Keshvari Fard, M, M Eftekhar, F Papier (2019) An approach for managing operating assets for humanitarian development programs. Production and Operations Management, 28(8): 2123-2151.

Background: Humanitarian organizations allocate a significant portion of their limited funds to procure, operate, and maintain essential assets, crucial for service delivery. Yet, to our knowledge, even a change in the management team of a country office may lead to a significant alteration in the number of operating assets while there is no instrument to evaluate the value of the new policy. In this study, focusing on vehicles as key operational assets, we explore strategies for optimizing operational capacity to reduce expected deprivation costs in the last-mile delivery of humanitarian services. We introduce a stochastic dynamic programming model, complemented by an efficient heuristic that navigates asset acquisition and operation under budget uncertainty. Using data from a major international organization, we calibrate our model for numerical analysis.

Setting: To develop our model, in addition to the common cost functions (such as vehicle acquisition costs, operating and fixed costs, and residual value), we took four essential factors inherent to humanitarian settings into account: (i) the randomness of individual vehicle disposal, (ii) the unpredictability of budget availability, (iii) the restricted budget to be spent during a certain time window, and (iv) the variation in criticality of transportation missions. As the input for our numerical experiments, we used field data to estimate the model parameters empirically. Our dataset contained information on 1074 Toyota Land Cruisers that a large international humanitarian organization owned from 2000 to 2015 in five countries of operations. We applied Bayesian analysis method to obtain point estimation for the variables of interest.

Key takeaways: The findings reveal: (i) Budget uncertainty elevates expected deprivation costs and lowers capacity utilization, yet allowing for inter-period budget savings can lessen this effect; (ii) An optimal cost-minimization policy might not deploy all assets at all times; (iii) High variability in mission criticality leads to reduced expected deprivation costs and fleet utilization; and (iv) A centralized procurement model (with a longer procurement lead time but a cheaper purchase price) generally surpasses decentralized models (with a shorter lead time but a more expensive purchase price) in reducing both logistic and deprivation costs.

The detrimental effects of budget uncertainty on the formulation of an optimal policy significantly outweigh the challenges posed by financial limitations.

Side points:

- To our surprise, the optimal procurement policy derived from this more complex model closely aligns with the findings of Eftekhar et al. (POM 2014), despite the latter being a less data-intensive model.
- The deprivation costs increase in harsh environments where the probability of vehicle disposal is high.
- Despite field managers typically favoring the utilization of their full operating capacity to meet imminent demands, our findings indicate that an optimal policy aimed at minimizing expected deprivation costs over time does not involve deploying all vehicles in every period. This approach stems from budget uncertainty and the unpredictability of vehicle disposal, prompting a forward-looking manager to embrace a strategy of frugality!

- The average deprivation costs surges if there is less variation in the criticality of the transportation missions. Likewise, we observe that in situations where variations in mission criticality decrease, fleet utilization grows.

  Eftekhar, M., A. Masini, A. Robotis, L. N. Van Wassenhove. 2014. Vehicle procurement policy for humanitarian development programs. Production and Operations Management, 23(6): 951–964.