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DECADAL OPPORTUNITIES FOR SPACE ARCHITECTS

Abstract

A significant challenge for the field of space architecture is the dearth of project opportunities. Yet every year young professionals continue to express interest to enter the field. The paper outlines human space flight (HSF) opportunities that can be reasonably expected over the next few decades so those interested in the field can map their plans to reality. Design concepts for HSF systems have clearly followed NASA advanced planning trends: LEO in the 1980s, Mars in the 1990s, ISS assembly in the early 2000s, lunar surface outposts later in that decade, and presently uncertain. As NASA's direction continues to evolve, the likely trends bear reëxamination. The paper synthesizes four sources to do this: prior analyses published by the author; trends in societal context for the first half of the 21st century; commercial HSF projects; and current NASA planning. The paper describes project opportunities likely to emerge for space architects through 2050. They are mapped according to destination (from Earth to deep space) and scale ("from spoons to highways"). Discussion of the "why" of HSF leads to cataloguing options for the "what" and "where" that could be economically and technologically achievable over the next several decades; and then to conclusions about scenarios for the "when." The resulting project opportunities available for space architects are described. One scenario synthesizes three drivers: severe NASA outyear budget limitations, nascent space adventure travel, and a steadily worsening petroleum-based energy milieu. The scenario begins with continued operation of ISS, then integrates HSF activities within our grasp: government human servicing of GEO assets, and commercial LEO passenger travel. These steps extend human presence to the nearest deep-space environment and drive increasing launch reliability, laying the foundation for large, commercially transported construction crews building GEO solar power satellites. This public-private megaproject makes HSF integral to major contemporary issues including energy security, environmental degradation, and geopolitics. The foundation of human launch, heavy-lift launch, routine beyond-LEO operations, abundant in-space power, and commercial in-space support services then opens many possible futures for decades beyond about 2030: lunar tourism, trans-lunar exploration, and space settlement. In this scenario, human exploration of faraway places is the beneficiary rather than the driver of advanced human space flight. The paper extracts and characterizes time-phased project opportunities for space architecture, aligned with this and other scenarios.