

## Chapter 40

# Resilient Emergency Response: Supporting Flexibility and Improvisation in Collaborative Command and Control

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### ABSTRACT

*The focus of this chapter is the design and development of Information and Communication Technologies that support collaborative work and processes in command and control teams, more specifically, in joint emergency response operations. The unique contexts and varying circumstances of response operations have an impact on how collaborative work and interactions among commanders emerge, as well as on the extent to which Information and Communication Technologies are used. This emergence of response operations poses specific methodological complications and demands on how to study command and control teams, and also how to approach high-level design problems. The chapter demonstrates how such analysis can be performed. It presents a study of scenario-based role-playing simulation with professionals – emergency management commanders – as participants. The study documents the work practice of a team of commanders from the Swedish local and regional emergency response organizations responding jointly to an emergency, a medium size forest fire. The study also identifies areas and/or activities that may be enhanced by command and control tools. A combined set of bottom-up data driven and top-down methods – topical episode analysis, communicative roles, socio-metric status and communication modelling – are used to assess communication and interactions among the commanders. The findings indicate that the studied commanders used informal arrangements within the established formal command and control structures, and took informal functions and communicative roles across organizational and domain boundaries to handle diverse incidents and so called pseudo-problems. This identified adaptive and improvised behaviour of the commanders – and the team as whole – was identified as a critical characteristic for effective com*

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*mand and control work in joint response operations. Cross-domain and cross-organizational knowledge was found to be the most important feature of this type of capability to adapt and improvise. The study, further, highlights the significance of employing bottom-up, data driven methods for analysis of design and development processes, as well as important methodological challenges related to this type of analysis.*

## INTRODUCTION

The research focus of this chapter is the design and development of information and communication technologies (ICT) that support collaborative work and processes in heterogeneous command and control teams involved in emergency response operations.

Response operations can be defined as non-routine activities that require situation-driven and problem-solving behaviour by responding organizations, teams and individuals (e.g. Comfort et al., 2001; Drabek & McEntire, 2003; Kedra & Wachtendorf, 2003). Response operations, as well as related command and control (C<sup>2</sup>) work, are characterized by loosely defined and shifting goals, versatile situations, time pressure, high stakes and involvement of multiple actors (Orasanu & Connolly, 1993). Commanders in charge of response operations must therefore show flexibility and have the capability to adapt and improvise. They may, for example, need to shift between different work modes, thus leaving standard operational routines for situation-driven, even emergent, needs and operations. In short, commanders in emergency response need to –must – cope with high coordinative and interactive complexity.

Many organizations in the emergency response domain invest in diverse ICT to increase C<sup>2</sup> capabilities and/or to facilitate effective and sophisticated response when facing such challenges. ICT that are particularly relevant in this context are C<sup>2</sup> tools designed to enhance resource management, real-time situation assessment and communication. A key feature of modern C<sup>2</sup> tools is that they are intended to support teams of collaborating commanders. As these tools often lead to new work procedures, radical organizational

and technological changes may appear (Woods & Dekker, 2000; Cummings, 2004).

One important issue is if, and also in what ways, these tools increase C<sup>2</sup> capabilities and actually facilitate enhanced response in reality. Therefore, authors working in diverse fields such as computer supported cooperative work (Schmidt & Bannon, 1992), distributed cognition (Hutchins, 1995), and cognitive systems engineering (Hollnagel & Woods, 2005), all emphasize the importance of scrutinizing the usefulness and the actual effect(s) of new tools when being applied in practice, in addition to assessment of their potential effects from a more theoretical perspective. It is, in other words, essential to empirically evaluate how an actual C<sup>2</sup> organization performs and how the C<sup>2</sup> organization's performance changes when using new C<sup>2</sup> tools. Taking into account the complexity of C<sup>2</sup> activities in emergency response, it is equally important to observe how a C<sup>2</sup> organization should behave as it is to notice what an actual C<sup>2</sup> organization does when designing new C<sup>2</sup> tools (Adelman, 1991; Hollnagel & Woods, 2005). It is a challenge to explore human behaviour and to gain in-depth knowledge from C<sup>2</sup> work in emergency response with respect to its dynamics and complexity (Killian, 2002; Stallings, 2006). Varying circumstances and the emergence of response operations pose specific methodological complications and demands (e.g., Drabek & McEntire, 2003; Mendonça & Fiedrich, 2006).

This chapter describes how such analysis of C<sup>2</sup> organizations can be carried out by focusing heterogeneous C<sup>2</sup> teams with team members distributed across different organizations. It presents an empirical study of scenario-based role-playing simulation with professionals – emergency management commanders – as participants. The

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