

26th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)  
Human Exploration of Mars (2)

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CONCEPTUAL STUDY OF THE DESIGN AND ASSEMBLY OF A MARS HUMAN OUTPOST:  
FEASIBILITY AND TECHNICAL CHALLENGES

**Abstract**

The paper summarizes the results of a study on a Mars Human Outpost (MHO), which was part of the Master course "Space Exploration Project" at the Department of Aerospace Engineering at the University of Applied Sciences Aachen. The mission scenario studied is the conceptual design of the MHO with a particular focus on the initial assembly process and survival during the assembly phase. The student team investigated the feasibility and technical challenges of building the first MHO on the surface of Mars around the year 2050 based on current technologies and those currently under development. In addition to systems engineering in the definition of mission design, the following subsystems of the MHO were studied in greater detail: Thermal, power, life support system (LSS), communication navigation, logistics, crew mobility and habitat design. The final habitat is expected to accommodate four astronauts over a 560-day period and SLS launchers are assumed as the transport vehicles. Part of the study was to analyze the logistics required and the number of launches to ensure crew safety and mission success. The main focus was put on the conceptual design of the MHO, which consists of a Mars Descent Vehicle

(MDV) and a surface habitat, for which the different development stages, from initial deployment to the final 560-day unit, were studied. In addition, the team defined consumables and subsystems that must be transferred to the Martian surface by cargo shipments prior to crew arrival. After touchdown, the MDV ensures astronaut survival for up to 60 days and serves as the base of operations for robot-assisted habitat assembly and commissioning. During this time, the habitat is assembled from modular, pre-deployed modules, after which nominal science operations can begin. This presentation focuses on the design and assembly phases of the MHO subsystems until the nominal phase is reached and establishes requirements and budgets for all major subsystems of an early Mars habitat. Overall, this study provides insights into the technical challenges of the initial phase of a long-term human presence on the surface of Mars. Various elements from other studies have been considered for conceptualizing the MHO, defining an initial Mars base construction process.