Abstract

Climate change is having a significant effect on disasters worldwide. In response, societies have attempted to mitigate the consequences by developing standardised arrangements, known as incident command systems. Many of these systems have a military heritage using hierarchical command-and-control principles that are authoritative by nature and fit well within bureaucratic organisations. While emergency services agencies have embraced these incident command systems, other agencies have not, thereby making the multi-agency response to disasters challenging. This research investigated current incident command systems to develop an improved framework that includes all agencies and improves the multi-agency response to emergencies and disasters. A multi-modal qualitative research approach was undertaken using a literature review, semi-structured interviews with informants and a policy analysis of recent disaster reviews and inquires. This combined data informed the development of 4 options for improvements to the multi-agency response and consolidated the issues into 5 domains. These domains and options for improvement were presented to a panel of experts at the strategic level of emergency and disaster management by way of a 2-round modified Delphi study. This paper reports on the final phase of the research; the policy analysis and modified Delphi study. The most significant outcome of this research was a new level of understanding of strengths and weakness of the incident command system. This contributed to the development of a new conceptual framework based on modifications to the incident command system principles.

Improving the response to disasters by enhancing the incident command system

Peer reviewed

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Introduction

There is growing evidence that the changing climate is influencing the frequency and severity of hazard events worldwide (Hallegatte, Vogt-Schilb and Rozenberg 2020; Ripple *et al.* 2022; Pörtner *et al.* 2022; Mishra, Bruno and Zilberman 2021). The Intergovernmental Panel on Climate Change (IPCC 2021) found the Earth's temperature has already increased by one degree Celsius and is expected to exceed 1.5 degrees within the coming 2 decades. During 2022, the Asia-Pacific was the world's most disaster-prone region with floods in Afghanistan, Australia, Bangladesh, India, Pakistan and Thailand, droughts in China, Kiribati and Tuvalu, typhoons in the Philippines, heatwaves in India, Japan and Pakistan and severe earthquakes in Afghanistan, Fiji and Indonesia (United Nations 2023). Despite mitigation efforts and up-to-date preparation initiatives, millions of people continue to be negatively affected by these extreme weather events. As a consequence, how we respond remains a significant aspect of disaster management and will become more important in the future (De Smet, Schreurs and Leysen 2015).

Emergencies and disasters are complex, dynamic and often fast-paced. Successful resolution is reliant on effective teamwork and the ability of emergency services agencies to interact and integrate with other disaster management agencies (Power 2018; Kelman 2017). Emergency and disaster management requires multiple agencies to work together and crucial information needs to change rapidly and accurately as the event evolves. This interoperability is pivotal to enable collaboration among all agencies involved and to reduce the effects of emergencies and disasters on communities and the environment (Kapucu and Garayev 2011). Large and complex declared disasters such as Tropical Cyclone Debbie in 2017 and the subsequent flooding in South East Queensland involved multiple hazards over a long period of time and required a significant inter-agency coordinated response (Eburn 2013; IGEM 2017). Since that time, it is uncommon for these large events to be managed independently by a single agency or jurisdiction without assistance from other emergency services or government and non-government organisations such as local councils (Owen *et al.* 2013; Yates 1999). However, the capacity

to carry out collaborative and coordinated responses can be challenging due to political, cultural, economic and other motives and reasons. Achieving the required level of collaboration between agencies can be problematic as each agency has its own operating procedures, legislation, protocols and requirements for managing response (Coppola 2015; Hayes 2012; Yates 1999).

Regardless of the type of hazard, the response requires elements of an incident command system. This system can vary between countries, the types of agencies involved, the legislative requirements and the local emergency management policies and procedures (Paton and Owen 2013; Comfort and Kapucu 2007). The incident command system was developed in California, USA in the 1970s after a series of catastrophic wildfires highlighted the need for an effective system to manage response operations (Stambler and Barbera 2011). It was designed to alleviate issues commonly observed in responding to emergency incidents, such as ineffective coordination, varied terminology, conflicting priorities and poor communication (Williams and Treadaway 1992; Townsend 2006; Dynes 2003; Pitt 2008). The incident command system is based on principles that govern and standardise the organisational structure as well as the management of decisions, resources and personnel during a response (Bigley and Roberts 2001; Comfort and Kapucu 2007; Moynihan 2009). These principles include command, which incorporates unity of command, unified command structures and transfer of command. It also includes a manageable span of control and coordination or joint planning of operational activities while conducting integrated operations (FEMA 2008).

