Developing a Habitat for Long Duration, Deep Space Missions

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One possible next leap in human space exploration is a mission to a near Earth asteroid (NEA). In order to achieve such an ambitious goal, a space habitat will need to be designed to accommodate a crew of four for the 380-day round trip. The Human Spaceflight Architecture Team (HAT) developed a conceptual design for such a habitat. The team identified activities that would be performed inside a long-duration, deep space habitat, and the capabilities needed to support such a mission. A list of seven functional activities/capabilities was developed: individual and group crew care, spacecraft and mission operations, subsystem equipment, logistics and resupply, and contingency operations. The volume for each activity was determined using NASA STD-3001 and the companion Human Integration Design Handbook (HIDH). Although, the sum of these volumes produced an over-sized spacecraft, the team evaluated activity frequency and duration to identify functions that could share a common volume without conflict, reducing the total volume by 24%. After adding 10% for growth, the resulting functional pressurized volume was calculated to be 268 m^3 distributed over the functions. The work was validated through comparison with the International Space Station (ISS), Bigelow Aerospace's proposed habitat module, and NASA's Trans-Hab concepts. In the end, the team developed an internal layout that (a) minimized the transit time between related crew stations, (b) accommodated expected levels of activity at each station, (c) isolated stations when necessary for health, safety, performance, and privacy, and (d) provided a safe, efficient, and comfortable work and living environment.