exercises or undertake orientation visits to the emergency operations centre where they may be deployed. Drawing upon the activities linked to collaboration and knowledge and applying them in exercising and/or orientation visits to the emergency operations centre can assist to initiate inter-agency collaboration. It can also address some of the socio-technical complexities encountered in this domain.

2.1.1 Engagement champion

Liaison officers have to actively engage in multi-agency exercising and orientation visits to the emergency operations centre in an effort to forge organizational linkages with other agency liaison officers. In addition, experience gained from previous operational deployments can assist with creating networks between agencies.

2.1.2 Forging organizational alliances

Fostering relationships with stakeholders from other agencies can commence trust building between the parties involved. Performing this activity in the preparedness phase can lay the foundations for trust building and provide legitimacy for the liaison officer that is often difficult to attain within hastily formed temporary organizations, especially in the response phase of a disaster. Trust building

Table 1 A summary table mapping the four previous papers utilised in this theoretical framework

Paper	Aims	Study	Findings	Association with theoretical framework
Curnin and Owen, 2014	Develop a foundation of knowledge to understand how liaison officers in two strategic level emergency operations centres coordinate their activities in multi-agency coordination.	Individual interviews (n=39)	Proposes a typology of nine boundary spanning activities that liaison officers enact when working in multi-agency coordination arrangements within two strategic level emergency operations centres.	The boundary spanning activities of Representative and Networking are aligned to *Forging Organizational Alliances*. The boundary spanning activities of Resource Coordinator, Organizational Expert and Domain Expert are affiliated with *Mastery of Emergency Management Structures*. The boundary spanning activities of Information Conduit and Information Analyst are synonymous with *Information Expert*. Lastly, the boundary spanning activity of *Legitimate Enabler* remains the same. The activity of Communicator is linked to negotiation skills required as a *Conflict Resolver*.
Curnin, Owen and Trist, 2014	Establish a framework defining the constraints that the work domain puts on the liaison officers and the mechanisms they adopt to manage the challenges faced in the work domain.	Individual interviews (n=31) Observational studies (24 hrs) Focus group interviews (n=15)	Presents six core-task demands that identified the key content of a liaison officers work practice from the point of view of generic work demands that need to be fulfilled when accomplishing their role in a strategic level emergency operations centre.	Four of the core-tasks*: Forging Organizational Alliances*; *Engagement Champion*; *Lateral Thinker*; and *Legitimate Enabler* remain the same as the activities described in the theoretical framework. The core-task described as Knowledge of Supra-structure can be identified with *Mastery of Emergency Management Structures*.
Curnin and Owen, 2013	Investigate the perceived information requirements of stakeholders (including liaison officers) in a strategic level emergency operations centre and explore how they obtain this information.	Organizational survey (n=92) Observational study (16 hrs)	Data indicated that multiple cognitive artefacts were used to obtain information in the strategic level emergency operations centre depending upon the urgency of the information.	The perceived information requirements of the participants and how they accessed the information can be linked to the activity of *Information Expert*. Their knowledge of the information also influences the activity of *Legitimate Enabler*. Additionally, the urgency and how they acquire the information can be associated with the activity of *Lateral Thinker*.
Curnin, Owen, Paton, Trist and Parsons (Manuscript submitted for publication)	Explore emergent data entrenched in the cultural constraints confronted by critical infrastructure liaison officers working in three strategic level emergency operations centres.	Individual interviews (n=16) Observational study (16 hrs)	The findings revealed that two facets of swift trust evident in the data may be suitable for critical infrastructure liaison officers to manage the complexities associated with cultural challenges when forming inter-personal trusting relationships in multi-agency coordination arrangements.	Liaison officers exerting Role Clarity can ensure other agencies understand their limitations and what they can contribute thus influencing the activities of *Legitimate Enabler* and *Information Expert*. Liaison officers emphasising Future Interaction may assist in *Forging Organizational Alliances* thus providing the opportunity to become an *Engagement Champion*.

is challenging during emergency management multi-agency coordination as it invariably involves agencies from public and private sectors that differ socially and structurally. Emergency services are often structured hierarchically and operate within command and control arrangements. This is in contrast to non-emergency agencies that may operate along the concept of horizontal management among subordinates as opposed to vertical management between superiors.

Typically in an emergency event one agency will be the lead agency such as the police or fire service. These agencies are structurally hierarchical in nature with a clear command and control arrangements. This is often in contrast to agencies that do not perceive emergency management as a core function (e.g., critical infrastructure agencies) and do not typically operate within a command and control environment and may use decision and management processes and procedures that are flatter, more organic, and less prescriptive. Subsequently, in temporary supra-organizations with multiple public and private organizations striving to collaborate, networking with other agencies will allow the opportunity for liaison officers to clarify their and their agencies role within the emergency operations centre. Parting with this knowledge requires mastery of the emergency management structures and in particular a comprehensive understanding of the liaison officers own agency's intent and limitations in an emergency management context.

2.1.3 Mastery of the emergency management structures

Having mastery of the emergency management structures incorporates three facets: (1) knowledge of the liaison officers own agency; (2) knowledge of other agencies; and (3) knowledge of the work domain arrangements. If liaison officers have a comprehensive understanding of their own agency's structures and intentions in an emergency management context then they can provide a clear explanation of their practices and limitations when forging organizational alliances. Knowledge of their own agency can aid in legitimising the liaison officers presence in the temporary supra-organization and enhance trust building and subsequent collaboration. This is a necessity in this domain where the emergency services often work together in routine operations thus attaining familiarity that is gained over time which can foster a sense of trust. This is in contrast to non-emergency agencies that may not have worked with each other or operated in an emergency management context previously and therefore have to swiftly establish a basis for trust (Meyerson et al., 1996). The preparedness phase of emergency management is an appropriate environment to initiate inter-agency collaboration.

Knowledge of other agencies intents, limitations and potential resourcing requirements can be gleaned from forging organizational alliances but also assist in the activity of legitimate enabler as will be described in section 2.2.4. An understanding of the structural arrangements in the work domain can assist the liaison officer to 'think outside the box' as defined in section 2.2.2. Knowledge of the specific work domain arrangements and in particular increasing the liaison officer's familiarity with the various information systems can address the technical complexities associated multi-agency coordination and impacts the activity of information expert that will be discussed in section 2.2.1 and also occurs in the response phase.

Nevertheless, during prolonged emergency events and based on operational requirements there may be a need to rotate multiple liaison officers through the emergency operations centre due to fatigue management issues and potential workforce limitations within agencies. Consequently it may not be possible for all liaison officers to have engaged in preparedness phase proceedings such as exercises or orientation visits to the emergency operations centre. Therefore liaison officers may not have had the opportunity to forge organizational alliances which allows for the transfer of knowledge between agencies and ultimately assists with mastering the emergency management structures. In these circumstances liaison officers may have to initiate activities associated with the preparedness phase 'on the fly' in the response

phase. Quickly forging linkages in the response phase requires the liaison officer to provide clarity of their practices and emphasize the likelihood of future interaction with other agencies during networking which may assist in fostering problem-solving relationships in the future.

2.2 Response phase activities

In the response phase stakeholders need to legitimize their presence and consequently facilitate multi-agency coordination in the temporary supra-organization. This requires activities based upon skill and collaboration.

2.2.1 Information expert

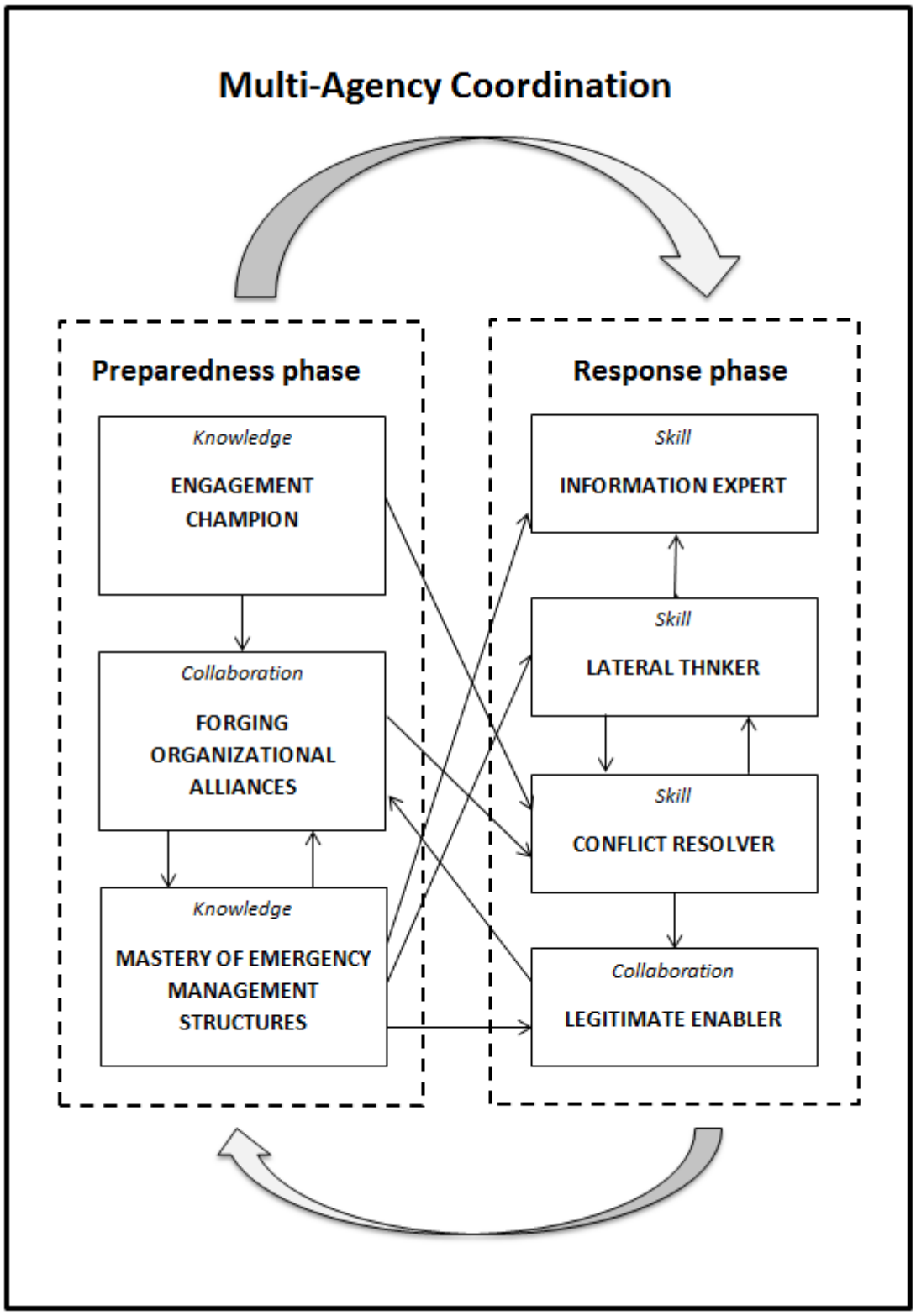
Liaison officers need to fulfil the activity of information expert to provide timely and relevant information across organizational boundaries so the agencies involved in the response efforts can share their coordination needs. Liaison officers must draw upon their skills to accurately collate, analyse and disseminate information within their agency and to other agencies within the temporary supra-organization. There is a requirement for all agencies involved in multi-agency coordination to have a situation awareness of the event. However, it is not always a requirement for agencies to have the same situation awareness for all the elements in a system and the development of shared situation awareness is important within the supra-organizational context. This is especially the case in complex and collaborative temporary supra-organizations when different agencies may have differing objectives. In these circumstances liaison officers seek to inform their and therefore their agency's distributed situation awareness of the event. The concept of distributed situation awareness is applicable to strategic level emergency operations centres as each agency's awareness is unique but complementary (not shared) and thus each of the liaison officers are instrumental in the development and maintenance of other agencies situation awareness (Salmon et al., 2008). The complexity of this activity clearly highlights the need for training and organizational development the preparedness phase. This reinforces the benefits of including a feedback loop from the response phase to the preparation phase as illustrated in Fig. 2. It will be difficult to anticipate all the issues that need to be accommodated in distributed situation awareness prior to events, but learning from events can expedite this process. This process can also be facilitated by information experts.

