



Interfaces with Other Disciplines

OR/MS research in disaster operations management

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Abstract

Disasters are large intractable problems that test the ability of communities and nations to effectively protect their populations and infrastructure, to reduce both human and property loss, and to rapidly recover. The seeming randomness of impacts and problems and uniqueness of incidents demand dynamic, real-time, effective and cost efficient solutions, thus making the topic very suitable for OR/MS research. While social sciences and humanities literatures enjoy an abundance of articles on disaster management, the OR/MS community is yet to produce a critical mass. In this paper, we survey the literature to identify potential research directions in disaster operations, discuss relevant issues, and provide a starting point for interested researchers.

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1. Introduction

The experience of the 2004 Indian Ocean Tsunami shows that disasters continue to cause loss of human life, environmental damage, disruption of infrastructure, and economic loss. A review of available databases such as EM-DAT, maintained

by the Center for Research on the Epidemiology of Disasters and the United States Office of Foreign Disaster Assistance, DesInventar, a project of La Red and OSSO, and the Disaster Database Project, maintained by the University of Richmond (see [Appendix A](#) for the URLs of these databases) demonstrates the scale of the problem. As an example, in 2004 the Disaster Database Project added a variety of events ranging from earthquakes to maritime accidents, averaging three new disasters a day.

On 26 December 2004 the Indian Ocean tsunami killed in excess of 225,000 people and dislocated millions more in countries spread around the

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Ocean's rim from Kenya to Indonesia. The 2001 bombing of the World Trade Center in New York generated direct and indirect losses that most probably will exceed 50 billion US Dollars. And the human cost of extended genocide in a variety of countries in the last two decades has reached totals varying from 100,000 to 800,000 people per incident. These are large, intractable problems that test the ability of communities, nations, and regions to effectively protect their populations and infrastructure, to reduce both human and property loss, and to rapidly recover. Tens of thousands of dead and billions of dollars of damages signal the existence of significant problems for study by any discipline with the capability of reducing the impacts and improving the response to such events.

There is increasing recognition of the need for study of OR/MS issues in disaster management. Dr. Luk van Wassenhove from INSEAD recently wrote six cases on Humanitarian Logistics in Disaster Situations, commenting that “the subject of disaster management is an absolutely fascinating one that is growing in importance” (Van Wassenhove, 2003). Another promising development is the announcement of the EURO Management Science Strategic Innovation Prize—MSSIP 2006. The invited topic, OR/MS in Humanitarian Security, is defined as “all those situations in which the survival, the welfare, the health, or the fundamental rights and liberties of people, whether entire populations or particular social groups, are threatened”. The MSSIP 2006 Jury states that “from the many challenging problems arising within the humanitarian security area, there is an emerging need to develop new methodologies or new variants of old ones, such as emergency logistics, conflict management and resolution, security assessment, strategic management of crises...” (from <http://www.euro-online.org>).

The objectives of this paper are to (i) point to issues in disaster operations management, (ii) survey existing OR/MS literature, (iii) suggest future research directions, and (iv) act as a tutorial for interested researchers. We believe operations research has significant application to the management of disaster preparedness programs as part of a unified community effort and to the actual conduct of disaster response operations.

In the following section we explain the boundaries of the study. A review of literature is presented in Section 3. Section 4 suggests future research directions, while Section 5 points to some problems and issues in disaster operations management. Section 6 concludes the paper. [Appendix A](#) should direct interested researchers to a sample of organizations and disaster related resources as a starting point.

2. Boundaries of the study

Much of the disaster management research relates to social sciences (see Hughes, 1991 and <http://www.geo.umass.edu/courses/geo510/index.htm> for a comprehensive bibliography). This type of research focuses on disaster results, sociological impacts on communities, psychological effects on survivors and rescue teams, and organizational design and communication problems. Even a comprehensive Emergency Management Related Bibliography compiled by the Federal Emergency Management Agency contains only one article from a traditional OR/MS journal (available from <http://www.fema.gov>). We were unable to locate any study which surveys the OR/MS literature and analyzes current efforts in disaster operations management (DOM).

2.1. Definitions of key concepts

To highlight the boundaries of the study three questions need to be answered: What is OR/MS? What is a disaster? And what constitutes disaster operations? The last question is relatively easier to answer. We consider the set of activities that are performed before, during, and after a disaster with the goal of preventing loss of human life, reducing its impact on the economy, and returning to a state of normalcy as disaster operations.

The definition of OR/MS on the other hand, is not clear cut. Churchman et al. (1957) defines OR/MS as the application of scientific methods, techniques, and tools to problems involving the operations of systems so as to provide those in control of the operations with optimum solutions to the problems (p. 9). Winston (1994) defines it as a sci-

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