Eftekhar, M, LN Van Wassenhove (2016) Fleet management policies for humanitarian organizations: Beyond the utilization–residual value trade-off, Journal of Operations Management, 44: 1-12.

(This paper represents one of the pioneering efforts to apply econometric methods to address a question in humanitarian logistics, reflecting the data limitations in the humanitarian sector at the time of this study.)

Background: In humanitarian development programs, the delivery of humanitarian services to beneficiaries, known as last-mile distribution (LMD), is the most critical operations. The centerpiece of LMD is the vehicle, which is used to transport food, materials, and humanitarian workers. Fleet management decisions in humanitarian operations crucially affect both operational performance and costs. Humanitarian organizations (HOs) strive to maximize their vehicles' utilization while minimizing the depreciation of their residual value, facing an inherent trade-off between these goals. Field offices (or delegations) naturally aim to use their vehicles extensively to cover as much demand and complete as many missions as possible. However, the practice of headquarters reselling vehicles at the end of their operational life means that excessive use could diminish their resale value, thereby reducing the budget for future operations and indirectly impacting service levels in the future. To optimize vehicle use and preserve residual value, most HOs have adopted specific fleet management policies. These policies are typically based on the organization's predictions about how various operational decisions might affect vehicle utilization and residual value. Yet, the actual efficacy of these policies on enhancing fleet performance and reducing costs remains uncertain, with little evidence to confirm their implementation. To assist HOs in addressing fleet management challenges, we conducted an in-depth study of a prominent international HO's operations across four countries over a decade. Our data analysis specifically focused on three crucial operational decisions at the field level:

1. Optimal vehicle assignment to missions:
    - Is it more effective for delegations to allocate higher-quality vehicles to heavy-duty missions?
    - Should the assignment of vehicles to missions (from heavy-duty to light-duty) be adjusted as vehicles age or surpass a critical mileage threshold?
2. Optimal vehicle utilization pattern:
    - Is it advisable for vehicles to be utilized at a constant rate throughout their operational lifecycles?
    - Should newer vehicles be subjected to more intensive use than older ones?
    - How does the pattern of utilization affect the vehicle's total mileage and residual value?
3. Efficiency of the Current Replacement Policy:
    - Is the replacement policy being implemented the most effective in terms of operational efficiency and cost-effectiveness?

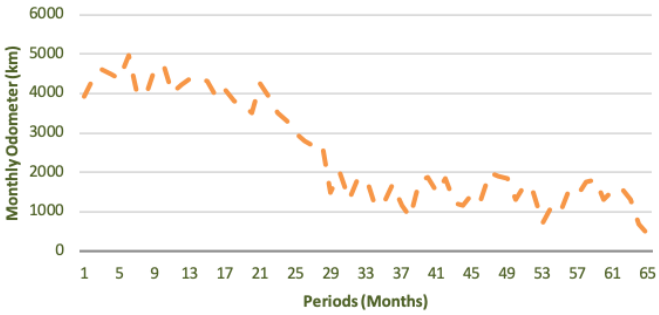
Our study aims to provide actionable insights and recommendations for optimizing fleet management strategies, thereby enhancing operational performance and reducing costs for HOs.

Results:
Vehicle-to-mission assignment: HQs recommend that field offices initially deploy newly acquired vehicles for heavy-duty missions, transitioning them to light-duty tasks as they age past a certain threshold or

surpass a critical mileage. Similar to most HOs, the focal organization operated two vehicle types: (i) standard vehicles and (ii) specially-equipped vehicles, the latter featuring enhanced suspension and bumpers and costing approximately US$ 4,000 more, intended solely for heavy-duty missions. Our analysis revealed that field offices do NOT adjust vehicle assignments over time: A vehicle dedicated to heavy-duty or light-duty missions remains so throughout its service life. Contrary to expectations, almost all standard vehicles are allocated to heavy-duty missions! Despite the purchase of specially-equipped vehicles for safety reasons, their utilization does not align with HQs' expectations. On average, vehicles assigned to heavy-duty tasks accumulate 10,000km more than those in light-duty missions, resulting in about 10% higher utilization. Furthermore, vehicles from heavy-duty missions fetch a higher resale value, over US$ 3,200 more, surpassing 10% of the new vehicle's purchase price. Our findings support the HQs' *unimplemented* policy as being effective. Properly assigning specially-equipped vehicles to heavy-duty missions and standard vehicles to light-duty ones could extend each vehicle's total mileage by approximately 24,000km (24% higher utilization), translating to savings of over US$ 3,400 per vehicle, or more than 11% of a new vehicle's cost. We recommend that if HQs cannot enforce this optimal vehicle-to-mission assignment strategy, they should consider supplying only standard vehicles to all delegations, thereby reducing procurement expenses.

Vehicle utilization over time: Headquarters recommend that field offices adopt a *decreasing-usage trend*, as illustrated in the figure below. The guidance is to utilize vehicles more intensively during their initial years. Then, after two or three years, the vehicles should be relegated to shorter trips. HO management assumed that this decreasing-usage strategy enhances the safety of humanitarian workers. The rationale was that vehicles with higher cumulative mileage are more prone to breakdowns during extended field missions, potentially jeopardizing the safety of humanitarian personnel.

Our findings indicate that a decreasing usage trend, regardless of the mission type, does not extend a vehicle's total mileage nor enhance its residual value. Furthermore, such a trend does not necessarily improve the safety of humanitarian workers, as vehicle failure rates are not solely dependent on total mileage, especially if the cumulative odometer reading remains below a certain threshold (150,000km for standard vehicles and 200,000km for specially-equipped vehicles). Typically, humanitarian vehicles are sold well before reaching these thresholds. We recommend that all vehicles be utilized intensively throughout their operational lifespan and sold immediately after three years. To maximize a vehicle's usage, we advise delegations to employ the same vehicle for both heavy-duty and light-duty missions, alternating its use between these two types over different periods. Additionally, we propose the sharing of vehicles between delegations (or programs) to further increase efficiency and resource utilization.



We do not recommend a decreasing-usage trend.

Vehicle replacement policy: Following the manufacturer's recommendation, HQs suggest replacing all vehicles after five years or 150,000 km, whichever comes first. However, we found that field offices do not adhere to this policy in practice! Additionally, we found that a vehicle's total mileage does not impact its residual value. Instead, the age of a vehicle significantly and negatively affects its residual value. Surprisingly, there is no correlation between a vehicle's age and its total mileage, indicating that keeping a vehicle longer in the fleet does not necessarily mean it will be used more. Therefore, we recommend that offices utilize vehicles intensively during the first three to four years (aiming to reach the 100,000km total mileage threshold as soon as possible) and then promptly replace them. This strategy would ensure a fleet comprised of younger vehicles on average, boasting higher transportation capacity and lower operational costs. Implementing these recommendations could result in substantial savings, estimated at around US$ 8,000 per vehicle (more than 26% of the purchase price) over its operational lifespan. For a fleet of several hundred vehicles, these savings could easily surpass the US$ million mark.

Further reading: While working on this paper, I particularly enjoyed:

Hendel, I., Lizzeri, A., 1999. Adverse selection in durable goods markets. American Economic Review. 89 (5), 1097–1114.

Lapre, M.A., Scudder, G.D., 2004. Performance improvement paths in the U.S. airline industry: linking trade-offs to asset frontiers. Production and Operations Management. 13 (2), 123–134.

Larcker, D.F., Rusticus, T.O., 2010. On the use of instrumental variables in accounting research. Journal of Accounting and Economics. 49 (3), 186–205.