The activity of the information expert is intrinsically linked with the activity we term, mastery of emergency management structures. The liaison officer requires knowledge of their own agency's intent and limitations as well as that of other agencies involved in the response efforts to inform their own agency's distributed situation awareness and that of other agencies involved in the multi-agency coordination efforts. Furthermore, liaison officers require knowledge of the specific information systems used within the emergency operations centre to expedite the collation, analysis and dissemination of information. However, the ability to access information systems necessitates that the constraints associated with privacy and security barriers be addressed by governments in the preparedness phase (Kruchten et al., 2008; Reddick, 2011; Vogt et al., 2011). Legislative changes addressing these information sharing barriers could improve information flow potentially increasing the liaison officer's ability to negotiate collaboration with greater ease. In performing the task of information expert the liaison officer must take into account the temporal constraints and dynamism of the work domain that requires adaptability and flexibility with an ability to think laterally.

2.2.2 Lateral Thinker

In a strategic level emergency operations centre there is often a requirement to access information from a variety of sources using multiple cognitive artefacts. In the fast action environment of a disaster the traditional means of organizing that are based upon routines can be non-existent. Liaison officers require the ability to work under time pressures and address high risk, high consequence demands that are often present in an emergency management environment in an effort to ensure information quality (Gryszkiewicz and Chen, 2012; Mishra et al., 2011). However, the flow of information (in terms of quantity and quality) needed to provide continuous situation awareness can cause increases in cognitive workload which can be problematic (Raj et al.,

Fig. 1 A theoretical framework for facilitating emergency management multi-agency coordination



2011; Tsang and Wilson, 1997). Therefore liaison officers require the ability to 'think outside the box' and access information from the most appropriate source. This requires mastery of emergency management structures in an effort to comprehend the most appropriate source for the particular situation. The challenges accompanying the requirements for quality information can also lead to information inconsistency resulting in conflict between stakeholders. Consequently, the liaison officer requires the skill of conflict resolver.

2.2.3 Conflict resolver

The skill of conflict resolver can be facilitated with the activities of engagement champion and forging organizational alliances. Familiarity with other stakeholders gained in preparedness phase events may assist in easing any conflicting situations. Due to the temporal constraints associated with strategic level emergency operation centres, liaison officers must have the ability to provide a rapid decision making capability in high risk, dynamic decision environments (Faraj and Xiao, 2006). An inability to provide a timely decision can result in tension between the parties involved resulting in conflict. Therefore liaison officers require the attributes of a legitimate enabler.

2.2.4 Legitimate enabler

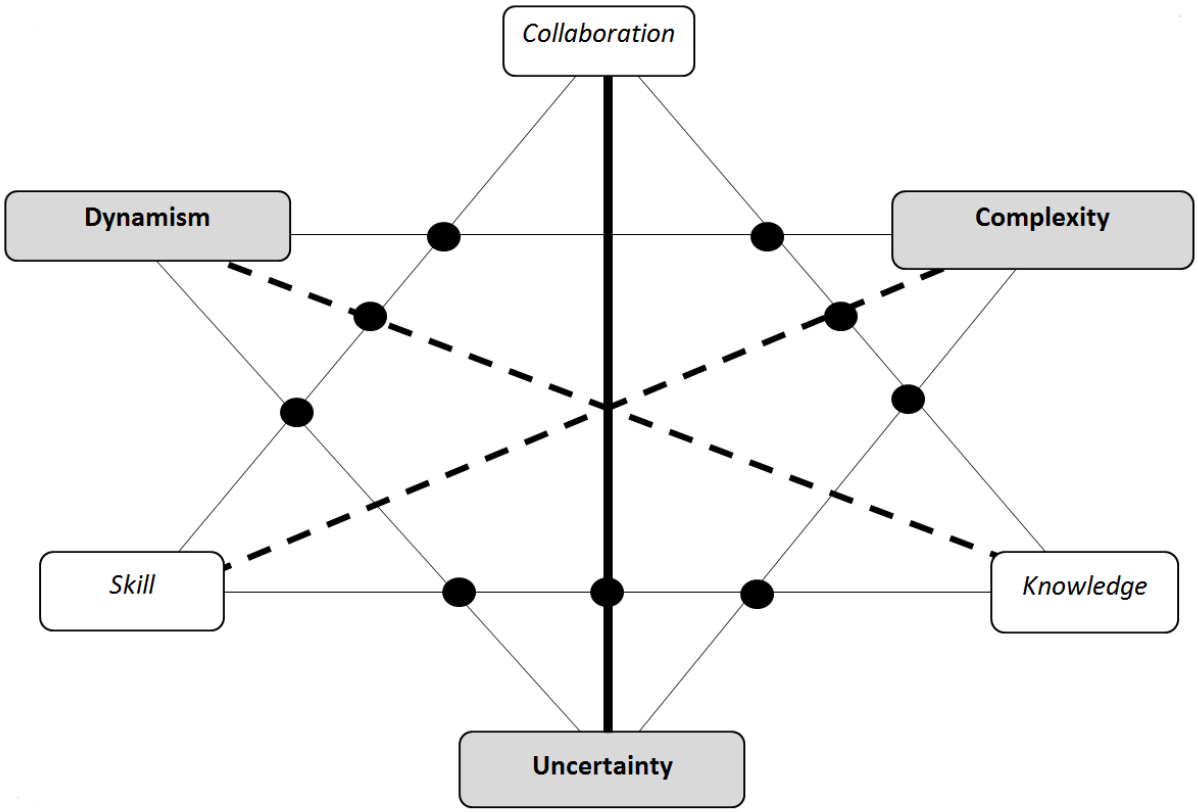
The activity of legitimate enabler entails the liaison officer to have rapid access to a decision or the authority and empowerment to make a decision to commit to their agency's actions. This is enacted by having mastery of emergency management structures. Liaison officers require an understanding of other agencies and their own agency's limitations and potential resourcing requirements so they can potentially pre-empt other agencies requests and give a rapid answer. Anticipating resourcing requests from other agencies and providing a rapid decision can assist in providing the liaison officer with legitimacy within the emergency operations centre thus enabling collaboration between the agencies which can strengthen organizational alliances. Collectively these activities can address some of the socio-cultural and socio-technical complexities identified when working within emergency management temporary supra-organizations.

3. Discussions

In undertaking the development of this theoretical framework it is clear that emergency management multi-agency coordination is an inherently complex phenomenon for liaison officers working within strategic level emergency management arrangements. Liaison officers deployed to work in a strategic level emergency operations centre have to incorporate a number of activities in an effort to address the diverse socio-technical and socio-cultural constraints associated with operating in this type of environment and may have to do so over long periods of time. The theoretical framework presented in this paper provides some guidance for industry in the development of training and operational policies for liaison officers working within strategic level emergency management arrangements. It offers direction for agencies to understand the requirements for the role of liaison officers in various stages of the emergency management cycle. It also advocates active learning from crisis events, even if not directly affecting a given agency (e.g. Folke et al., 2003). The infrequent nature of events makes it imperative that maximum value is extracted from events in the preparedness phase.

The theoretical framework acknowledges the interdependency of the activities depicted and why liaison officers should encompass these in the preparedness and response phases of the emergency management cycle in an effort to facilitate multi-agency coordination. The authors recognize that not all liaison officers have the luxury of engaging in activities in the preparedness phase and thus suggest that some of the activities situated in the preparedness phase can be adopted in the response phase if required. The value of this research lays in its empirical origins and exploring the challenges of multi-agency coordination from the perspective of human-environment interaction that ultimately analyses how to address these constraints. Within the practice of human factors and ergonomics this framework explicitly draws on the core-task analysis (Norros, 2004) methodological framework whilst

Fig. 2. Elaborated core-task analysis framework (adapted from Norros, 2014)



simultaneously extending the theory of core-task analysis in an alternative high reliability environment.

