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

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WHAT WE DON'T KNOW CAN KILL US

Abstract

This paper presents the perspective of a space architect on what we need to know to build spacecraft and Libration point/ Moon/ Phobos/ Deimos/ Mars habitats that will protect human health, safety, and sanity effectively. It argues that the current funding for research and development is woefully inadequate in the five critical areas of radiation protection, lunar/Mars dust protection, microgravity and partial gravity countermeasures, reliable regenerative life support, and psychological/social support. To a great extent, the solutions to these threats will rely upon the design and outfitting of the Mars surface and interplanetary habitat architecture and the associated pressurized elements such as airlocks, pressurized rovers, and EVA suits.

The threats to human health and safety can prevent a human Mars mission from succeeding or even getting started. These five deficiencies threaten any long duration human Mars Mission or permanent settlement, and affect the Mars mission design, system architecture, habitat architecture, and the concept of operations in transit and on the surface. While NASA and the other space agencies do the best they can to fund small programs in each of these critical areas, they focus almost entirely near-term challenges to maintain, repair, and upgrade the ISS to support the crew. Funding for this critical research has lagged so far behind the theorized milestones of exploration strategy and policy as to render these ambitions unrealistic at best.

The US National Research Council has published dozens of reports commissioned by NASA that define the first four these threats and explicate the reasons for why NASA must solve them. With respect to psychological and social support, NASA has not commissioned any NRC reports yet. This paper reviews those reports to organize their findings to show how the missing research applies to Space Architecture. These data will be essential the standards and "building codes" to build successful risk-managed crew habitats and spacecraft for Mars missions.