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Space Architecture: technical aspects, design, engineering, concepts and mission planning (1)

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MODULAR SPACE ARCHITECTURE: DESIGN CONSIDERATIONS FOR TRANS-PLANETARY
MANNED EXPLORATION

Abstract

Manned spaceflight has always been a challenging task involving factors concerning crew safety and comfortably. Heavy lift launch vehicles are essential components, which enabled us to step on the Moon and lift large and heavy habitats into LEO such as Skylab and currently orbiting ISS. In addition, dozen of heavy lift launches would be required to complete highly discussed Mars mission with current chemical engines. New propulsion technologies, standardized payload module design, and modular interior architecture may lead to safer and cost-effective manned exploration.

This opens up a research dedicated to general mission architecture design consideration as well as habitation module interior design. Phobos and Deimos exploration (Mars precursor mission) is utilized as a reference mission project, which led us to further development of the modular system and its analysis. The main goal of the project is to reduce the mission mass and volume by increasing the crew safety. A catalogue of different payload modules was developed based on launch vehicle's constraints (e.g. payload fairing size and volume). Modular system can be applied to various trans-planetary missions to surfaces of: 1) Mars, 2) Ganymede, 3) Europa and 4) Titan. The comparison between these missions resulted in general estimations and evaluations: habitability, contingency situations evaluations, amount of propellant required per mission, number of launches, and last but not least the missions overall size and cost.

Such design approach may lead to reusable, cost effective and the most important safe trans-planetary manned exploration. At the same time, it enables us to quickly evaluate mission parameters and habitat requirements for future manned exploration to Mars and beyond.