IGI PUBLISHING **ITJ 4653**

701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.igi-global.com

This paper appears in the publication, International Journal of Information Systems for Crisis Response Management, Volume 1, Issue 1
edited by **Murray E. Jennex, Bartel Van de Walle © 2009, IGI Global**

Effects of Real-Time Imaging on Decision-Making in a Simulated Incident Command Task

J. McGuirl, The Ohio State University, USA

N. Sarter, University of Michigan, USA

D. Woods, The Ohio State University, USA

ABSTRACT

Eight Incident Commanders (ICs) took part in a simulation exercise to determine the impact of real-time imaging feedback on situation assessment and decision-making in an uncertain and high-tempo environment. The imaging feedback simulated the video feed from an unmanned aerial vehicle (UAV) that allows incident command centers to monitor developments at the crisis site. Nearly all of the ICs failed to detect important changes in the situation that were not captured in the imaging but that were available via other, more traditional data sources. It appears that the ICs placed an inappropriately high level of trust in the imaging data, resulting in a narrowing of their data search activities and limited cross-checking between the data sources being used. This research helps anticipate and guard against undesirable effects of introducing similar technologies on training and operational procedures in a variety of domains.

Keywords: *command and control; crisis management; decision-making; feedback; fixation; incident command; presence; sense making; UAVs (unmanned aerial vehicles)*

INTRODUCTION

Managing an emergency response presents the decision-maker with many of the challenges observed in any complex, naturalistic setting, such as: time stress, high costs for failure, and solving ill-structured problems with limited reliable information (Klein et al, 1986). Efforts to support decision-making in such environments often revolve around introducing technologies that increase the amount of, and timeliness of, available data. In the case of incident command, several remote-sensing technologies that provide real-time imaging to decision-makers have begun to be utilized during emergency response operations. It is expected that this new feedback channel will aid in situation assessment and also allow planners to consider challenges faced by local operators (e.g., restricted access, potential dangers) as they develop response strategies.

However, previous research has shown that altering the nature and/or the timing of the information available to a practitioner invariably alters the nature of the cognitive work needed to process it, often resulting in new challenges and new pathways to failure (Billings, 1997; Norman, 1990; Sarter and Woods, 1992, 1995; Smith et al., 1997). Independent of whether the new technology provides the expected benefits, or simply exchanges one set of challenges for another, its introduction produces a point of change that offers a unique opportunity for analyzing how the cognitive work in that domain is conducted (Cook and Woods, 1996; Patterson et al., 2002). The current research seeks to take advantage of one such opportunity—the introduction of real-time image-based feedback into emergency management. The availability of unmanned aerial vehicles (UAV) allows incident command centers to monitor developments at the crisis site remotely. This new data channel provides real time video that allows incident commanders to monitor developments at the crisis site. The goal of the study is to assess how this new data channel changes data gathering, integration, and sense making of emergency management decision-makers. Command centers find access to real time images from the scene of interest to be very compelling, but anecdotal reports and observations from exercises and deployments suggest the new image data channel may be too compelling and lead command decision makers to over-rely on information from this one data channel. This study observes eight actual incident commanders manage a simulated crisis (petro-chemical plant fire) with a real-time feed providing images of the crisis site. The crisis management exercise evolved in ways designed to challenge incident command decision making, in particular, to reveal if the incident commanders over-relied on information coming in through the image data stream and under-utilized information available from other data channels.

Challenges in Incident Command

Emergency operations management is a classic case of what has been termed "multi-threaded work" (Woods and Hollnagel, 2006), in which the practitioner must assess the situation by gathering and integrating multiple data sources, detect anomalies in the evolution of events, and exercise authority over a distributed, multi-level organization. Incident Commanders (ICs) generally prefer to gather information via direct observation which provides them detail-rich data without delay and allows them to apply their expertise to draw meaning from the raw data given the uncertainties of emergency situations.

However, in managing crisis events, ICs often have limited access to first-hand information. The physical size of many incidents often limits the IC's ability to directly observe the entire situation. Instead, the data they receive is often mediated, or processed, through other actors and subject to delays. Both of these conditions can limit their ability to assess the situation, re-plan and manage the overall response operation (Brehmer and Allard, 1991; Johansson et al, 2002; Woods et al, 1994). Feedback delays present a challenge to the decision-maker whose expertise "is tuned to the future" (Woods, 2002). The goal of anticipating events, rather than reacting to them, often drives the IC's desire for more, more direct, and more immediate feedback (Danielsson and Ohisson, 1999).

The majority of the information used by the IC consists of verbal or text-based messages from remote team members. However, verbal communications between non co-located team members can be time-consuming, requiring turn taking between the participants in order to establish and maintain "common-ground" (Clark and Brennan, 1991). While vital for reducing ambiguity, this context building requires continuous effort in a highly dynamic, multi-task environment. Similarly, receiving text-based data from multiple sources can require significant cognitive work to integrate into a cohesive framework needed for making

Rebuilding Higher Education Systems Impacted by Crises: The Impact of Wars and Conflicts on Higher Education

Mulatedzi Calvin Rammbuda (2024). *Rebuilding Higher Education Systems Impacted by Crises: Navigating Traumatic Events, Disasters, and More (pp. 239-252).*
www.irma-international.org/chapter/rebuilding-higher-education-systems-impacted-by-crises/343837