

SPACE SYSTEMS SYMPOSIUM (D1)
System Engineering - Methods, Processes and Tools (1) (3)

Author: Prof. Joseph Homer Saleh
Georgia Institute of Technology, United States, jsaleh@gatech.edu

Ms. Kailah Snelgrove
School of Aerospace Engineering, Georgia Institute of Technology, United States, ksnelgrove@gatech.edu

TOWARD A NEW SPACECRAFT OPTIMAL DESIGN LIFETIME: EFFECTS OF OBSOLESCENCE,
COST OF DURABILITY, AND REDUCED LAUNCH PRICE**Abstract**

The average design lifetime of satellites continues to increase, in part due to the expectation that the satellite cost per operational day decreases monotonically with increased design lifetime. In this work, we challenge this expectation by revisiting the durability choice problem for spacecraft in the face of reduced launch price and under various cost of durability models. We first provide a brief overview of the economic thought on durability and highlight its limitations as they pertain to our problem (e.g., the assumption of zero marginal cost of durability). We then investigate the merging influence of spacecraft cost of durability and launch price, and we identify conditions that give rise cost-optimal design lifetimes that are shorter than the longest lifetime technically achievable. For example, we find that high costs of durability favor short design lifetimes, and that under these conditions the optimal choice is relatively robust to reduction in launch prices. By contrast, lower costs of durability favor longer design lifetimes, and the optimal choice is highly sensitive to reduction in launch price. In both cases, reduction in launch prices translates into reduction of the optimal design lifetime. Our results identify a number of situations for which satellite operators would be better served by spacecraft with shorter design lifetimes. Beyond cost issues and repeat purchases, other implications of long design lifetime include the increased risk of technological slowdown given the lower frequency of purchases and technology refresh, and the increased risk for satellite operators that the spacecraft will be technologically obsolete before the end of its life (with the corollary of loss of value and competitive advantage). We conclude with the recommendation that, should pressure to extend spacecraft design lifetime continue, satellite manufacturers should explore opportunities to lease their spacecraft to operators, or to take a stake in the ownership of the asset on orbit.