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

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AN INDEPENDENT ASSESSMENT OF THE TECHNICAL FEASIBILITY OF THE MARS ONE MISSION PLAN

Abstract

In mid-2012, the Mars One program was announced, aiming to build the first human settlement on the surface of Mars. Following a series of precursor missions to demonstrate and deploy the key technologies required for an operational surface habitat, the first crewed mission would depart Earth in 2024, sending four people on a one-way journey to the surface of Mars. Following this initial mission, additional four-person crews would be sent to Mars at every subsequent launch opportunity to further support and expand the extraterrestrial colony.

While this program has been received with great fanfare, very little has been published in the technical literature on the analyses that led to the formulation of its mission architecture. This is particularly important as the mission plan relies on the availability of in-situ resource utilization (ISRU) and life support technologies that are far more capable than the current state of the art. Moreover, little detail is published on the resupply manifest and logistics plan of the proposed colony – a mission aspect that it is deeply coupled to the selection and sizing of the initial technologies emplaced, and one that is critical to the sustainment of a planetary habitat.

In light of this, we perform an independent assessment of the technical feasibility of the Mars One mission plan. We review the current state of the art in life support and in-situ resource utilization (ISRU) technologies, and discuss the gaps in capability that need to be addressed in order to meet the technical challenges inherent to the Mars One mission plan. Following this, we perform a preliminary tradespace exploration and sizing of the life support and ISRU technologies required for the mission, and perform an analysis of the space logistics chain required to simultaneously resupply the colony, and support its planned biennial expansion. Based on the obtained results, we perform a sensitivity analysis to investigate the sensitivity of resupply demands to variations in the profile by which crew members are added to the settlement over time. This will allow for an estimate of the required launch capability, and hence mission cost.

Using the insights gained from this analysis, we evaluate the feasibility of the Mars One mission plan, and suggest alternative architectures to achieving the goal of sustaining a human settlement on the surface of Mars.