This paper includes findings from the final phase (Phase 3) of a policy analysis and modified Delphi study that was part of a broader study (Bradley, Tippett and Fitzgerald 2023). This broader study applied a 3-phase multi modal approach (see Figure 1) that highlighted issues regarding the practicability of incident command systems when applied to multi-agency emergency management. Problems such as the ineffectiveness of the incident control system for large scale, complex disaster situations and the unwillingness of some response agencies to adopt incident control system principles (Farcas *et al.* 2020; Drakek 1985; Dynes 1983; Quarantelli 2002 as cited in Bradley, Tippett and Fitzgerald 2023). Other reported barriers included difficulties around the coordination of stakeholders, including volunteers; conflicting agency priorities; poor communication and the lack of information sharing between agencies. These and the other reported challenges associated with disaster and emergency management in general have motivated this research to focus on the application of the incident command system to a multi-agency disaster.

For context, each state or territory in Australia is responsible for its own disaster and emergency arrangements. Disaster and emergency planning is premised on the concept of shared responsibilities, partnerships and collaboration between government and non-government sectors (Arklay 2012). The incident control system is known as the Australasian Interservice Incident Management System (AIIMS). This system has synergies with other incident management systems around the world, such as the New Zealand Coordinated Incident Management System and the U.S. National Incident Management System.

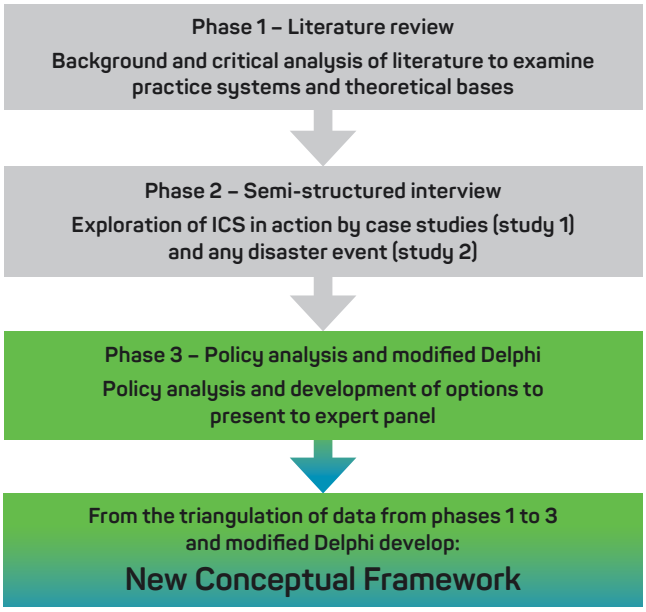

Figure 1: The data collection process encompassing all phases of the research study. Phases 1 and 2 are indicated in grey. Phase 3, depicted in green, is the focus of this paper.

Method

A 2-round modified Delphi study sought the input of an expert panel made up of senior leaders and decision-makers from across the Australian emergency management sector regarding the relevance and applicability of the current incident command system. The research by Bradley, Tippet and Fitzgerald (2023) identified the barriers of the system by employing a critical analysis of the literature followed by semi-structured interviews with informants who had been involved in the 2018 Central Queensland bushfires and the 2019 North and Far North Queensland monsoon trough floods (*n*=15). These events were chosen as they represent major and complex multi-agency events with different agencies taking the lead in the response. They were also chosen because they both occurred around the same time within a single jurisdiction. This enabled issues of jurisdictional variation in policy and practice and other variations over time to be minimised so that core issues could be exposed. The research objectives were then investigated by interviewing participants who had been involved in any type of disaster after 2017 (*n*=22).

