

Comments for Extreme Events Workshop

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The impetus of our research is our continuing desire to help ensure effective, efficient and equitable emergency management. Our particular contribution is the use of information technology for emergency response planning and operations to mitigate the adverse impact of the sudden onset of hazards. However, advanced communications and computing technologies alone do not process data into information that will make a decision maker "smarter". Models that provide appropriate cognitive support and are embedded in decision aids that employ these technologies are one way, and one reason for the existence of our research.

Our work in this area began with decision support for emergency management for the US Coast Guard in the marine environment, initiated in support of legislation prompted by the Santa Barbara oil spill. Since that time, we have investigated the use of decision support technologies in a variety of problem domains, including a study of the *Exxon Valdez* oil spill. A monograph presents a new logic, Operational Risk Management, to support emergency response planning and operations (Beroggi & Wallace, 1998). This logic was developed based upon our research and field experiences in emergency response.

Emergency response relies on one or more response plans. The proper execution of plans is typically managed by a command and control center. A commander at the scene coordinates the activities of the units responding to the emergency. The on-scene commander and support staff gathers and analyzes data, makes decisions, and monitors their implementation and consequences. The activities required to respond to an incident are often dangerous and must be carried out under time pressure.

Activation of emergency plans is based upon assessment of the potential impacts of an accident and the courses of action needed to eliminate or at least mitigate this impact. These response plans can rarely be executed as expected, as the case of the Exxon Valdez accident showed. Flexible approaches to emergency management are therefore required. Any such approach must be able to deal with an uncertain and changing environment and allow for revision of planned courses of action. Moreover, the approach must be able to support emergency managers in improvising when no standard operating procedure can alleviate the catastrophe.

Unanticipated events affecting planned activities may arise during response operations. Examples include traffic congestions delaying the arrival of the response team and bad weather preventing needed response equipment from arriving on-site. In such situations, the commander must be supported in assessing the potential of these events and deciding whether to continue following planned courses of action or to pursue alternate activities in order to maintain safety and efficiency of the operations. Performing these tasks requires that real-time monitoring and control of response activities, as well as of any external events that have the potential to affect these activities, be considered as integral parts of effective emergency response.

The operational risk management (ORM) paradigm takes into account the uncertain nature of response activities. For example, fire trucks may be unavailable, weather conditions may change unexpectedly, or chemical dispersants may not work as planned. ORM also accounts for the fact that this uncertainty may change the risks associated with various courses of action. For example, a fire may overrun a barricade or the use of water could increase the threat of fire. Although ORM supports the emergency manager's decision-making process, human cognitive limitations in operational environments must be considered as a constraint. Consequently, decision support in emergency management must always consider the human as an integral part of the decision making process. Technological and analytic support should be tailored to the human's capabilities and constraints, and not vice versa.

ORM is not meant to be an alternative to strategic planning. Rather, it should complement strategic risk management for issues that cannot be addressed from a planning perspective. Consequently, any analytic approach proposed for operational risk management must be in accordance with strategic considerations, and vice versa. However, there are some fundamental differences in the motivations for strategic and operational risk management, as summarized in the following table.

<u>Strategic Risk Management</u>		<u>Operational Risk Management</u>
planning	↔	acting
before and after the operation	↔	during the operation
thorough data collection	↔	rapid data transfer
sufficient time for decision making	↔	limited time for decision making
sufficient estimates	↔	high uncertainty
probability of events matters	↔	possibility of events matters
policy decision making	↔	designation of courses of action
outcome feedback	↔	cognitive feedback
technology poses constraints	↔	human poses constraints
rational decision making	↔	emotional decision making

In very low frequency, high-consequence events, one's experience with crisis events will certainly influence judgments and behavior. Written plans and procedures have been shown to serve the valuable purposes of training and familiarization for new organizations, individuals, and public officials. It has been demonstrated repeatedly that

when emergency operations are conducted in accordance with existing plans, reaction time is reduced and coordination improved with fewer casualties, less property damage, and higher socioeconomic capability.

These plans and procedures provide a normative model for simulation scenarios in the context of education and training activities. In turn, conducting these activities creates an opportunity for evaluating the plans and procedures. An additional and equally important benefit of such simulations is that they can provide a field laboratory for studying operational decision-making during emergency response. We have conducted gaming simulations with experienced emergency responders, e.g. at the Port of Rotterdam and FEMA's National Emergency Training Center, and novices, e.g. senior cadets from US Merchant Marine Academy. We were also very fortunate to be able to conduct an evaluation of gaming simulation when an actual crisis situation occurred less than a week after we had observed and evaluated a full-scale training simulation (Belardo et. al., 1983). Although these simulations cannot capture the stress of life-threatening environments, they can be, and have been to us, laboratories for "quasi-experimentation" designed to study the value of decision support systems for emergency response.

References

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Beroggi G. E. G. and Wallace W. A., 1998. *Operational Risk Management: The Integration of Decision, Communications, and Multimedia Technologies*. Kluwer, Boston.