To the best of our knowledge, the core-task analysis methodology has had no recent application in an emergency management context. We applied the methodology to our research thus exploring its applicability in the domain of strategic level emergency operations centres. We deem that the core-task analysis approach was most suitable for this research as it directed systematic attention to the particular constraints of the work as bases of defining the demands on the liaison officers and mechanisms they enacted to manage the associated constraints. In particular, aligning the activities to the resources of collaboration, skill and knowledge, in the context of dynamism, complexity and uncertainty was wholly appropriate to this theoretical framework as it characterized the multifaceted challenges associated with working in the domain of emergency management.

Furthermore, we feel that we can also suggest how a new issue recently assimilated into the core-task analysis methodological framework can be adapted to emergency management. A recent article by Norros (2014) specifies how core-task analysis has received an elaboration so that the connections between the environmental constraints and the human resources have been handled in a more comprehensive way. The initial core-task analysis framework (Norros, 2004) had six core-task work demands as a result of the activities labelled collaboration, knowledge and skill interacting with any two of the three control demands termed dynamism, complexity

and uncertainty (as illustrated by the dots in the fine solid lines in Fig. 2). This earlier framework was adopted throughout our research project. The recently revised framework now includes the interaction of all three control demands (as illustrated by the dots intersected by the broken lines in Fig. 2) with all three of the functional resources of activity thus creating nine core-task work demands.

Norros (2014) demonstrates the elaborated modelling approach in the context of human operators' work in the on-line management of telecommunication networks and illustrates the three additional core-task demands applied in this context. In this model adapted from Norros et al (2012), a new issue of dialogical communication was added and is associated with the link between collaboration and uncertainty (as illustrated by the bold solid line in Fig. 2) .

This is very interesting and our work is in alignment with this new demand as it had anticipated the need for a communicative process using a collaborative activity as a mechanism to address uncertainty in the work domain. In our earlier empirical data collection and analysis the liaison officers described the utilisation of communicative processes in addressing the challenge of information uncertainty. Yet applied in its purist form the concept of dialogical communication may need to be customized for the emergency management domain.

The concept of dialogical communication is often associated with the theologian Martin Buber who suggested that dialogue involves an effort to recognize the value of the other person and is not merely a means to achieving a desired goal. Buber suggested that dialogical communication is based on reciprocity, mutuality, involvement, and openness (Buber, 1970). The concept of dialogical communication is indeed suited to the study reported by Norros et al (2012) in which twenty people who operate the networks of a Finnish communications company were interviewed. As all the participants in the study were employed by the same company it would be sensible to believe that they may have some history of interaction with each other and had similar overall objectives. Subsequently they may embrace the potential to possibly achieve 'real dialogue'.

It would appear that facets of dialogical communication are evident in our previous research. The concept of distributed situation awareness was practiced by the liaison officers to manage some of the challenges associated with information uncertainty. This concept is also aligned to the notion of dialogical communication where there is a requirement for communicative processes and in particular the collaboration with other personnel in the emergency operations centre to address any information uncertainties. However, dialogical communication may need to be adapted in the context of emergency management multi-agency coordination. Despite the similarities between the two high reliability environments of telecommunication networks and emergency management, strategic level emergency operations centres are multifaceted and comprise of multiple agencies all with differing agendas and objectives. Liaison officers with a history of working together such as the police and fire services may have a history of trust building and therefore able to engage in dialogical communication. However, compounding the complexities of multi-agency coordination is the fact that some liaison officers may never have interacted with each other previously. Therefore with no basis for trust building the concept of dialogical communication in its purist form may need to be modified for these stakeholders.

We posit that liaison officers in the aforementioned domain assume the activity of dialogical communication but for those liaison officers with no history of trust building we propose that communication is based upon its factual content. This form of communication is in the ethos of swift trust (Meyerson et al., 1996) where trust is not so much about interpersonal factors and relating to people, as is evident in traditional forms of trust building over a prolonged period of time. It is more about action and the requirement to 'get things done' influenced by the ability to develop shared understanding of (evolving) situations and the respective contributions made by different liaison officers. It avoids personal disclosure in favour of a reliance and absorption in the task driven by the generic features of the setting (Meyerson et al., 1996).

It would seem appropriate that some liaison officers adopt this style of communication to address the emerging work demands associated with strategic level emergency operations centres.

We have proposed a theoretical framework for facilitating multi-agency coordination in emergency management that can be applied in the development of operational doctrine and may assist designers in mitigating the challenges associated with multi-agency coordination in disasters. This research has investigated multi-agency coordination using a methodological framework grounded in human factors and ergonomics and applied it within a new domain. By applying the core-task analysis framework in an alternate high reliability environment we have been able to extend the theory of this method embracing the unique requirements of emergency management.

This current research is to some extent exploratory in nature and thus our theoretical framework requires testing by liaison officers working within strategic level emergency operations centres to assess its applicability in facilitating multi-agency coordination. Nevertheless, the study is currently facilitating participatory development interventions with industry stakeholders. At the time of writing this article there was a lack of dedicated training for liaison officers specifically working in strategic level emergency operations centres in Australia. The subsequent phase of this study has involved extensive consultation with liaison officers from multiple agencies in the development of a workshop for training purposes. The theoretical framework suggested in this paper in tandem with other insights gained by the research regarding the core content of the liaison officer's work in multi-agency coordination arrangements has assisted in the development of the workshop. Positively, two pilot workshops have been conducted with liaison officers at two of the participating strategic level emergency operations centres involved in this study. The workshop is only in the early stages of development but it is anticipated that it will enhance the role of liaison officers and facilitate multi-agency coordination in strategic level emergency operations centres. By exploring multi-agency coordination from a human-environment interaction perspective we believe that we have improved the ability for liaison officers working in strategic level emergency operations centres to manage expected as well as unexpected work situations and thereby cope more efficiently (Hollnagel, 2014).

References

Boin, A., McConnell, A., 2007. Preparing for Critical Infrastructure Breakdowns: The Limits of Crisis Management and the Need for Resilience. J. Contingencies Cris. Manag. 15, 50–59.

Buber, M., 1970. I and thou (W. Kaufmann, Trans.). Charles Scribner's Sons, New York.

Comfort, L., Kapucu, N., 2006. Inter-organizational coordination in extreme events: The World Trade Center attacks, September 11, 2001. Nat. Hazards 39, 309–327.

Comfort, L., Wisner, B., Cutter, S., Pulwarty, R., Hewitt, K., Oliversmith, a, Wiener, J., Fordham, M., Peacock, W., Krimgold, F., 1999. Reframing disaster policy: the global evolution of vulnerable communities. Glob. Environ. Chang. Part B Environ. Hazards 1, 39–44.

Curnin, S., Owen, C., 2013. Obtaining information in emergency management: a case study from an Australian emergency operations centre. Int. J. Hum. Factors Ergon. 2, 131–158.

Curnin, S., Owen, C., 2014. Spanning Organizational Boundaries in Emergency Management. Int. J. Public Adm. 37, 259–270.

Curnin, S., Owen, C., Paton, D., Trist, C., Parsons, D., 2014a. Swift trust: a mechanism to manage critical infrastructure challenges in emergency management? Manuscrpt submitted.

Curnin, S., Owen, C., Trist, C., 2014b. Managing the constraints of boundary spanning in emergency management.

Cogn. Technol. Work. DOI: 10.1007/s10111-014-0285-z

Doyle, E.E.., McClure, J., Johnston, D.., Paton, D., 2014. The Shifting of Likelihood Perceptions for Time Window Forecasts of Volcanic Eruptions. J. Volcanol. Geotherm. Res. 272, 1–15.

Faraj, S., Xiao, Y., 2006. Coordination in Fast-Response Organizations. Manage. Sci. 52, 1155–1169.

Folke, C., Colding, J., Berkes, F., 2003. Synthesis: Building resilience and adaptive capacity in social-ecological systems, in: Berkes, F., Colding, J., Folke, C. (Eds.), Navigating Social-Ecological Systems: Building Resilience for Complexity an Change. Cambridge University Press, Cambridge, UK, pp. 353–387.

Gryszkiewicz, A., Chen, F., 2012. Temporal aspects in crisis management and its implications on interface design for situation awareness. Cogn. Technol. Work 14, 169–182.

Harrald, J.R., 2006. Agility and Discipline: Critical Success Factors for Disaster Response. Ann. Am. Acad. Pol. Soc. Sci. 604, 256–272.

Helsloot, I., 2005. Bordering on Reality: Findings on the Bonfire Crisis Management Simulation. J. Contingencies Cris. Manag. 13, 159–169.

Hollnagel, E., 2014. Human factors/ergonomics as a systems discipline? "The human use of human beings" revisited. Appl. Ergon. 45, 40–4.

Janssen, M., Lee, J., Bharosa, N., Cresswell, A., 2010. Advances in multi-agency disaster management: Key elements in disaster research. Inf. Syst. Front. 12, 1–7.

Kruchten, P., Woo, C., Monu, K., Sotoodeh, M., 2008. A conceptual model of disasters encompassing multiple stakeholder domains. Int. J. Emerg. Manag. 5, 25–56.

Marcus, L.J., Dorn, B.C., Henderson, J.M., 2006. Meta-leadership and national emergency preparedness: A model to build government connectivity. Biosecur. Bioterror. 4, 128–34.

McGuire, M., Silvia, C., 2010. The Effect of Problem Severity, Managerial and Organizational Capacity, and Agency Structure on Intergovernmental Collaboration: Evidence from Local Emergency Management. Public Adm. Rev. March/Apri, 279–288.

