20th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Human Exploration of Mars (2)

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HUMAN MARS MISSION DESIGN: THE ULTIMATE SYSTEMS CHALLENGE

Abstract

A human mission to Mars will occur at some time in the coming decades. When it does, it will be the end result of a complex network of interconnected design choices, systems analyses, technical optimizations, and non-technical compromises. A human mission to Mars will extend the technologies, engineering design, and systems analysis to new limits, and may very well be the most complex undertaking in human history.

A human Mars mission can be illustrated as a large menu of design decisions, or as a large decision tree. Whatever the visualization tool, there are numerous design decisions required to assemble a human Mars mission, and many of these decisions interconnect with one another. This paper examines these many design decisions, and further details a number of design choices that are highly interwoven throughout the mission design. The large quantity of design variables, and the interconnectedness of many of the variables, results in a highly complex systems challenge, and the paper illustrates how a change in one design variable results in ripples (sometimes unintended) throughout many other facets of the design.

The paper concludes with a discussion of some mission design variables that can be addressed first, and those that have already been addressed as a result of ongoing NASA developments, or as a result of decisions outside the technical arena. It advocates the need for "reference design" that can be used as a point of comparison, and to illustrate the system-wide impacts as design variables change.