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ON THE ASSESSMENT OF MANNED MARS MISSION ARCHITECTURES

Abstract

Numerous manned Mars mission architectures have already been proposed but none seems more efficient or acceptable than the others. An important difficulty is to determine relevant criteria to assess different architectures and carry out fair comparisons. IMLEO is usually considered a key criterion. However, IMLEO calculation depends on numerous parameters and assumptions, such as the mass of consumables for the round trip, the specific impulse, the structural to propellant mass ratio of the propulsion systems, the planetary configuration at Earth departure or the constraint on interplanetary trip duration that is sometimes required. Comparisons based only on IMLEO are therefore often biased, unfair or inappropriate. We propose a new methodology that takes the main elements of the mission into account and assesses manned Mars missions in a fairer way. It is based on the standardization and parametrization of important variables, such as the mass of consumables per day and astronaut and the mass of the propulsion systems for each maneuver. Another important issue is the definition of the objective, which is often considered a mixture of competing goals, e.g., minimizing the cost, maximizing exploration capabilities and minimizing the risks. It is proposed here to embed this objective in a global formula with several parameters. With the proposed methodology, any manned Mars mission can be assessed according to a given objective and a standardized set of criteria.