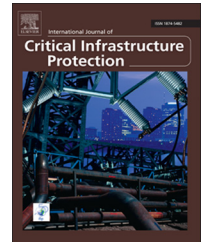Available online at www.sciencedirect.com

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Multidisciplinary coordination of on-scene command teams in virtual emergency exercises

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ABSTRACT

This paper presents the design and the results of a comparative study of multidisciplinary on-scene command teams at work in virtual emergency training exercises. The principal goals of the study were to understand how "on-scene command teams" coordinate on multidisciplinary objectives and tasks, and how the manner in which this is done affects their performance. The study involved 20 on-scene command teams consisting of various individuals, such as police, fire and medical services personnel, municipal officers and infrastructure operators, drawn from a Safety Region in The Netherlands. Integrated video recordings by five synchronized cameras captured the coordination processes during the virtual exercises. The integrated and synchronized video recordings were then transformed into numerical data for analysis. Performance was operationalized by scoring the progress and completion of emergency management tasks for which individual members and/or teams as a whole were responsible. Team coordination was operationalized using network centrality and density measures. The significant findings are the following: (i) emergency management performance and coordination patterns within and among on-scene command teams have considerable variation; and (ii) teams that use less coordination during the intermediate phases of emergency management perform significantly better than teams that do not; moreover, actors who have central positions in a network are better able to achieve their performance goals.

1. Introduction

Emergency response covers all operational and procedural tasks that are conducted individually or collaboratively by qualified professionals with the goal of normalizing the situation after a disruption [7,9]. It generally involves tasks such as conducting rescues, providing medical aid, policing, performing evacuations, rerouting traffic, firefighting and containing spills. A wide range of responsibilities are attributed to specific emergency response disciplines such as ambulance, fire services and police. First responders who arrive at the scene of an incident commonly follow a set of standard operating procedures (SOPs) for which they are professionally trained. These skills are further developed and maintained in drills and simulations. For reasons of safety and efficiency, this training has become increasingly "virtual" and game-based [1,10,11,24].

Incidents for which emergency responders are called upon commonly occur in and around critical infrastructures such

as railways, roads, waterways, power stations and airports [23]. In modern society, even a small incident can cause considerable infrastructure disruption (e.g., traffic congestion or power outage), resulting in large-scale socioeconomic losses that could lead to an institutional or political crisis. The rapid repair and recovery of disrupted infrastructures are, therefore, essential components of emergency response. This brings even more actors to the scene of an incident, such as road inspectors and repair personnel, infrastructure operators, public utility managers and municipal officials, all of whom have specific objectives that they attempt to achieve using their own standard operating procedures. Therefore, the objectives and procedures of actors at the scene of an incident in or near a critical infrastructure must be prioritized, aligned and sequenced to implement an integrated response.

The term "emergency (response) management" refers to tactical and strategic tasks aimed at the smooth operation of emergency response services during the proactive or "cold" phase, such as planning and training, or during the reactive or "hot" phase. During the hot phase, emergency response management is generally undertaken by a team comprising representatives of the involved disciplines – a blend of monodisciplinary professionalism and multidisciplinary teamwork. In The Netherlands, such a team is referred to as a "CoPI," an acronym for on-scene command team (Commando Plaats Incident, in Dutch). In the early phases of an incident, an on-scene command team is faced with many, possibly conflicting, objectives and standard operating procedures. Upon arriving at the scene, a command team must prioritize, align and sequence the objectives rapidly. In other words, an on-scene command team must coordinate its activities in the most effective manner possible [7]. How is this done? What forms of coordination work well? Which ones do not?

This paper presents the design and the results of a comparative study of multidisciplinary on-scene command teams at work in virtual emergency training exercises. The study attempts to understand how on-scene command teams coordinate on multidisciplinary objectives and tasks, and how the manner in which this is done affects their performance. The study involved 20 on-scene command teams comprising various actors, such as police, fire and medical service personnel, municipal officers and infrastructure operators, all of them drawn from a Safety Region in The Netherlands.

2.   Research design

Two research questions are considered in this paper: (i) How do on-scene command teams coordinate multidisciplinary objectives and procedures; and (ii) how does the way they do this determine their emergency management performance? These questions are highly relevant given the increasing complexity of emergency response management and its consequential gains and losses. However, there is little empirical understanding about what on-scene command teams actually do and what makes one team more effective than another.

Research in this area is far from simple. Real-time observations during an emergency are severely constrained by all kinds of practical complications, scientific limitations and moral objections. Incidents are chaotic and response management is dispersed and lengthy (hours to weeks), which require large numbers of observers or some other way of logging and tracking interactions. Moreover, the occurrence of incidents is unpredictable, demanding researchers to "stand by" for long periods of time. Such factors make it virtually impossible to collect quantitative or quantifiable data while on-scene command teams are working on an incident.

Some researchers have tracked digital communications and gathered related data during crisis situations (e.g., using data from mobile phone networks), but this type of data is meaningful only for specific purposes in large-scale events (e.g., for determining locations and movements) [17]. Moreover, it is highly impractical and unethical to record the actions of first responders using cameras, let alone distribute questionnaires. Interactions between victims and first responders are often confrontational and emotional; these are not good environments to start counting or coding. Even structured interviews would almost certainly interfere with and degrade the performance of an on-scene command team. In short, where emergencies are concerned, researchers should be unobtrusive observers.

Although field research has generally delivered valuable insights, field research focused on emergency response tends to be evaluative, case-based, qualitative and interpretative, if not anecdotal. There is, however, an alternative solution, where larger amounts of qualitative data about multiple emergency management events can be transformed into quantitative data for comparative analysis – video observation and network analysis of virtual emergency management exercises.

This study of the coordination and performance of on-scene command teams was conducted using video observations of 20 teams of professionals at work in four different scenarios in a virtual emergency response training environment. The four scenarios involved the following: (i) hazardous material spill in a tunnel; (ii) evacuation of victims from a tunnel; (iii) hazardous material spill in an urban area; and (iv) carbon monoxide release in a port. The research was conducted between 2011 and 2014 with the support of one of the 25 Safety Regions in The Netherlands. Safety Regions are coordinating organizations that are responsible for emergency response and crisis management in a significant geographic area or areas that include important infrastructures such as the Port of Rotterdam or Amsterdam Airport Schiphol. Written permission was granted by the Safety Region and participants to make video recordings during all their training sessions. The results were anonymized and cannot be traced back to individuals or teams. The participants were operational officers – ranging from novices to experienced seniors – in relevant disciplines such as police, fire services, medical services, municipality and infrastructure operation.

The exercises were part of a mandatory training program for on-scene command team members. An on-scene command team usually consists of officers on duty. As in the real world, many of the virtual training exercise participants did not know