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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Exploration of Mars (2)

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ONE-WAY VERSUS RETURN MARS MISSION ARCHITECTURES - A COMPARISON OF
LIFECYCLE OPERATING COSTS

Abstract

In recent years, the concept of one-way missions to Mars has steadily gathered support as a means for accelerating the time-to-first-landing of humans on the planet's surface. Based on the notion that not having to return crew from the Martian surface will bring about significant mass and cost savings, this concept represents a significant departure from the return-trip architectures that have been studied throughout the human spaceflight community over the past sixty years. As NASA's long term exploration goals refocus towards developing "Earth Independent" capabilities for future multi-decade and multi-vehicle mission campaigns, understanding the impacts of major architectural decisions on lifecycle cost will become increasingly important. This is especially the case for the decision on whether the crew should be returned or not. Focusing on the technical and operational aspects of both concepts, this paper presents a comparative analysis of the lifecycle costs of developing a twenty-person Mars surface base using both the one-way and return-trip architectures. In both cases, the impact of differing crew ramp-up profiles will be explored and for the return-trip case, crew changeover profiles will be investigated as the surface habitat increases its capacity towards twenty crewmembers. These crew schedules will be used in concert with the selected surface base architecture to determine the frequency and amount of consumables and spare parts resupply required from Earth. With this information, the emplaced and resupply mass required to sustain and expand the surface base can be determined, from which a deployment and operating cost can be determined over the mission lifecycle. This paper expands upon the methodology employed for this analysis, presents the results obtained, and discusses the implication of these results on key architectural and programmatic decisions that are currently being discussed within the human spaceflight community.