Asset Replacement and Fleet Sizing In the Truck Rental Industry

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Abstract

Determining the optimal size of a fleet, in general, involves decisions from three different levels of hierarchies: strategic, tactical, and operational. While decisions based on each level have traditionally been examined separately, they are economically interdependent and must be analyzed simultaneously to minimize life-cycle costs. This paper addresses this problem in the context of the truck rental industry, subject to nonstationary stochastic demand which is dependent on geographical location, time, and the economic cycle of the industry, and uncertain truck travel time. We integrate vehicle buy and sell decisions with operational utilization decisions so as to achieve the optimal fleet size. A tractable time-space network with dynamic and stochastic demand is developed and solved through both transient and steady state analysis. Two decomposition procedures are then applied, including the decomposition of customer demand into individual components and resource-directive decomposition which allocates the demand among available assets defined by their type and age. The solution consists of asset movement decisions, both loaded and empty, and asset procurement and disposal decisions over time.