Thematic analysis identified themes and patterns in the data collected based on the barriers, facilitators and suggested improvements to the use of incident control systems for multi-agency response. Building on these results, Phase 3 involved a policy analysis of recent disaster reviews and inquires in Australia. The established barriers (from the broader study) and the issues identified in the policy analysis were consolidated into 5 domains, shown in Table 1. Table 1 informed the development of 4 potential options (see Table 2) for improving the multi-agency response to emergencies and disasters. The domains and options were presented to an expert panel by way of a 2-round modified Delphi study; round one (*n*=15) and round 2 (*n*=11) via an online platform. The options were ranked from 1. *Most likely to succeed* to 4.

Table 1: The domains of core issues.

Domain	Description
Doctrine	Refers to the conceptual, legal and organisational frameworks within which an incident control system operates. Issues identified are the ambiguity and disconnection between the incident control system principles and the legislative-based roles and responsibilities and, in particular, how those change throughout the Prevention, Preparedness, Response and Recovery (PPRR) continuum of disaster management.
Communication	Despite improved communication being a core aspiration of incident control system, there is a failure of communication between emergency services agencies due to inconsistent terminology, a lack of effective exchange of information and a lack of technological capability required to facilitate communication.
Competency	Identifies the lack of knowledge and understanding of incident control systems, not only by emergency services agencies less familiar with response but also within traditional response agencies* (such as police, fire, ambulance). Efforts to build competency have had limited effectiveness.
Social aspects	Recognises that effective coordination is often reliant on personal relationships and on the psychological and welfare aspects of emergency management and these often conflict with the highly structured approach of an incident control system.
Operational aspects	Includes issues such as fatigue and continuity of operations that influence compliance with any system of governance. These aspects need to be considered in the design of any system.

* For the purpose of this research, traditional agencies include police, fire, ambulance and other organisations that exist for ensuring public safety by addressing different emergencies. Conversely, non-traditional agencies such as councils, non-government organisations and community groups, typically have other non-emergency roles within the community.

Least likely to succeed. An advantage of an expert panel is that results are gained quickly and opinions and views can be used to build on the research (Marshall and Rossman 1999). In this study, 'agreement' was taken to be the true consensus (75% agreeance) of what the panel thought.

Participants

Participants were recruited using the research team's professional contacts and LinkedIn network connections who were operationally involved or experienced in contemporary disaster or emergency management. Participants were able to nominate other potential participants. Suitably qualified participants were contacted by email providing the research information, ethics and consent forms and information on how the study would progress.

Table 2: The options for incident control system future development presented to the expert panel.

Option	Description	Agreeance % (likely to succeed in future) *
1	Enforce compliance of incident control system/AIIMS for all agencies	20%
2	Redesign AIIMS to include new criteria (AIIMS+)	90%
3	Develop a new system (DICS)	80%
4	Maintain status quo – do nothing	40%

* Panel participants were asked to rank each option from 1. *Most likely to succeed* to 4. *Least likely to succeed* and provide additional written feedback.

The modified Delphi was carried out by providing the expert panel participants with 2 rounds of questionnaires and information using an online Qualtrics survey. The panel consisted of senior leaders and strategic decision-makers from across the Australian emergency management sector and included representatives from the health sector, fire, police, Inspector General Emergency Management (IGEM), Australasian Fire and Emergency Services Authorities Council (AFAC) and local government. The definition of 'expert' for this study was:

- participants must have had a designated disaster management response role at a strategic level in multiple (3+) declared disaster events
- participants must have extensive knowledge through practice or education in disaster response.

The first round of the online Qualtrics survey was distributed by email. The email contained an overview of the issues identified in the research, a description of how the Delphi study would progress and the 4 potential options and descriptions (see Table 2). The second round provided the results from round one and asked for feedback on improvements to 2 options (Option 2: AIIMS+ and Option 3: Develop a new system) that were aggregated and agreed as the ones most likely to succeed in the future.

The surveys were conducted until saturation was reached and when it was identified that no new information to address the options was found; round 1 (n=15) and round 2 (n=12). The total panel sample included 2 female and 13 male participants. Ten participants completed both rounds of the survey and 3 participants were unable to complete both rounds due to operational commitments or leave.

Ethics approval was granted by the Queensland University of Technology ethics committee (Ethics Approval Number 2000000061). This included the recruitment email, participant information sheet and consent form.

