

The Integration of Geographical Information Systems and Capacitated Vehicle Routing Problem with Simulated Demand for Humanitarian Logistics in Tsunami-Prone Area: A Case Study of Phuket, Thailand

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Abstract : As a result of the Indian Ocean tsunami in 2004, logistics applied to disaster relief operations has received great attention in the humanitarian sector. As learned from such disaster, preparing and responding to the aspect of delivering essential items from distribution centres to affected locations are of the importance for relief operations as the nature of disasters is uncertain especially in suffering figures, which are normally proportional to quantity of supplies. Thus, this study proposes a spatial decision support system (SDSS) for humanitarian logistics by integrating Geographical Information Systems (GIS) and the capacitated vehicle routing problem (CVRP). The GIS is utilised for acquiring demands simulated from the tsunami flooding model of the affected area in the first stage, and visualising the simulation solutions in the last stage. While CVRP in this study encompasses designing the relief routes of a set of homogeneous vehicles from a relief centre to a set of geographically distributed evacuation points in which their demands are estimated by using both simulation and randomisation techniques. The CVRP is modeled as a multi-objective optimization problem where both total travelling distance and total transport resources used are minimized, while demand-cost efficiency of each route is maximized in order to determine route priority. As the model is a NP-hard combinatorial optimization problem, the Clarke and Wright Saving heuristics is proposed to solve the problem for the near-optimal solutions. The real-case instances in the coastal area of Phuket, Thailand are studied to perform the SDSS that allows a decision maker to visually analyse the simulation scenarios through different decision factors.

Keywords : demand simulation, humanitarian logistics, geographical information systems, relief operations, capacitated vehicle routing problem

Conference Title : ICGDMRM 2018 : International Conference on Geomatics, Disasters Management and Rescue Maps

Conference Location : Singapore, Singapore

Conference Dates : March 22-23, 2018