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TRADESPACE EXPLORATION OF MULTI-MISSION CREWED MARS SURFACE SYSTEM ARCHITECTURES

Abstract

In recent years, an unprecedented level of interest has grown around the prospect of landing humans on Mars for the exploration and eventual settlement of that planet. A review of past Mars mission planning efforts, however, reveals that while numerous studies have explored the challenges of transporting people to the red planet, relatively little effort has been invested in quantitatively characterizing the challenges of sustaining humans upon arrival, especially across campaigns of multiple crew landings and logistics resupply missions. In light of this trend, this paper performs an integrated architectural analysis of two long duration, multi-mission Mars campaign scenarios to evaluate the impact of various technology options on the costs of sustaining multiple crewed expeditions on the surface of Mars. Specifically, this analysis explores the effect of increasing levels of life support resource recycling and local food production on required in-situ resource utilization infrastructure and logistics resupply demands. This is accomplished by computing and comparing the infrastructure required to deploy and support eight representative surface system architectures, each with varying levels of life support resource recycling and food production. Through this analysis, trends relating life support and in-situ resource utilization architectures are identified and analyzed, and their wider implications on system development, deployment, and operating costs are discussed.