Results

Overall, the expert panel members agreed that changes were needed to the current incident command system to support the complexities of emergency and disaster management particularly regarding strategic political decision-making and consequence management. Summarised feedback for each:

- Option 1: Enforcing compliance – fails to address the barriers identified and would require a level of compliance among all governments and organisations. Overall, it was ranked as the option very unlikely to succeed.
- Option 2: Redesign the current AIIMS system to include new criteria to address the problems identified (AIIMS+) – requires inclusion of a detailed recovery section to address the emergency management cycle changes to legislation to improve multi-agency interoperability and improvement to strategic-level reporting. Minor changes to terminology, improved training and competency maintenance were also suggested. Overall, it was ranked as the option most likely to succeed but with a few conditions.
- Option 3: Develop a new system (Disaster Interagency Coordination System) – was reported as having merit but would be extremely challenging. Suggested improvements included changing terminology and legislation changes, improved multi-agency training and better reporting systems. Overall, it was ranked as likely to succeed but with the introduction of a new model being acknowledged as extremely difficult to implement.
- Option 4: Maintain the status quo – regarded as a middle ground with most participants ranking this as unlikely to succeed but with others suggesting that natural evolution may support an improved system.

Overall, most participants agreed that building on the current incident control system to include changes that encompass the intricacies of disaster and emergency management was the most advantageous option. AIIMS+ was ranked as the option mostly likely to succeed as it built on a 'well-known and well established' system (Bradley, Tippet and Fitzgerald 2023, p.242). Other changes included a detailed recovery section, changes to legislation, improvements to strategic-level reporting and inclusive training and competency maintenance programs as well as the recognition of good relationships and relevance of the social or psychological aspects of disaster management. The incorporation of successful practices from other states and territories and moving from the C2 (Command, Control) towards a C4I (C2 plus Coordination, Communication, Intelligence) or C6I (C4 plus Consequences, Community connection) model were also suggested by the expert panel.

Discussion

The findings of this research are that the current incident control system used for contemporary emergency and disaster response requires updating. Although useful components remain, reform is required. Emergency services agencies have embraced the incident control system, but other agencies often involved in community-level disaster response, such as non-government organisations and community groups, have not.

The incorporation of an incident control system across traditional and non-traditional response providers is recommended due to the increasing frequency, complexity and severity of high-risk hazard events and man-made disasters, which require wider definitions of response. There is more to emergency and disaster management than technical knowledge and expertise, such as recognition of the adverse effects to the health and wellbeing of individuals and communities. This study confirmed the importance of recognising non-technical skills. Future studies might examine this and focus on incident control systems in relation to new technologies, changes in the threat environment and other threats such as cyber-attacks and pandemics.

Limitations

A limitation of this study was the lack of representation of expert health participants. The availability of strategic-level health participants was difficult to obtain due to leave or work commitments. Another limitation was that research quality is dependent on the skills of the researcher and can be influenced by the researcher's personal biases and idiosyncrasies. To address this the study included steps to present a relatively unbiased analysis, such as involving university supervisors in the validation of initial coding categories during the pilot study.

Conclusion

Climate change has a significant effect on the frequency and severity of disaster events worldwide and increases the importance of good emergency and disaster management systems. Disasters are complex, dynamic and fast-paced environments and involve many emergency services agencies including first-response agencies, non-government organisations, community groups, volunteers and local governments. Successful response relies on effective teamwork and the ability of agencies to interact and integrate. The response to these events often includes components of an incident control system. Although pitched as all-hazard, all-agency systems there has been debate that the incident control system has a number of shortcomings and challenges related to how principles are applied across disaster events.

This research generated a useful evidentiary platform on which to pursue the development of a conceptual framework to reform the incident control system to improve multi-agency coordination during an emergency response. The findings suggest that much can be done in the area of psychological research to understand how people operate during complex events and how best to support the health and wellbeing of communities and emergency management personnel. Similarly, the study found that successful disaster management is about people and relationships. The importance of developing non-technical skills such as social, cognitive, decision-making and emotional intelligence is a useful inclusion in developing a new system.

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