Applied Ergonomics 43 (2012) 38–47

Contents lists available at ScienceDirect

Applied Ergonomics

journal homepage: www.elsevier.com/locate/apergo

Multi-agency operations: Cooperation during flooding

Richard McMaster*, Chris Baber

School of Electronic, Electrical and Computer Engineering, The University of Birmingham, Edgbaston, Birmingham B15 2TT, UK

ARTICLE INFO

Article history:
Received 25 August 2009
Accepted 16 March 2011

Keywords:
Command and control
Communications
Emergency services
Sociotechnical systems

ABSTRACT

This paper presents an investigation of command and control during Multi-Agency Operations; the purpose of this study was to elaborate on known themes associated with multi-agency emergency response, through a study of the successful combined military and civilian defence of Walham electricity substation from rising flood water in July 2007.

This case study demonstrates that effective coordination during major emergencies requires the development of a deeper, shared understanding of the incident and a high level of trust between responding organisations, both of which are effortful to achieve and difficult to support with current communications systems. Adoption of a sociotechnical systems approach during the development process may enable future communications systems to support these important social processes.

1. Introduction

1.1. Overview

The significant body of work within the field of disaster research has identified a number of problem areas associated with the coordination of large-scale emergencies, though much of the previous work on floods and other disasters concentrates more on the high-level (strategic) response. The current study is concerned with the coordination of a relatively small and well defined incident, which was part of a wider emergency; it might therefore be expected that the response would proceed in an entirely straightforward manner. Consequently, the difficulties encountered by the responding agencies during the successful resolution of this 'simple' incident have implications for the future management of larger and more complex disasters.

1.2. Features of major emergencies

Major emergencies typically feature high levels of complexity and ambiguity. Recognizing that large-scale emergencies occur with little or no notice, involve temporary organisations of agencies who rarely (if ever) work together and improvised organisational structures (Smith and Dowell, 2000), effective management of major emergencies would appear to be an impossible task (Boin and T'Hart, 2003). Major emergencies have been defined in terms of their "un-ness", i.e. unexpected, unprecedented and unmanageable (Hewitt, 1983). Thus, multi-agency emergency operations share a number of potentially problematical features, including:

- Ad hoc teams that work together only when responding to an emergency incident;
- Multiple objectives which have to be achieved in parallel for the incident to be successfully contained;
- High psychological demands, with people working under time pressure and stressful conditions;
- Role specialisation, with the need to pool different types of expertise.

(Crichton et al., 2000, p. 208)

During the initial stages of an incident, it is unlikely that any single organisation will be in possession of all available information – various organisations will hold 'pieces of the puzzle' (McMaster et al., 2007). First responders to the incident will seek to gather as much local information as they can, in order to both assess the situation and determine an appropriate response. However, these activities of assessment and response generation will be defined by the training, Standard Operating Procedures (SOPs) and experience of the first responder. When personnel from other agencies arrive and seek briefings from the first responder, there is a challenge in developing a shared understanding of the incident. Close cooperation between responding agencies is therefore required, in order to enable a coherent response to the emergency. However, cooperation does not

Abbreviations: CDM, Critical Decision Method; COP, Common Operational Picture; DCFO, Deputy Chief Fire Officer; NGO, Non-Governmental Organisation; PPE, Personal Protective Equipment; RNLI, Royal National Lifeboat Institute; SOP, Standard Operating Procedure.

* Corresponding author. Tel.: +44 (0) 121 414 7511; fax: +44 (0) 121 414 4291.
E-mail address: r.mcmaster@bham.ac.uk (R. McMaster).

0003-6870/$ – see front matter © 2011 Elsevier Ltd and The Ergonomics Society. All rights reserved.
doi:10.1016/j.apergo.2011.03.006

appear to come easily in crisis situations, with problems of mistrust between agencies and disagreement over who is in charge (Boin and T'Hart, 2007). Improvisation, in terms of developing novel, situation-specific organisational structures, coordination mechanisms and individual roles, has also been identified as a recurring response to the unique demands of crisis situations (Mendonça et al., 2007; Auf der Heide, 1989). This requires the application of knowledge outside of traditional emergency response domains and the coordination of interdependent tasks, with high levels of uncertainty (Dynes, 1970; de Marchi, 1995; Boin, 2004; Becerra-Fernandez et al., 2008; von Lubitz et al., 2008).

