

## PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

# Realopt-contingency – A Computational Platform For All Hazard And Disaster Planning, Training, And Response

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Catastrophic calamities such as an earthquake, nuclear or pandemic disasters, or deliberate terrorist attacks could cause tens or hundreds of thousands of casualties, destroy the physical and social livelihoods of the displaced, paralyze the economy, and trigger cascading effects across critical infrastructures and national security. In response, rapid decisive actions and mobilization of limited resources must be carried out for mass casualty mitigation and population protection.

This work aims to advance applied scientific knowledge, and in-service training in national and public health emergency response and logistic operations by developing a computational platform, RealOpt-Contingency, that enables logistics and scenario analysis, inventory management, and computational modeling technologies to support all hazard and disaster response during a contingency. RealOpt-Contingency enables users to (1) establish camps and medical facilities for the affected population; (2) design facility layout for optimal usage and safety; (3) optimize distribution of relief supplies; (4) determine rations, water, fuel, and other supplies required per camp and medical facilities; (5) calculate transportation labor and resource requirements, and determine/optimize routes; (6) develop distribution plans from the incident LSA to LSA hubs and to camps and medical facilities; (7) design decontamination and dispensing sites; (8) perform epidemiological disease/contamination plume modeling; and (9) track movement of displaced personnel for rapid on-the-ground reconfiguration.

The front-end graphical interface allows users to outline the affected region, design layout of facilities, input inventory level, demand requests, estimated population size, etc. The backend translates this information automatically via cognitive analytics into appropriate mathematical formulations and simulation parameters.

RealOpt-Contingency includes powerful computational-optimization engines including multiple resource allocation, transportation and routing algorithms, simulation and ODE disease spread modeling, facility layout design heuristics, inventory control stochastic processes, and machine learning/AI and prediction of influence networks. The modular design allows continued technological advances and adaptation using on-the-ground knowledge.

RealOpt-Contingency facilitates experimentation, operations analysis, and decision support for preparedness, planning, and response, enabling decision/policy makers to understand tradeoffs, competing goals, and interdependencies during disaster emergency response.

We will discuss actual usage of RealOpt-Contingency for (a) biological incidents of diagnostic tests, mass vaccination, and clinical redesign; (b) radiological emergency response for sheltering, resupply, decontamination, and population health registry; and (c) earthquake emergency response, rescue, and treatment.

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