

EMERGENCY RESPONSE FOR HOMELAND SECURITY: LESSONS LEARNED AND THE NEED FOR ANALYSIS

Larson, R., Metzger, M., & Cahn, M.

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**Center for Risk and Economic Analysis of Terrorism Events
University of Southern California
Los Angeles, California**



Emergency Response for Homeland Security: Lessons Learned and the Need for Analysis

By Richard C. Larson, Michael D. Metzger, Michael F. Cahn
Structured Decisions Corporation
1105 Washington Street, Suite 1
West Newton, Massachusetts 02465-2119

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Preface

This report addresses response preparedness for large-scale emergency incidents, be they acts of terrorism, acts of Mother Nature (e.g., earthquakes, floods, tornadoes, hurricanes) or human-caused accidents. We call such events *major emergencies*, in which local first-responder resources are overwhelmed. There simply are not enough local resources to do the many jobs at hand. Response to a major emergency requires careful planning and professional execution. Decisions involve the deployment of people, equipment and supplies. Peoples' lives are at stake. Proper planning for a major emergency can save many lives, perhaps thousands.

Our role is to discover decisions that have to be made before and during a major emergency and to develop quantitative tools to assist local planners and decision makers to assure that their emergency response plans are as effective as they can be. Our approach is quantitative, systematic, based on data and past experience. The tools of systems analysis, statistics and operations research are those that we apply to the problem. For the sake of brevity, we will just refer to the methodology as *operations research*, or simply "O.R."

This report, the first in a series, is organized in three sections. The first, Chapter 1, reviews O.R. approaches to emergency response up to the present time. Much of this extends back to the 1960's, when 'crime on the streets' led analysts to study emergency response of our cities' first responders, i.e., police, fire and emergency medical. The 40 years of cumulative research provides a sound foundation for going forward with emergency response within a Homeland Security context. The second section, Chapters 2 through 7, provides an historical review of six well-publicized major emergencies that have occurred in recent years. These include acts of nature, industrial accidents and terrorist attacks. In this section, we are particularly concerned with 'lessons learned' and with recurring decisions that must be made and may become better informed with quantitative decision support tools. The third and final section is Chapter 8, which extracts from the historical analysis and from the review of research to date, the need for additional O.R. research needed to move forward with new planning models in emergency response for major emergencies.

CHAPTER 1: APPLICATIONS OF OPERATIONS RESEARCH IN EMERGENCY RESPONSE

Operations research (O.R.), born during World War II, has for 65 years proved invaluable as a decision-planning tool. O.R. is an empirical science that uses the scientific method to assess the consequences of alternative decisions, be they long-term strategic planning decisions or shorter-range tactical or operational decisions. Since a decision can be viewed as an allocation of resources, Operations Research is the science and technology of resource allocation. In WWII, O.R. helped guide the allocation of scarce resources against the enemy. Today O.R. is ideally suited for evaluating and guiding our operational strategies and actions with regard to large-scale emergency incidents, be they acts of terrorism, acts of Mother Nature (e.g., earthquakes, floods, tornadoes, hurricanes) or human-caused accidents. We call such events major emergencies, in which local first-responder resources are overwhelmed. There simply are not enough local resources to do the many jobs at hand.

In this first chapter, with an eye toward future contributions in homeland security, we review briefly major O.R. work done to-date in emergency response. Some of this work is quite recent and aimed directly at homeland security issues. Most has evolved over the past 40 years, motivated by other emergency applications, especially operation of municipal first responders – police, fire and emergency medical. The new threats posed by terrorists present myriad new problems for O.R. analysts. In some ways, today we stand at a place analogous to the place that Philip M. Morse, George Kimball, Bernard Koopman and other O.R. pioneers stood near the beginning of WWII. There are numerous new O.R.-related problems to identify, frame, formulate and solve. Since these methods also apply to emergencies created by Mother Nature and by human accident, let us hope that the huge majority of major emergencies in which these methods are applied are from these latter two categories.

First Responders

The O.R. work on police, fire and emergency medical systems started with the Science and Technology Task Force of the President's Commission on Law Enforcement and Administration of Justice in 1966. It led directly to the national implementation of the three-digit emergency number “911,” and it sparked a generation of important O.R. emergency services research. When New York City implemented its 911 system in 1970, managers there discovered how useful queueing theory is in the scheduling of 911 call-takers. Their original call-taker scheduling yielded intolerable 30+ minute telephone queue delays. An O.R. queueing analysis quickly showed how rescheduling available personnel – without additions – brought the delays to within acceptable limits. The management of queues will be vitally important in the governmental response to any future terrorist attack or other major emergency.

Queues occur when the available resources are not adequate to handle real time demand for those resources. Queueing is a type of rationing of resources. Sometimes the rationing and delays are deliberate, as with some private sector call-in complaint centers. In a major emergency, queues are endemic and must be managed aggressively by using