McMaster, R., Baber, C., 2012. Multi-agency operations: cooperation during flooding. Appl. Ergon. 43, 38–47.

Meyerson, D., Weick, K., Kramer, R., 1996. Swift Trust in Temporary Groups, in: Kramer, R., Tyler, T. (Eds.), Trust in Organizations: Frontiers of Theory and Research. Sage Publications Ltd., Thousand Oaks, CA, pp. 166–195.

Mishra, J.L., Allen, D.K., Pearman, A.D., 2011. Information sharing during multi-agency major incidents. Proc. Am. Soc. Inf. Sci. Technol. 48, 1–10.

Moynihan, D.P., 2007. From forest fires to hurricane Katrina: case studies of incident command systems. Washington DC.

Norros, L., 2004. Acting under uncertainty. The core-task analysis in ecological study of work. VTT Publications, Espoo.

Norros, L., 2014. Developing human factors/ergonomics as a design discipline. Appl. Ergon. 45, 61–71.

Paton, D., Auld, T., 2006. Resilience in Emergency Management: Managing the flood, in: Disaster Resilience: An Integrated Approach. Charles C. Thomas, Springfield, Ill, pp. 268–288.

Paton, D., Owen, C., 2013. Incident management, in: Bradley Penuel, K., Statler, M., Hagen, R. (Eds.), Encyclopedia of Crisis Management. Sage Publications Ltd., Thousand Oaks, CA, pp. 502–506.

Pearce, T., Fortune, J., 2006. Command and Control in Policing: A Systems Assessment of the Gold, Silver and Bronze Structure. J. Contingencies Cris. Manag. 3, 181–187.

Perry, R.W., 2003. Emergency Operations Centres in an Era of Terrorism: Policy and Management Functions. J. Contingencies Cris. Manag. 11, 151–159.

Raj, A.K., Doyle, M.J., Cameron, J.D., 2011. Psychphysiology and performance: Considerations for human-centered design, in: The Handbook of Human-Machine Interaction: A Human-Centred Approach. Farnham: Ashgate, pp. 53–74.

Reddick, C., 2011. Information technology and emergency management : preparedness and planning in US states. Disasters 35, 45–61.

Salmon, P., Stanton, N., Walker, G., Jenkins, D., Baber, C., McMaster, R., 2008. Representing situation awareness in collaborative systems: a case study in the energy distribution domain. Ergonomics 51, 367–84.

Scholtens, A., 2008. Controlled Collaboration in Disaster and Crisis Management in the Netherlands , History and Practice of an Overestimated and Underestimated Concept. J. Contingencies Cris. Manag. 16.

Schraagen, J.M., Van de Ven, J., 2008. Improving Decision Making in Crisis Response Through Critical Thinking Support. Hum. Factors 2, 311–327.

Teague, B., McLeod, R., Pascoe, S., 2010. 2009 Victorian Bushfires Royal Commission Final Report. Melbourne.

Tsang, P., Wilson, G., 1997. Mental workload, in: Salvendy, G. (Ed.), Handbook of Human Factors and Ergonomics. Plenum, New York, pp. 417–449.

Van de Walle, B., Turoff, M., 2008. Decision support for emergency situations. Inf. Syst. E-bus. Manag. 6, 295–316.

Van Scotter, J., Pawlowski, S., Cu, T., 2012. An examination of interdependencies among major barriers to coordination in disaster response. Int. J. Emerg. Manag. 8, 281–307.

Vogt, M., Hertweck, D., Hales, K., 2011. Optimizing ICT Portfolios in Emergency Management : A Modular Alignment Approach, in: Proceedings of the 8th International ISCRAM Conference. pp. 1–11.

Walker, G., Stanton, N., Salmon, P., Jenkins, D., 2014. Human performance under two different command and control paradigms. Appl. Ergon. 45, 706–713.

Walsh, D., Christen, T., Christen Jr, H., Lord, G., Miller, G., 2011. National incident management system: Principles and practice. Jones & Bartlett Publishers.

Wise, C.R., 2006. Organizing for homeland security after Katrina: Is adaptive management what's missing? Public Adm. Rev. 66, 302–318.

Wolbers, J., Boersma, K., 2013. The Common Operational Picture as Collective Sensemaking. J. Contingencies Cris. Manag. 21, 186–199.

Appendix F: Project and ethics information for individual interviews

Information sheet for individual interviews: Multi-agency Emergency Coordination Research Project

Project title of overall study:

Enhancing emergency management team effectiveness and organizational learning

Specific PhD Research Question: Achieving multi-agency emergency management coordination

The University of Tasmania, through the Bushfire Co -operative Research Centre, is working to enhance inter-agency coordination of critical information flows between emergency management partner organizations to support relevant and timely information to communities. As a key stakeholder involved in emergency events, you are being invited to participate in an interview to discuss what you think enables and constrains successful multi-agency information flow in emergency events at state level of emergency management. Some information on the study and the interview phase is outlined below.

Who is responsible for the investigation?

Chief Investigator:

Dr. Christine Owen, Senior Lecturer, University of Tasmania, Faculty of Education

Telephone: (03) 6226 2555

E-mail: Christine.Owen@utas.edu.au

Other investigators:

Mr. Steven Curnin, PhD Candidate, University of Tasmania
Telephone: (03) 6226 7621
E-mail: Steven.Curnin@utas.edu.au

Please contact Christine or Steve if you have any queries about the project.

What is the purpose of the research?

The study aims to investigate coordination and information flows between agencies involved in emergency events in order to enhance relevant and timely information to communities. It has a specific focus on how coordination occurs at regional and state levels of emergency management. You have been sent this information sheet by a third party because your agency has agreed to participate. The research is being undertaken as part of a Bushfire Co -operative Research Centre study. We hope that the research will make a significant contribution to understanding what organizational processes help and hinder making multi -agency co-ordination more effective. The three main objectives are:

1. Identify and map the inter-relationships that support the dissemination of critical information;

2. From Objective 2, model similarities and differences in inter-agency coordination and information dissemination; and,

3. From Objectives 1, 2 and 3, make recommendations for improvement.

What are the likely benefits of the research for me and others?

We will be making a report on the collated data to agencies involved in the study, with recommendations for improvement. There are no specific benefits for you as an individual but it is expected there will be benefits from an organizational perspective. Although Management in the Agencies are not bound to implement any of our recommendations we would hope you may see some of the following benefits:

- improved inter-agency networking and coordination;
- improved information flow from response agencies to emergency management partner organizations;
- more seamless transition between planning, response and recovery phases of an emergency event; and
- better emergency services provision supporting communities.

Why have I been chosen as a potential participant in this research?

The study is exploring coordination and information flow within multi-agency operations in emergency events at regional and state levels of command and control as well as coordination. Recent research has shown that the quality and timeliness of information flow is crucial.

As a valued stakeholder with experience in this s field, you are being offered a unique opportunity to take part in this ground -breaking and important research. Participation is entirely voluntary, but we would hope you can see the benefits and will feel comfortable about participating.

What am I being asked to do?

We are asking if we might be able to interview you to gain your experience of being involved in an emergency event. We expect the interview to take between 45 -60 minutes. A copy of the questions you will be asked are included with this Information Sheet. If you do not have a copy of the interview questions, please email

Christine.Owen@utas.edu.au or

Steven.Curnin@utas.edu.au

Telephone (03) 6226 7621

With your permission, the researchers will audio-record your answers. We are particularly interested in what you think helps or hinders effective information flow, and multi-agency coordination, particularly at regional and state levels and how this supports incident management at a local level.

Participation is entirely voluntary. You can ask the researcher to stop the interview at any time. Your agency is supporting this research so the interview can occur in work time. The interview will be

conducted in a location of your own choosing. That is, it may occur in a private space in the workplace if you are comfortable with this, or in another location nominated by you. If the interview is happening face to face you will need to read and sign the consent form attached to this information sheet. The interview may also be conducted by telephone at a time nominated by you. If the interview is conducted by telephone, the interview will commence by asking you if you have read the information sheet, if you have any questions and if you have read the consent form, and are willing to give your verbal consent and to have the telephone interview recorded. If you answer yes to these questions, the interviewer will turn on the tape recorder and ask you to acknowledge formally that you have read the information sheet, the consent form and are willing under these circumstances to participate in the interview, knowing that the interview is being taped and that you can ask the tape to be turned off at any stage.

Are there any potential risks or discomforts to me?

_
We have thought carefully about what possible risks there might be for you and we have identified the following possible risks. We have also thought carefully about how we may protect you from those risks. The risks and the strategies we have developed to mitigate those risks are outlined below.

Why have I been chosen as a potential participant in this research?

The study is exploring coordination and information flow within multi-agency operations in emergency events at regional and state levels of command and control as well as coordination. Recent research has shown that the quality and timeliness of information flow is crucial.

As a valued stakeholder with experience in this s field, you are being offered a unique opportunity to take part in this ground -breaking and important research. Participation is entirely voluntary, but we would hope you can see the benefits and will feel comfortable about participating.

What am I being asked to do?

We are asking if we might be able to interview you to gain your experience of being involved in an emergency event. We expect the interview to take between 45 -60 minutes. A copy of the questions you will be asked are included with this Information Sheet. If you do not have a copy of the interview questions, please email

Christine.Owen@utas.edu.au or

Steven.Curnin@utas.edu.au

Telephone (03) 6226 7621

With your permission, the researchers will audio-record your answers. We are particularly interested in what you think helps or hinders effective information flow, and multi-agency coordination, particularly at regional and state levels and how this supports incident management at a local level.

