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Technology

ADVANCEMENTS IN SPACE TRAVEL TECHNOLOGY: FROM LUNAR MISSIONS TO MARS EXPLORATION

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ABSTRACT

Since the beginning of human space exploration, a Mars mission has been a major goal, though it continues to be postponed. A journey to Mars is a milestone with various limitations, involving traveling humans 200 times farther than ever before, keeping them in space 50 times longer than they ever have been, and securing life-essential resources 100 times more than has ever been done. Such a venture requires technological readiness in structural, environmental, and human aspects to ensure sustainable life support system and resources in space. This brings heightened risks, including extended exposure to radiation, space elements, low gravity, and isolation.

This study assesses the changes in Mars trip dates and the delays over the past five decades, along with the main reasons behind these delays. It uses the RMTS technology development-based system to evaluate the current and future technological status of the components involved in such missions and projects the anticipated timeline for accomplishing a human Mars trip. The analysis outlines (1) the technology readiness status for the Mars trip, (2) the factors involved in the ongoing delays, and (3) their relation to the advancement of lunar missions and space travel in general.

RMTS's elements and Readiness matrices are used in conjunction with the nonlinear application of the general Technology Pace Coefficient (TPC) via simulations. However, applying the general TPC directly is not practical for this study, as it was originally derived for extended time periods. Adjustments were made to refine the coefficient so that it could be applied to a shorter timeframe, considering factors such as: (i) scientific breakthroughs, (ii) lag time in rebuilding technology, (iii) political and funding fluctuations, and (iv) public and private space travel progress. Hundreds of simulations were conducted using the modified TPC to explore the possibilities for Mars trip readiness, based on the technology status of the related RMTS items. The results, in conjunction with the orbital cycles of Mars and Earth, were used to forecast the two most favorable dates for human trips to Mars with the shortest possible transit duration. Despite all the technological advancements in the past couple of decades, the traditional steps in achieving the next milestones in human space travel have not changed. The study delineated that the gradual advancement from lunar to planetary exploration remains an integral part of any projection for

future space travel milestones, and that a trip to Mars is directly connected to returning humans to the Moon.

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Comments:

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