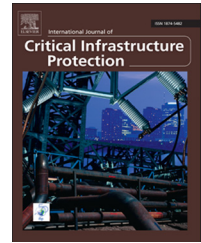


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## Regional response to large-scale emergency events: Building on historical data

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### ABSTRACT

A widespread emergency event in the United States triggers the activation of a regional emergency operations center that manages a coordinated response to the disaster. Historically, the time-critical decisions made by emergency managers in the face of incomplete information and inadequate historical emergency event data have been guided primarily by their experience. The learning curve for emergency managers, especially novice managers, is steep, and is exacerbated by the complexity and scope of emergency events. This paper proposes a methodology designed to provide emergency managers with locality-specific information and resource allocation recommendations for large-scale event response, creating the foundation for a decision support system that draws on emergency event data. This work is the first to use locally-specific data for an emergency management decision support system. Two major allocation scenarios that influence the number of resources allocated to an event are considered and solutions are suggested to address them. Although the methodology is developed for a mid-sized region, it is generalizable to any region.

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## 1. Introduction

When an emergency occurs that is beyond the capability of a single incident commander to handle, control of the response is usually assumed by a centralized emergency operations center that operates under a unified command system. Several characteristics of centralized response management make regional large-scale emergency (disaster) management a difficult, if not wicked, problem. First, efficient emergency operations rely on

effective resource allocation under severe time constraints. Second, mid-sized (one to five million persons) and smaller regions rely heavily on volunteer responders and are typically resource-constrained. Third, the emergency manager and the emergency operations center must integrate multiple heterogeneous data streams arriving at varying rates, often resulting in incomplete, possibly incorrect, knowledge of the scope of the disaster. Finally, the emergency manager's personal experience with local crisis management heavily influences the overall

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effectiveness of the response. These characteristics highlight the need for a robust decision support system (DSS) for regional emergency management that is built on local historical data and incorporates crucial information about the critical infrastructure assets in the region of interest.

Emergency management and incident command rely heavily on information and experience to implement an effective response. As disasters inherently combine repeated elements (historical experience) with new information, experienced emergency managers quickly categorize repeated elements and focus on novel aspects of the information flow, thus speeding up decision making. Inexperienced emergency managers, however, cannot efficiently triage the information, which often delays critical decisions.

The difference between a veteran emergency manager and a novice manager is experience; but the basis of all decision making, no matter the skill level, is relevant and usable information transformed from the available raw data. If a novice emergency manager could access this information and be guided by it, the playing field between veteran and novice becomes more level and the learning curve for the new emergency manager flattens out.

So where does the needed information come from? All the municipalities in the United States or Canada with 911 systems (and equivalent systems in other countries) possess enormous amounts of locally-specific data on emergency events in their regions. This data includes – at minimum – what, where and when events occurred; their durations; the resources used in event response; and the timelines of actions during the active response periods. If this data can be mined effectively, the historical experience of many responders, beyond that of a single individual, can be replicated.

Fig. 1 shows how historical data can contribute to a decision support system for regional disaster response. The system receives real-time data from an event along with monitored

data from first responders such as police and fire stations, and public utilities such as water and transportation. This data is sent to a central monitoring and reaction center (MRC), where it is aligned, integrated and fused with scenarios based on historical data. The monitoring and reaction center then provides recommendations to the emergency manager on the appropriate action plans for responding to events.

This paper focuses on the historical data and scenarios portion of the system shown in Fig. 1. It examines issues involved in mining historical data for decision support, presents a methodology for using the data in regional response and discusses decision making in two distinct multi-nodal scenarios.

## 2. Decision support systems in emergency management

This section provides an overview of the use of decision support systems [11] in emergency management and examines some of the related work.

In the United States, the Department of Homeland Security (DHS) coordinates homeland protection. Created in 2002 from 22 existing agencies, the U.S. Department of Homeland Security has paid special attention to the integration of communications systems and processes, such as the National Incident Management System [10] and Tactical Interoperable Communication Planning [7], particularly during large-scale regional emergency responses that involve multiple agencies. Communications are the foundation for coordinated information flows and information flows serve as the foundation for situational awareness and decision making.

A variety of approaches have been adopted to incorporate decision support systems in emergency management. A typical decision support system divides information into processes,

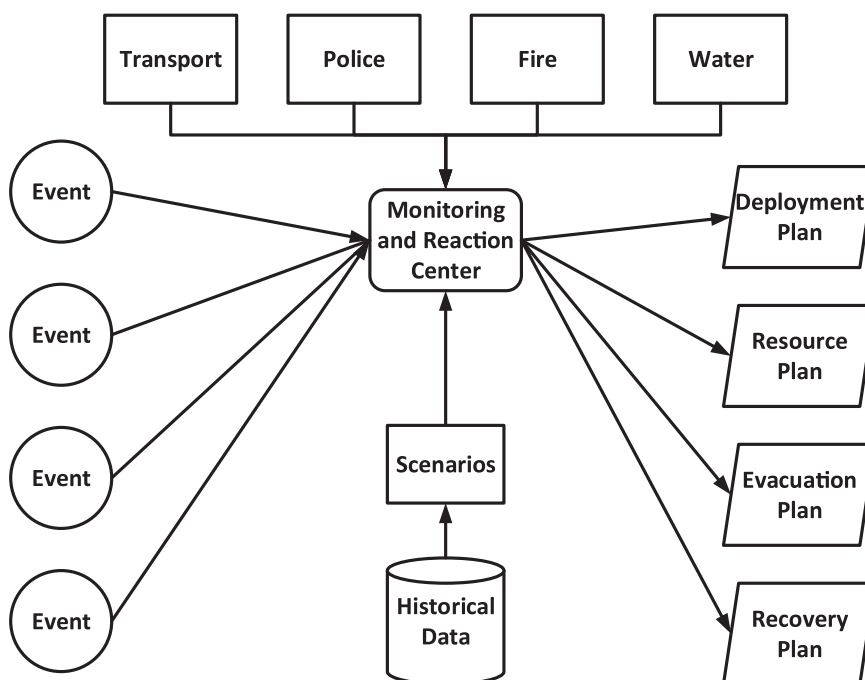


Fig. 1 – Role of historical data in emergency management decision support.

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