Participation is entirely voluntary. You can ask the researcher to stop the interview at any time. Your agency is supporting this research so the interview can occur in work time. The interview will be conducted in a location of your own choosing. That is, it may occur in a private space in the workplace if you are comfortable with this, or in another location nominated by you. If the interview is happening face to face you will need to read and sign the consent form attached to this information sheet. The interview may also be conducted by telephone at a time nominated by you. If the interview is conducted by telephone, the interview will commence by asking you if you have read the information sheet, if you have any questions and if you have read the consent form, and are willing to give your verbal consent and to have the telephone interview recorded. If you answer yes to these

questions, the interviewer will turn on the tape recorder and ask you to acknowledge formally that you have read the information sheet, the consent form and are willing under these circumstances to participate in the interview, knowing that the interview is being taped and that you can ask the tape to be turned off at any stage.

Are there any potential risks or discomforts to me?

We have thought carefully about what possible risks there might be for you and we have identified the following possible risks. We have also thought carefully about how we may protect you from those risks. The risks and the strategies we have developed to mitigate those risks are outlined below.

Will I be identified?

No personal information will be sought, recorded or published. Only data that has been aggregated will be made available for publication and review.

How private is the information I give?

This information has been sent to you by a third party in your agency and the researchers do not have your names or contact details.

In addition the researchers will not be advising the agency who from their organization did participate in the research.

Once you have participated, we are ethically required to store de -identified data for a minimum period of five years after the publication of a report or Thesis. All data will be stored in locked filing cabinets or as password protected files in a secure (locked) room at the University of Tasmania, Faculty of Education. When your data is no longer needed, electronic files will be erased and printed material shredded.

Can I withdraw if I wish?

_
Participation is entirely voluntary. Should you decide to participate, you will be able to withdraw at any time during the interview without effect or explanation. However, from the time the interview is transcribed your data will not be available for withdrawal because we will have no way of telling which data is yours.

Has the research been approved by an ethics committee?

The project has received ethical approval from the Human Research Ethics Committee Tasmania) Network which is constituted under the National Health and Medical Research Council. The committees under the HREC (Tasmania) Network use the National Statement on Ethical Conduct in Research Involving Humans Guidelines to inform their decisions.

Who should I contact if I have any ethical concerns about the project?

If you have any concerns of an ethical nature or complaints about the manner in which the project is conducted, you may contact the Executive Officer of the Human Research Ethics Committee (Tasmania) Network. The Executive Officer can direct you to the relevant Chair of the committee that reviewed the research.

Executive Officer: (03) 6226 2763 or Katherine.Shaw@utas.edu.au

How can I access the research results?

You will be sent a copy of your interview transcript for review as necessary and to confirm the contents are correct.

What should I do now?

If you decide you would like to participate in an interview, please contact Christine Owen either by email Christine.Owen@utas.edu.au or Steven Curnin at Steven.Curnin@utas.edu.au or by telephone (03) 6226 7621or facsimile (03 6226 7839) to arrange a suitable time for the interview. The interview can either be by telephone or at a time convenient when a researcher will be in your area.

Thank you for taking the time to read this Project Information Sheet. If you have any queries, either before or after the meeting, please contact Christine or Steven any time.

Date: 02 July 2012

Dr. Christine Owen (chief investigator on behalf of the research team)
Telephone: (03) 6226 2555
E-mail: Christine.Owen@utas.edu.au

Semi-structured interview questions

1. What would you define are the core tasks of a liaison officer at the strategic command level? (E.g. Boundary spanning, Information conduit, Communicator)

2. How do you achieve these tasks? (E.g. What information systems do you use, how do you achieve situational awareness, what personal skills to you use, and what training did you receive to perform this role)

3. What do you see are the challenges and constraints that impact your capacity to perform this role? (E.g. IT, cultural, trust)

4. How do you overcome these challenges? (E.g. Do you see these challenges as specific to the liaison officer role in your specific agency or are they inherent problems applicable to other liaison officers from any agency)

5. What do you think would be the impact of a failure in coordination between agencies involved in a multi-agency incident?

6. Do you think there are circumstances when this could occur due to uncontrollable factors, such as poor communication channels?

7. Have you ever been in a situation where this has occurred and how did you overcome these obstacles? (E.g. did you encounter any resistance?)

8. And finally, what do you see as some of the challenges for the future in the emergency management domain?

Participation consent form for interviews for the project
Multi-agency Emergency Management Coordination Research Project

In volunteering to participate in the above project, I hereby acknowledge that:

1. I have read and understood the "Project Information Sheet" for this study.
2. The nature and possible effects of the study have been explained to me.
3. I understand that this phase of the study involves the following procedures:
4. An audio taped interview of approximately 40-60 minutes that will be transcribed and, once de-identified, form part of the collated findings.
5. I understand that I will be sent a transcribed copy of the interview for review as necessary and to confirm the contents are correct.
6. I understand that only authorised personnel will have access to the audio-tape, and that, no unauthorised person, including myself, will be able to listen to the audiotape, and that the transcription made from the interview will be de-identified in the ways outlined in the information sheet.
7. I have read the Project Information Sheet and understand the risks involved in participating in this research. I understand that the risks identified are mitigated by the strategies outlined in the Project Information Sheet.
8. I understand that de-identified transcribed interview data will be stored securely at University of
9. Tasmania premises for at least five years and will be destroyed when no longer required.
10. Any questions I have asked have been answered to my satisfaction.
11. I agree that research data gathered for the study may be published provided that I am not identifiable as a Participant.
12. I understand that my identity will be kept confidential and that any information I supply to the researcher will be used only for the purposes of the research.
13. I agree to participate in this investigation and understand that I may cease the observation or withdraw from the interview at any time. Whether or not I withdraw, I appreciate that I will not be able to withdraw or modify my data because the data will be de-identified.

Participant's name:

Participant's signature:

Date:

Statement by investigator:

I have explained this project and the implications of participation in it to this volunteer and I believe that the consent is informed and he/she understands the implications of participation.

Investigator's name:

Investigator's signature:

Date:

Follow up consent form for interviews for the project
Multi-agency Emergency Management Coordination

Would you be interested in allowing us to contact you again in subsequent years to discuss your experiences and any changes you might have noticed? If yes, could you please provide your contact details below?

Please note this page will be kept in a separate location from your consent form.

Yes I am happy for the researchers involved with this project to contact me again. My contact details are:

Name:

Phone number:

Email address:

Appendix G: Project and ethics information for observational studies

Information sheet for observations as part of PhD study

TO ALL PARTICIPANTS INVOLVED IN – 2012/2013 Bushfire Season

Project title: Enhancing emergency management team effectiveness and organizational learning (Ethics Reference: H8810)

Specific Research Question: Achieving multi-agency emergency management coordination
You are invited to attend a briefing to hear more about a research project to be conducted at an operationally convenient time. Some information on the study is outlined below. Please contact the researchers to learn more or approach them prior to the exercise to ask any questions you may have.

Who is responsible for the investigation?

Chief Investigator: Dr. Christine Owen - Senior Lecturer,
University of Tasmania Faculty of Education
Telephone: (03) 6226 2555
E-mail: Christine.Owen@utas.edu.au

Other investigators: Steven Curnin - PhD candidate,

University of Tasmania Faculty of Education
Telephone: (03) 6226 7621
E-mail: Steven.Curnin@utas.edu.au
Please contact Christine or Steven if you have any queries about the project.

What is the purpose of the research?

The study aims to investigate communication strategies and collaborative work practices in incident management team work and this agency has been selected as one of those agencies. The research is being undertaken as part of a Bushfire Co-operative Research Centre study and will also be useful to assist Steven Curnin to fulfil the requirements of his PhD studies at the University of Tasmania. We hope that the research will make a significant contribution to understanding what organizational process help and hinder multi-agency coordination. The four main objectives of the study are:

1. Investigate individual and collective communication strategies and collaborative work practices, both in evidence, and needed for multi-agency incidents to work effectively;

2. Identify, map and model information and coordination processes within multi-agency-incidents, and identify those organizational structures, levels of information and communication technology (ICT) support, and training/learning programs that assist individuals and collectives to successfully coordinate information flows during emergencies;

3. From Objective 2, model similarities and differences observed; and,

4. From Objectives 1, 2 and 3, make recommendations for improvement.

What are the likely benefits of the research for me and others?
We will be making a report on the collated data to agencies involved in the study, with recommendations for improvement. Although Management in the Agencies are not bound to implement any of our recommendations we would hope you may see some of the following benefits:

- improved strategies to enhance communication and short-term collaborations with others;
- improved flows of information between yourself and your co-workers; and,
- improved training initiatives to enhance the effectiveness of multi-agencies in work practices.

Why have I been chosen as a potential participant in this research?
The study is exploring communication strategies and collaborative work practices in multi-agency incidents. Recent research has shown that the quality and timeliness of interactions are crucial. The big challenge is to identify what structures (e.g., training, ICT support etc.) support people to achieve seamless information flow across key functional areas of modern coordination centres.
As a valued member of your agency, you are being offered a unique opportunity to take part in this ground-breaking and important research. Participation is entirely voluntary, but we hope you can see the benefits and are interested in helping us.

What am I being asked to do?
We are asking that you allow us to observe, which may include video and recording of your work practice, to interview you about what happened and to complete a brief survey (at an assessment sheet during an operationally convenient time). In case of planned incident training exercises you may be asked to complete the survey both before and after the exercise. We are particularly interested in how/when/why you performed certain tasks pertaining to your role.

We may also be taking still photographs of activities in the IMT/coordination Centre. These are similar to the photographs agencies typically take of Emergency Operations Centre work activity. We would like to use these photographs in our descriptions of the context of the setting under study.
Should you decide to participate, if you are completing the survey for a training exercise, we will ask you to make up a code so we can match your responses before and after the exercise. However, only you will know the code and so we will not be able to match your survey to any of the observed interactions.
For the observation you might be asked to wear a lapel microphone and be recorded for a period of time as you go about your work. As soon after the observation as possible, we would like to interview you to discuss what was going on at certain times. During the interview, we may use parts of the video as a memory aid. With your permission, the researchers will audio-record your answers. We are particularly interested in how/when/why you interacted with others and what factors affected your interactions and decisions.

