

Towards an online OR toolkit for humanitarian logistics

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Abstract:

There are several disasters every year that affect millions of people and trigger the need for relief items such as food, blankets, or tents. Humanitarian logistics networks organize the flow of relief items from various suppliers to the people in need. In the scientific literature, various OR models have been proposed for setting-up and running humanitarian logistics networks. Their practical application, however, is challenging because humanitarian organizations lack the necessary resources and often have not been included in the model development process.

In this thesis, the concept of an online OR toolkit for humanitarian logistics is proposed. Such a toolkit should enable practitioners in the field of humanitarian logistics to tap the full potential of the published OR models.

Two major steps were necessary to develop the structure of the toolkit. In the first step, characteristics of disaster management and humanitarian logistics were identified. In the second step, available OR models for humanitarian logistics were analyzed. The resulting structure divides models into those for tasks in the disaster preparedness phase and those for the disaster response phase. Subsequently, models are assigned to the specific task they are meant to support, e.g. specifying the locations and relief item stocks of temporary warehouses. Then, the available models for a specific task are grouped by the OR methodology they are based on. Finally, each model is described by its mathematical formulation, by a translation of the mathematical formulation into a suitable program code, and by the problem that is captured in the mathematical formulation. A problem structuring scheme is used to analyze consistently the problems that are captured in OR models for humanitarian logistics.

The proposed structure of the toolkit is exemplarily filled with nine published mathematical programs. Three of them support the specification of stationary warehouses; three support the specification of local distribution centers; and the others support the specification of transportation activities. Thereby, the cornerstones of any humanitarian logistics network can be laid with the present state of the toolkit's content: stationary warehouses as sources of relief items, local distribution centers as the sinks of relief items, and transportation activities to realize the flow of relief items in between. It is shown that the proposed problem structuring scheme can characterize different types of mathematical programs in a consistent way. Furthermore, it is indicated how the proposed structure of the toolkit can support practitioners in finding, adapting, implementing, building databases for, and combining available OR models for humanitarian logistics as well as supporting academics in identifying open research questions.