

Determining Evacuation Fleet Sizes for US Noncombatant Evacuation Operations in South Korea

Ryan Winz¹, John A. Kearby², Brandon M. McConnell¹

¹ Center for Additive Manufacturing and Logistics, NC State University, Raleigh, NC

² Department of Mathematical Sciences, United States Military Academy, West Point, NY

The purpose of this research is to support US noncombatant evacuation operations (NEO) planning in South Korea and enhance an existing decision-support tool with a simulation model that evaluates alternative resource allocations using outputs from an optimization model. Designed in Simio, the simulation model replicates the South Korean transportation network using nodes and timed arcs. Buses, helicopters, and trains traverse the network with various fleet sizes and corresponding allocation of these vehicles on different pre-determined routes. Evacuees arrive to assembly points following a stochastic time-varying arrival rate for each region. Key outputs of interest include resource utilization, the average number of evacuees at each node, and the total evacuation time. Multiple computational experiments analyzing the scenario of evacuating US Department of Defense families and US government employees reveal increasing the bus fleet size decreases the total evacuation time, with diminishing returns, until a practical limit for the system is reached. Increasing the number of helicopters results in diminishing returns on time saved as well, but without the performance plateau for all realistic helicopter fleet sizes. Military planners could adopt these methods to better assess evacuation operations under different conditions and to determine how resource allocation affects the total evacuation time in a chaotic environment in an effort to adequately support a NEO mission in South Korea. This research enables planners to better capture tradeoffs between evacuation time and required resources for the commander while providing the capacity to conduct timely what-if analysis for operational risk assessment.

References:

Kearby, J.A. 2019. *Time-Staged Network Flow Modeling and Transportation Planning for Noncombatant Evacuation Operations in South Korea*. Masters thesis, Operations Research graduate program, North Carolina State University.

<http://www.lib.ncsu.edu/resolver/1840.20/36331>.

Kearby, J.A., Hodgson, T.J., Kay, M.G., King, R.E., and McConnell, B.M. 2019. Modeling and Transportation Planning for US Noncombatant Evacuation Operations in South Korea, in review at *Journal of Defense Analytics and Logistics*.