Participation is entirely voluntary, but if you choose to take part you will need to read and sign the consent form attached to this information sheet. You can ask the researcher to stop the observation or interview at any time.
Once the video has been transcribed and coded for types of communications and collaborations it will be destroyed within 30 days of your observation.
Examples of the kinds of communications we will be coding for the observation include ‘how do you gain situational awareness, who do you liaise with, how do you disseminate and receive information, do you do this using an IT platform/telephone/face-to-face’.

Are there any potential risks or discomforts to me?

We have thought carefully about what possible risks there might be for you and we have identified the following possible risks. We have also thought carefully about how we may protect you from those risks. The risks and the strategies we have developed to mitigate those risks are outlined below.

Legal risk
You may be at legal risk if sub-optimal performance was recorded and if this was subsequently able to be linked to an adverse outcome in your work practice.

How will this possible risk be minimised?
We will ensure that the date and time of your observation are not included when data is recorded. No personal details will be recorded or linked to the observation. In the survey only you will know your code, so we cannot connect your survey responses to any of the interactions observed. If there is anything said or done in the observation that could identify you, we will change it and make it generic rather than specific. **Once the video and/or audio recording of your observation has been transcribed, and the type of collaboration and team-based practices in evidence coded, the video tape will be destroyed**. **This will occur within a 30 day period of the observation**.

Psychological/social risk
If your work is particularly stressful or if an unforeseen event occurred during the observation, you could be subjected to unnecessary stress should the observation continue? You may feel scrutinised or coerced into taking part.
There is a potential social risk if we were to fail to fully protect your identity.

How will this possible risk be minimised?
At any time during the observation, you can inform the researcher that you would like the observation to cease. If this happens, the researcher will immediately cease observing or recording and physically remove themselves from the scene.
The video and interview will only occur for a brief period and will be discrete. Management will not know whether or not you have declined to participate since Management have been advised that only a sample of those willing to participate will be observed and interviewed. If a member of management walked past if the video observation was occurring they may know that you participated in the study but they would not know if your data is to be included (we have advised management that we are only including a sample of the data collected).

Risk of harming professional standing
There is a risk to your professional standing and future career prospects if your manager/ supervisor learned that you made a mistake during the recorded observation.

How will this possible risk be minimised?
Management have been advised and understand that they will not have access to any raw data **(or video should it be used)** collected as part of this study and that **the video footage will be destroyed after we have coded it. We will make sure** that no identifying information is recorded, either during the observations or the interviews by ensuring that any activities that could identify you in particular will be removed or changed. No one other than those authorised by the University ethics committee will have access to the video footage (for 30 days) or to the de-identified interview/observation transcripts. Those authorised include the researchers and a University-employed transcriber who will sign a confidentiality agreement.

Will I be identified?
No personal information will be sought, recorded or published. **Video tapes will be destroyed within 30 days of the observation following coding**. All interview data will be de-identified. Only data that has been aggregated will be made available for publication and review. This process will also be time-delayed (that is, data that is at least 6 months old and collected/analysed from all the observations of communication patterns) will be discussed. Management may know that you participated in the observations if they were to walk past when an observation was occurring however, they will not

know if your data has been included in the overall study and will not be able to link any observational data to your observation.

How private is the information I give?
We are ethically required to store de-identified data for a minimum period of five years after the publication of the findings and the PhD thesis. All data will be stored in locked filing cabinets or in a locked filing room or as password protected files in a secure (locked) room at the University of Tasmania, Faculty of Education. When your data is no longer needed, electronic files will be erased and printed material shredded.

Can I withdraw if I wish?
Participation is entirely voluntary. Prior to taking part, you will be asked to sign the consent form accompanying this information sheet, and, should you decide to participate, you will be able to withdraw at any time during the data collection period without effect or explanation. However, from the time the observation and the post-observation interview is concluded and consent is confirmed, your data will not be available for review or withdrawal. There are two reasons for this, namely:

1. We are trying to capture what actually happens in real-time and for this we need unedited data; and,

2. Immediately after the observations, your data will be de-identified and coded and no longer identifiable as yours. The video tape will be destroyed within 30 days and we will have no way of telling which data is yours.

Has the research been approved by an ethics committee?
The project has received ethical approval from the Human Research Ethics Committee (Tasmania) Network which is constituted under the National Health and Medical Research Council. The committees under the HREC (Tasmania) Network use the National Statement on Ethical Conduct in Research Involving Humans Guidelines to inform their decisions.

Who should I contact if I have any ethical concerns about the project?
If you have any concerns of an ethical nature or complaints about the manner in which the project is conducted, you may contact the Executive Officer of the Human Research Ethics Committee (Tasmania) Network. The Executive Officer can direct you to the relevant Chair of the committee that reviewed the research.

Tel: (03) 6226 2763

E-mail: Katherine.Shaw@utas.edu.au

How can I access the research results?
We are planning to conduct debriefing sessions in your agency to share the main findings with staff following the conclusion of the project. You may also receive a copy of the collated findings at the completion of the investigation, should you request it. If you wish to receive a copy of the collated findings you need to tell us at the time of interview. A copy of the findings and the PhD Thesis, will be available in the organization's library should you wish to review the entire project.

What should I do now?
The researchers will conduct a briefing before the commencement of the exercise and will be available for answering any questions at the briefing or in private. We invite you to attend before deciding whether or not you would like to take part in the research. If you subsequently decide to participate you will need to let the researchers know and you will need to sign the consent form. One of the researchers will then approach you and ask you to complete the survey.

Even if you don't want to participate, please understand that at some designated times observations of others will be occurring within your workspace. On the day of the observations and interviews, notices will be displayed that observations are occurring. If for some reason you manage to cross in front of a video camera this will not be included in the subsequent transcription of the observation. If you talk with a person being observed it will be recorded as 'third party enters area and engages in interaction'. We are only interested in the communications of the participant being observed.

We may also be taking still photographs so we can describe the broad context of work activity in publications and displays. If you do not wish your face to be included in the photographs please let one of the researchers know and we will ensure any photographs that include you are not used. Thank you for taking the time to read this Project Information Sheet. If you have any queries, either before or after the meeting, please contact Christine or Steve at any time.

Kind regards

Date: 14 June 2012

Dr. Christine Owen (chief investigator on behalf of the research team)

Telephone: (03) 6226 2555

E-mail: Christine.Owen@utas.edu.au

Participation consent form for observations of training exercises 2012/2013BushfireSeason
Project title:
Enhancing emergency management team effectiveness and organizational learning

In volunteering to participate in the above project, I hereby acknowledge that:

1. I have read and understood the "Project Information Sheet" for this study.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves the physical presence of a researcher observing my actions and taking notes using the observational protocol document during the exercise. There are additional components that you can choose to select if you wish. However, there are no consequences to you if you do not wish to choose these additional components. You may wish to change your mind at any time and select or opt out of any component. If that is the case it is completely acceptable. The additional following procedures are as follows:
4. I agree to a video and audio taped on-site observation

   Yes No
5. I agree to an audio taped interview of approximately 30 minutes

   Yes No
6. I agree to a brief survey (during training exercises) of approximately 5 minutes, to be completed at the beginning and the end of the exercise each time it occurs.

   Yes No
7. I agree to periodic checking of my own assessment of how well I feel I am doing.

   Yes No
8. I agree to some still photographs of group work that may be displayed and published.

Yes No

9. If I have selected an option that allows the observation to use video I understand that only authorised personnel will have access to the video, and that, following the interview where we may discuss aspects of the videoed observation, no unauthorised person, including myself, will be able to view the video tape, and that the video tape will be destroyed following transcribing and coding after 30 days.

10. I have read the Project Information Sheet and understand the risks involved in participating in this research. I understand that the risks identified are mitigated by the strategies outlined in the Project Information Sheet.

11. I understand that de-identified coded observation data and de-identified transcribed interview data will be stored securely at University of Tasmania premises for five years after publication of this research project and will then be destroyed.

12. Any questions I have asked have been answered to my satisfaction.

13. I agree that research data gathered for the study may be published provided that I am not identified as a participant.

14. I understand that my identity will be kept confidential and that any information I supply to the researcher will be used only for the purposes of the research.

15. I agree to participate in this investigation and understand that I may cease the observation or withdraw from the process at any time without any consequences. If I decide to withdraw, I understand that I may also choose to withdraw any of my data which relates to me alone (group data cannot be separately identified and removed).

Participant's name: _____
Participant's signature: _____ Date: _____

Statement by investigator:

I have explained this project and the implications of participation in it to this volunteer and I believe that the consent is informed and he/she understands the implications of participation.

Investigator's name: _____
Investigator's signature: _____ Date: _____

Multi-agency Incident Exercise Observation Sheet

Researcher: _____ Time/date exercise commenced: _____
Date: _____ Time of observation: from _____to_____
Date/time of observation completion: _____
Exercise name: _____
Location: _____
Subjects' role: _____
Subjects' agency: _____

Please identify the following:

How did the subject gain situational awareness?

Who did the subject liaise with do disseminate and receive information?

How did they do this (IT platform/telephone/face-to-face)?

Did the subject face any challenges in their role?

What were these?

How did the subject overcome these challenges?