1.3. Multi-agency incident response to floods: previous research

Environmental disasters are having an increasing impact globally, in terms of the rising numbers of incidents, people affected and the economic cost (Boulle et al., 1997). The multi-agency responses to two recent crises – the South Asian Tsunami and Hurricane Katrina have both received criticism. Both of these disasters required improvisation on the part of the responding agencies, including the adaptation of procedures and the development of ad hoc coordination structures, though this was achieved with limited success in each case (Bennett et al., 2006; Chua et al., 2007). Additionally, military resources and logistical capabilities were invaluable in the immediate aftermath of the South Asian tsunami and Hurricane Katrina, though in both instances there was a failure to fully integrate the military into the response, which reduced their effectiveness (Bennett et al., 2006; Chua et al., 2007; Telford, 2007). Case studies of earlier floods reveal similar evaluations; for example, Rahman (1996) found that there was a lack of coordination of the response to the 1988 floods in Bangladesh, including a lack of trust of NGOs by local administrators, resulting in their exclusion from planning programs (Rahman, 1996). In summary, there are eleven broad issues that these studies raise:

(1) Lack of coordination between Agencies;
(2) Failure to communicate warnings and other information;
(3) Competitive practices;
(4) Lack of trust between Agencies;
(5) Slow mobilization of response;
(6) Response systems overwhelmed by the scale of the emergency;
(7) Failure to share information between Agencies;
(8) Poorly defined chains of command;
(9) Interoperability failures;
(10) Lack of awareness of the presence and activity of other Agencies in the area;
(11) Failure to fully integrate military into the response.

The fact that these issues recur so often imply that there are inherent challenges associated with the coordination of multi-agency emergency responses; given that the failure of agencies to coordinate their activities during emergency responses is hampering their effectiveness, what is it that is preventing them from cooperating?

1.4. Government response to major emergencies

Following any major emergency, there will be reviews and enquiries culminating in lessons learned and, in some instances, recommendations for new legislation and requirements on the Services involved in Emergency Response. For example, an inquiry into the fire at King's Cross London Underground station in November 1987 (Fennell, 1988) identified a lack of coordination amongst agencies involved and recommended the use of inter-agency training exercises (which are now held on an annual basis in the UK) and improvements in joint planning and communication. The UK Government recently implemented the 2004 Civil Contingencies Act which defines multi-agency Integrated Emergency Management in terms of six activities: Anticipate, Assess, Prevent, Prepare, Respond and Recover (HM Government, 2005a). These activities are supported by eight guiding principles for emergency response, which can be related to the conclusions drawn from investigations into previous emergency responses:

- Direction: clarity of purpose defined by a strategic aim and objectives;
- Integration: effective and efficient coordination between agencies involved in the response;
- Subsidiarity: coordination occurs at the lowest appropriate level;
- Preparedness: all agencies, and their members, have clear understanding of their role and appropriate knowledge and abilities to undertake these roles;
- Continuity: organisations should be able to employ Standard Operating Procedures such that their response to the emergency involves well-drilled activities, albeit at a greater tempo;
- Communication: reliable information is passed as efficiently as possible to all agencies who need it, including the public;
- Cooperation: agencies cooperate in a spirit of mutual trust and understanding;
- Anticipation: risk assessment and identification is performed in an ongoing manner in order to ascertain any possible changes in level of risk so that the response can be managed as appropriately and flexibly as possible.

(HM Government, 2005b, p. 6)

1.5. Overarching themes

The 8 principles of the 2004 Civil Contingencies Act can be combined with the 11 issues raised earlier to produce four overarching themes of multi-agency emergency responses which might be used to guide further research:

- Organisational structures and practices;
- Communications, information sharing and shared awareness of the incident;
- Cooperation and coordination of response activities;
- Command, strategy (command intent) and decision making.

Table 1 indicates how these broad themes have been derived.

2. Investigation

2.1. Case study: Gloucestershire floods July 2007

The summer of 2007 saw widespread flooding in several regions of the UK; the floods of June and July were the most costly in UK history and some of the most expensive disasters worldwide in 2007, with losses of over £2 billion for each month (Munich Re, 2008). One of the worst affected areas was Gloucestershire in the South West of England, with widespread flooding across the county. In addition to the extensive damage caused to businesses and residential properties, travel became difficult as roads and towns flooded, trapping hundreds of people in their homes. The electricity supply to large parts of the county was put at risk when both the Walham and Castlemeads substations came under threat from rising flood water (Elliott and Brown, 2007). Walham substation is a site of critical national importance, supplying electricity to over 500,000 homes (an estimated 2,000,000 people) in