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EXTENDING THE CURRENT NASA MARS HUMAN EXPLORATION ARCHITECTURE TO INCLUDE TITAN

Abstract

This paper describes the interim results of an independent study to investigate the human exploration of Titan using one of the Mars exploration concepts described in the NASA Mars Design Reference Mission document. The authors aim to show that the scientific and political return on investment for human exploration of Mars can be greatly extended by also using the same basic design for Titan exploration. This is enabled primarily due to the local availability of resources on Titan such as a significant nitrogen atmosphere, surface ice and liquid methane. Titan is uniquely suited to allow for self-sufficient habitation by human explorers, possibly for the long term. The study assumes that there is an undetermined but finite level of public support and resources available in the United States for solar system exploration and that only one major human exploration mission campaign past the moon will be funded in the next 50 years. This study discusses how and why Titan should be included as part of the upfront non-recurring expenditure for the development of that Mars human exploration mission. The major conclusions of the study are:

- Including Titan in the requirements definition for the Mars electric propulsion and deep space habitat stages increase the total return on investment for Mars exploration.
- The data yield per unit time and per unit cost for human exploration of Titan is superior to that of robot exploration due to the travel time and reduced NRE from using the Mars exploration hardware.
- The unit recurring cost of the Mars EP and deep space habitat stages could be reduced by as much as 30% due to reduction in piece part cost by allowing for larger lot buys and labor efficiencies due to continuous production as the quantities increase from the 9 EP stages required for Mars exploration to 15 EP stages for the combined Mars and Titan plan.
- The conclusions listed assume that human missions to Titan are long term, i.e. “one-way” for the initial crew.

The authors have aimed to show that the human exploration of Titan using the Mars exploration architecture allows for a unique opportunity to greatly increase our understanding of Titan in a shorter time than for robotic exploration. Human exploration of Titan likely provides significant political and cultural benefits as the public imagination and support for a permanent human outpost in the outer solar system will likely be high.