Appendix H: Amended observational study protocol guidelines

Name of the observer: **Date and time of the event:** **Location of observation:** **Observed participants agency:**			
GENERAL INFORMATION	**DESCRIPTION**		
Receiving information	(Describe how the participant is receiving information: briefings, IT systems, visual displays, informal face to face communication, using telecommunications, etc. Are there any challenges related to performing this task)		
Disseminating information	(Describe how the participant is disseminating information: briefings, IT systems, informal face to face communication, using telecommunications, etc. Are there any challenges related to performing this task)		
Receipt of information	(Describe how the participant is in receipt of the information: is closed loop communication practices established. Are there any challenges related to performing this task)		
Analysing information	(Describe if the participant analyses the information or if it is merely forwarded on to the appropriate person. Are there any challenges related to performing this task)		
SITUATIONAL AWARNESS	**DESCRIPTION**		
How do you feel your situational awareness of the event is?	*Time……* 0 – none 1 – poor 2 – average 3 – good 4 – excellent	*Time……* 0 – none 1 – poor 2 – average 3 – good 4 – excellent	*Time……* 0 – none 1 – poor 2 – average 3 – good 4 – excellent
Do you feel the information you receive for your agencies decision making process is…?	*Time……* 0 – none 1 – poor 2 – average 3 – good 4 – excellent	*Time……* 0 – none 1 – poor 2 – average 3 – good 4 – excellent	*Time……* 0 – none 1 – poor 2 – average 3 – good 4 – excellent

Appendix I: Project and ethics information for group interviews

Group Interview Information sheet: Multi-agency Emergency Coordination Research Project

Project title of overall study: Enhancing emergency management team effectiveness and organizational learning

Specific PhD Research Question: How do stakeholders from multiple agencies achieve multi-agency emergency management coordination?

The University of Tasmania, through the Bushfire Cooperative Research Centre, is working to enhance inter-agency coordination of critical information flows between emergency management partner organizations to support relevant and timely information to communities. As a key stakeholder involved in emergency events, you are being invited to participate in a group interview, which will involve meeting with other fellow emergency management professionals involved in state level multi-agency arrangements. The aim of this group interview is for the group to discuss what enables and constrains successful multi-agency information flow in emergency events at a state level. Some information on the group interview process and the interview phase is outlined below.

Who is responsible for the investigation?

Chief Investigator:
Dr. Christine Owen, Senior Lecturer, Faculty of Education, University of Tasmania
Telephone: (03) 6226 2555 Christine.Owen@utas.edu.au

Other investigators:
Mr. Steven Curnin, PhD Candidate, Faculty of Education, University of Tasmania
Telephone: (03) 6226 7621 Steven.Curnin@utas.edu.au

Please contact Christine or Steve if you have any queries about the project.

What is the purpose of the research?

As part of the research process the purpose of conducting interviews in a group environment is to engage a diverse cross section of emergency management professionals and discuss factors what the agency representatives believe enable and constrain successful multi-agency information flow in emergency events at state level of emergency management. It will also give the research team the opportunity to give feedback on the preliminary findings from the individual interviews conducted in 2012. It is envisaged that the information from this feedback will form part of the discussion.
This is consistent with the broader study which aims to investigate coordination and information flows between agencies involved in emergency events in order to enhance relevant and timely information to communities.
You have been sent this information sheet by a third party because your agency has agreed to participate and you may have already participated in an individual interview as part of this research project. The research is being undertaken as part of a Bushfire Cooperative Research Centre study. We hope that the research will make a significant contribution to understanding what organizational processes help and hinder making multi-agency coordination more effective.

What are the likely benefits of the research for me and others?

The benefit of conducting group interviews is that participants will have the opportunity to hear what representatives from other agencies think are the constraints and challenges of multi-coordination at the state level and to discuss these in a multi-agency environment. It is envisaged that this will potentially give the participants a new understanding of the requirements of the different agencies involved in multi-agency coordination. The group interviews will consist of participants from emergency services, critical infrastructure and other agencies. This gives the participants an opportunity to explore the requirements and challenges of agencies that may not regularly operate together except outside of an emergency management event.
Although agency management is not bound to implement any of the recommendations we would hope you may see some of the following benefits:

- Greater understanding of agency requirements during a multi-agency emergency management event and in the pre-event phase
- Improved multi-agency coordination at the state level

Why have I been chosen as a potential participant in this research?

You have previously participated in an individual in depth interview with the research team discussing the challenges and requirements of your role at a state level during multi-agency coordination. The research team interviewed representatives from multiple agencies and feel that it would be beneficial to interview you again but in a group interview. Along with other representatives from multiple agencies the group interviews will enable all participants to explore further the requirements and constraints of personnel operating in this environment and how these challenges can be addressed.

What am I being asked to do?

We are asking if you could participate in a group interview to gain your feedback on the results collected so far and to gain your insights in discussion with others about the challenges and constraints of operating in a multi-agency environment.. We expect the interview to take between 60-120 minutes. Prior to commencing the group interview a synopsis of the data collected during the individual interviews will be presented. A copy of the questions posed to the group is included with this Information Sheet. If you do not have a copy of the interview questions, please email Christine.Owen@utas.edu.au or Steven.Curnin@utas.edu.au telephone (03) 6226 7621.

With your permission, the researchers will audio-record your answers. We are particularly interested in how the group discusses the issues that help or hinder effective information flow, and multi-agency coordination, particularly at a state level
Participation is entirely voluntary. You can ask the researcher to stop the interview at any time and at this point you are welcome to leave. Should you decide to leave the group the interview will continue. Your agency is supporting this research so the interview can occur in work time. The interview will be conducted at the State Control Centre in Victoria or the State Fire Operations Centre in Tasmania.

Are there any potential risks or discomforts to me?

We have thought carefully about what possible risks there might be for you and we have identified the following possible risks. We have also thought carefully about how we may protect you from those risks. The risks and the strategies we have developed to mitigate those risks are outlined below.
Legal risk

During the group interview you may feel it is beneficial to the group to give examples of your experiences involved in multi-agency coordination. In this case you may be at legal risk if you mentioned that you were responsible for sub-optimal performance which was linked to an adverse

outcome and that this became publicly known.
How will this possible risk be minimised?
We will ensure that the date and time of your interview are not included when data is recorded. We will also ensure that no personal details will be recorded or linked to the interview. If we report anything said in the interview that could identify you, we will change it and make it generic rather than specific.

Psychological/social risk

There is a potential social risk if you were to disclose something you did not wish to and where you felt vulnerable. The interview may also raise issues or memories that you find distressing.
How will this possible risk be minimised?
Participation in the interview is entirely voluntary and you do not have to participate if you do not wish to do so. We will be interviewing 6-10 people per group as part of this project. Having the interview questions beforehand allows you to reflect on and consider the kinds of comments you wish to make in the group discussion.
If you find that you do feel distressed you are encouraged to contact the following support services for counseling and support by trained personnel:

- Lifeline (13 1114)
- Beyondblue (1300 22 4636)

Risk of harming professional standing

There is a risk to your professional standing and future career prospects if your manager/supervisor learns that you discussed doing something wrong during the recorded interview. There may be a risk to your professional standing as colleagues from other agencies will be present in the room.
How will this possible risk be minimised?
Management has been advised and understands that they will not have access to any raw interview data collected as part of this study. We will make sure that no identifying information is included in the interview transcript by ensuring that any discussion that could identify you in particular will be removed or changed. No -one other than those authorised by the University ethics committee will have access to the interview recording or transcription for coding purposes.

Will I be identified?

No personal information will be sought, recorded or published. Only data that has been aggregated will be made available for publication and review.
Prior to the commencement of the group interview, all participants will be asked to sign the attached consent form. All participants in the group interview will be asked to maintain confidentiality and anonymity of the group interview process and its participants. However, complete confidentiality cannot be guaranteed by the interviewer as the research team is unable to control what the participants communicate outside of the group interview process.
Anonymity of all participants involved in the group interview will be maintained by the research team. However, if an anonymous quote from the group interview is used in a publication, there is a risk that a fellow participant involved in the group interview may recognize the quote and subsequently recognize the interviewee who made the quote. Therefore, while every effort will be made to assure anonymity this cannot be guaranteed by the research team.

How private is the information I give?

This information has been sent to you by a third party in your agency and the researchers do not have your names or contact details.
In addition the researchers will not be advising the agency who from their organization did participate in the research.

As noted above, your anonymity and confidentiality cannot be entirely guaranteed given the nature of the group interview. All participants will be asked to ensure these, but it cannot be guaranteed. Once you have participated, we are ethically required to store de -identified data for a minimum period of five years after the publication of a report or Thesis. All data will be stored in locked filing cabinets or as password protected files in a secure (locked) room at the University of Tasmania, Faculty of Education. When your data is no longer needed, electronic files will be erased and printed material shredded.

Can I withdraw if I wish?

Participation is entirely voluntary. Should you decide to participate, you will be able to withdraw at any time during the interview without effect or explanation. However, from the time the interview is transcribed your data will not be available for withdrawal because we will have no way of telling which data is yours.

Has the research been approved by an ethics committee?

The project has received ethical approval from the Human Research Ethics Committee (Tasmania) Network which is constituted under the National Health and Medical Research Council. The committees under the HREC (Tasmania) Network use the National Statement on Ethical Conduct in Research Involving Humans Guidelines to inform their decisions.

Who should I contact if I have any ethical concerns about the project?

If you have any concerns of an ethical nature or complaints about the manner in which the project is conducted, you may contact the Executive Officer of the Human Research Ethics Committee (Tasmania) Network. The Executive Officer can direct you to the relevant Chair of the committee that reviewed the research.

Executive Officer: 03) 6226 276 3 Katherine.Shaw@utas.edu.au

What should I do now?

If you decide you would like to participate in an interview, please contact Christine Owen either by email (Christine.Owen@utas.edu.au) or (Steven.Curnin@utas.edu.au) or by telephone (03) 6226 7621or facsimile (03 6226 7839) to arrange a suitable time for the interview. The interview can either be by telephone or at a time convenient when a researcher will be in your area.
Thank you for taking the time to read this Project Information Sheet. If you have any queries, either before or after the meeting, please contact Christine or Steven at any time.

Date: 31 January 2013
Dr. Christine Owen (chief investigator on behalf of the research team)
Telephone: (03) 6226 2555
Christine.Owen@utas.edu.au

Semi-structured group interview questions

Prior to commencing the group interview a synopsis of the data collected during the individual interviews describing the main demands and challenges of performing liaison roles at a Strategic Command level will be presented.

