Risk Informed Optimization of a Hazardous Material Multi-Periodic Transportation Model

Vasiliki Kazantzi
Department of Project Management/Technological Education Institute of Larissa, Larissa, Greece

Nikolas Kazantzis
Department of Chemical Engineering
Worcester Polytechnic Institute, Worcester, MA, USA

Vassilis Gerogiannis
Department of Project Management/Technological Education Institute of Larissa, Larissa, Greece

ABSTRACT

This paper presents a systematic framework towards the development of a Transportation Model for Hazardous Materials (HazMat). In practice, the proposed modelling framework is realized through an appropriate generalization of the traditional transportation network problem in the presence of safety constraints that need to be satisfied. The objective is to minimize transportation cost while reducing risks at the desired levels.

In particular, the present research study introduces a systematic approach in hierarchically evaluating different risk factors that influence the HazMat transportation network. The above risk factors are identified, evaluated and prioritized using analytical methods.

Next, the transportation model is depicted graphically using nodes and arcs and optimal conditions are identified by solving the associated minimum cost flow network problem. The results show “safety levels” that help making informed decisions on choosing the optimal transportation configuration for hazardous material shipments.

Within the proposed methodological context, appropriately parameterized simulation studies elucidate the effects of occurrence probabilities of the different risk events on transportation cost. Furthermore, as the appropriate management decisions must consider the effect of actions in one time period on future periods, the proposed model is structured as a multi-periodic model.

Finally, the proposed methodological approach is employed to demonstrate the utility of proper analytical tools in decision making and particularly in ensuring that scientifically informed safety procedures are in place while transporting goods that can be potentially proven dangerous to the public and the surroundings.

Keywords
Hazardous Material (HazMat), Multi-Criteria Decision Making, Transportation Network, Risk Analysis