1. How do these findings relate to your personal experiences in multi-agency coordination?
2. What do you see as the current strengths and challenges of emergency management multi-agency coordination?
3. What strategies need to be established to facilitate effective multi-agency coordination at a

state level?

Participation consent form for Group interviews

Multi-agency Emergency Management Coordination Research Project

In volunteering to participate in the group interviews for the above project, I hereby acknowledge that:

1. I have read and understood the "Group Interview Information Sheet" for this study.
2. The nature and possible effects of the group interview have been explained to me.
3. I understand that this phase of the study involves the following procedures an audio taped interview of approximately 60-120 minutes that will be transcribed and, once de- identified, form part of the collated findings.
4. I understand that only authorised personnel will have access to the audio-tape and that no unauthorised person will be able to listen to the audiotape. The transcription made from the interview will be de-identified in the ways outlined in the group interview information sheet.
5. I have read the group interview information sheet and understand the risks involved in participating in this research. I understand that the risks identified are mitigated by the strategies outlined in the group interview information sheet.
6. I understand that de-identified transcribed interview data will be stored securely at University of Tasmania premises for at least five years and will be destroyed when no longer required.
7. Any questions I have asked have been answered to my satisfaction.
8. I agree that research data gathered for the study may be published provided that I am not identifiable as a Participant.
9. I understand that my identity will be kept confidential and that any information I supply to the researcher will be used only for the purposes of the research.
10. I understand that while every effort will be made by the research team to ensure all participants involved in the group interview process will maintain confidentiality and anonymity, this cannot be guaranteed.
11. I agree to participate in this investigation and understand that I may cease the observation or withdraw from the interview at any time. Whether or not I withdraw, I appreciate that I will not be able to withdraw or modify my data because the data will be de-identified.

Participant's name:
Participant's signature:
Date:

Statement by investigator:

I have explained this project and the implications of participation in the group interview to this volunteer and I believe that the consent is informed and he/she understands the implications of participation.

Investigator's name:
Investigator's signature:
Date:

Appendix J: Example of a coding list

Coding instructions for the theme – Constraints

Read the descriptions for each of the three categories below and then read the following twelve extracts from the data. Place the letter associated with the extract that most corresponds to the description of the category in the table below. If you believe the extract can be aligned to more than one category, place in multiple categories. However, indicate which category it is most applicable to by using a number from 1 to 3. The number 1 indicates the best match, 2 indicates some relevance to the category and 3 indicates a minor association with the chosen category.

Coding descriptors

Category	Description	Author	Other researcher
Cultural	The interviewee identifies challenges regarding the differences between agencies and how this may impact their role as an EMLO. This could apply to a lack of inclusion in activities in the pre-response and response phases, a lack of understanding of other agencies roles and requirements, or difficulties breaking in to the inner circle of the SCC.	D1 E G J2 K	D E G K
Information	The interviewee recognizes that there are factors that affect how they receive and pass on information to and from other agencies within the SCC. This could relate to a lack of interoperability between information systems, a lack of familiarity or difficulties regarding the complexity of the systems used in the SCC, no clarification of agencies actual information requirements, or challenges with gaining situation awareness of the event.	A C D2 F H1 I L	A C F H I L
Temporal	The interviewee makes reference to the challenges associated with time constraints operating in this role. This could refer to working in an environment that is fast acting and the requirement for EMLO's to make decisions quickly or work under time pressure.	B H2 J1	B J

Extracts from the data

A. The other thing just quickly is on top of all of this that everyone has different systems. So in terms of IT, information flow systems integration's a really big thing and to round that off, there is no common operating picture for Victoria to let everyone know at their different levels, what is going on.

B. I think we got the scan map 8 or 10 hours after it was done which as we know, from the way the fire spread, was going to be hugely inaccurate anyway because it would have been a much larger fire by the time we got it. So the timeliness is awfully important, I guess particularly for agencies that are trying to respond in and around the hazard, whatever it might be.

C. I think the greatest challenge I've come across is probably just being either out of the loop or not, as far as information flows or situation awareness.

D. The other issue is you know, the emergency services have a uniform and you can identify that uniform very quickly, they've always got name badges on and all that sort of thing. So you identify with these people a lot easier, you know, you see an ambo uniform and that sort of thing, you just instantly strike up a conversation. Whereas somebody who is dressed in a suit and they may or may not have their tabard on, and even then it might just say EMLO. So you don't know who they are or where they're from and suddenly they come up to you and start asking all sorts of questions, and you get very defensive cause you don't know them, they're asking all sorts of questions, you know, you don't necessarily want to give out all sorts of information, so, yeah, it's kind of a bit of a stand off until you get to know these people and that's happened to me a couple of times and just somebody coming up and they're obviously quite high level in their organization but you don't know who they are and you don't want to just offer them, you know, any information. But certainly the uniforms and the identity helps, I believe, quite a lot.

E. You turn up (to the SCC) with a shirt and tie, people haven't got a clue how long you've been in, what you know or courses you've done. It's not inferred. Whereas if you're wearing a uniform, it's already inferred. So, it's a problem. It's not really a problem, it's just a case of people won't necessarily jump to you because if they don't know you, they've got no, there's no outward sign of your training or your skills set and the only way round that is to actually prove it.

F. There's no interoperability that's an issue. Normally people bring in their own systems and things like that. They'll often bring in laptops and that type of thing, so that they can communicate. There's access to the external system so they can see what's going on from the external perspective on various websites. They just can't see the internal ones. But then again we can't see each other's internal ones' either at the moment. So we all have access to the external stuff but we don't have access to each other's systems. And we don't have one system here. We have a range of systems.

G. Let me put it this way, I reckon if you wear a uniform and I'm talking about the emergency services, the blue shirts, it's very easy to get credibility cause you've got some form of rank on your shoulder or whatever, on your uniform that says you're this type of person. But if you're from a land management agency like Parks or DSE in Victoria, then it is a bit harder because you don't actually have, you've got a badge but you haven't got a rank.

H. One of the issues that I see is that on, especially on a busy day in the State Control Centre there is a lot of people in there and there could be, I don't know, top of my head, but I would have said 40 to 50 people on a bad day and it's trying to then go to the, find the right person who's got the information, cause every single person in the room has got a little piece of

information and it's about how we share that (information), who you actually go to when you want something.

I. IT is a challenge because even the thing I'm reading now, there's no interoperability between the agencies at all really. We can't, we can log into a CFA system, we can log in to a DSE system and see what some of the stuff going on but we don't know how to operate the sites properly so you know you see a limited amount but you can't have 10 screens operating at the same time so a single IT platform is a far better way to go.

J. And it's a time thing. You may ask someone to just take this back and go and get advice and then an hour later they come back. They've got to be able to say, yep, you do this or as the co-ordinator say, yeah I need you to do that and know that they're going to do it cause the co-ordinator can then say to the State Controller, you'd better look at this.

K. And three times I had our State ESLO say to their controller, just sit down, where are you going, how can Telstra help you, we don't want anything from you, we want to help you. They're obviously of the opinion that everyone always comes in, they always want something, and they want priority or whatever. And were saying, no we don't want that, let us work together for the good of the community.

L. Look I still think the biggest challenge we have as a sector is building that common operating picture and that common situation awareness and a lot of that isn't just down to, a number of people think it's about technology, that we need to be on one platform or one system. I don't think that's the issue. I think there's, that's certainly going some way of facilitating that but we've actually got to work out ways in which information is shared, that we have an understanding of which piece of information is critical to which players.

Appendix K: Example of operational doctrine

EM Knowledge Filename – RS.25.05.doc

Planning – EMLO

Role Description

The role of the Emergency Management Liaison Officer (EMLO) located at the State Control Centre (SCC) is to provide a link between their parent organization and the emergency management agencies at the SCC.

Accountabilities

The primary accountabilities of an EMLO include:

- Represent their organization providing the technical or subject matter expertise to the SCC.
- Providing the primary contact and face-to-face coordination between their parent organization and the SCC.

Responsibilities

EMLO responsibilities include:

- Obtaining up to date information/intelligence from Emergency Management Agencies
- Maintaining an on-going awareness of emergency management efforts in respect to the operation of their organization
- Obtain collate and disseminate information to their parent organization and into the SCC.
- Providing authoritative and accurate information to EM agencies regarding the impact and consequence of emergencies and incidents on their organization and its operations
- Understanding their organizations resourcing requirements and coordinating resource requests from the SCC.
- Providing support to EM Agencies where requested
- Contributing to the production of SitReps
- Maintaining own and agency contact details
- Planning for relief staff from their organization
- Providing handover briefing to incoming EMLO.

Skills and Attributes

EMLO's should bring with them a range of skills and a level of expertise including an in-depth knowledge of their agency. They need to have the ability to speak on behalf of their agency, and;

- Ability to network with multiple stakeholders in the preparedness and response phases swiftly.
- Communicating effectively and succinctly with multiple agencies.
- Be a broad subject matter expert regarding their own organizations activities, capabilities and broader strategic aims appropriate to the emergency event.
- Requires broad knowledge of the multiple agencies involved, how they can contribute to the event and how their agency and other agencies complement the emergency management structure.
- Ability to work under time pressures.
- Demonstrate initiative and proactively deal with issue
- Demonstrate problem solving / decision making skills.

Key Relationships

- Reports to the Planning Officer. If this is not practical and the matter needs to be dealt with immediately the EMLO should contact the SCC Duty Manager.
- Works closely with the Intelligence Officer and the Situation and Analysis Unit members.
- Supports the Strategic Risk Unit in identifying potential risks and consequences related to their organization.

Other Requirements

N/A

Revision History

Topic No	RS.25.05
Topic Name	Plan - EMLO
Procedure Owner	FSC Planning and Intelligence Coordinator
Remote Copies	None
Revision Date	**Amendment Detail**
01/11/2013	Updates from Peter Norman, Cain Trist, Justin Kibell and EMLO Induction feedback.

End of Topic