



Enabling U.S. Leadership of Human Spaceflight

An Information Paper

Overview

Human spaceflight is an inspiring undertaking and a pinnacle of technological achievement. It has captivated the public imagination, inspired national pride, and enabled generations to see limitless possibilities in the new frontier. However, routine access to space remains technically challenging and costly. While the Vision for Space Exploration provided programmatic direction to NASA in the wake the 2003 Challenger accident, that “vision” of resumed human exploration beyond Earth orbit was never funded at a level that would make it sustainable.

With the Space Shuttle’s planned retirement in less than a year, the immediate space transportation concern is how to expeditiously obtain new, safe and reliable U.S.-supplied means for access to Earth orbit. A multi-year capability gap is now a certainty. This situation forces reliance on Russian launch vehicles for International Space Station (ISS) crew rotation. Also, with the proposed cancellation of the Constellation program, government sponsorship of *development* projects to enable extension of human spaceflight capability beyond Earth orbit is uncertain. The new NASA budget proposal outlines a research program that has robust propulsion and technology development components, but no clearly defined exploration mission, nor any specific achievement milestones. When funding proposals are not accompanied by specific human exploration schedules and objectives, the lack of a framework within which to define and accomplish necessary technological advances invites programmatic drift.

Background

The entire U.S. human spaceflight program since Apollo has taken place in low-Earth orbit. It presently consists of a vehicle to transport humans and cargo to orbit—the Space Shuttle—and a facility for humans to conduct space-unique research—the ISS. After the second Shuttle accident involving loss of life, it was decided to retire the Space Shuttle in 2010, and to seek a “compelling mission” (as the Columbia Accident Investigation Board’s report put it) that would justify spaceflight’s risks to human life. That compelling mission, supported by the Bush Administration and Congress, was a human exploration program beyond Earth orbit. The resulting *Constellation* program aimed to develop new vehicles for a return to the Moon, with Mars as a longer-term objective. However, *Constellation* did not receive sufficient funding to meet its intended schedule. Now, six years later, the Obama Administration proposes the cancellation of *Constellation*, with resources applied instead to providing incentives for commercially developed means of human access to Earth orbit.

The President’s budget proposes that the old model of government-led development of transportation to Earth orbit be replaced with incentives for commercial development of space transportation services that can be procured by the government. Based on systems derived from the ongoing Commercial Orbital Transportation Services program, U.S.-supplied ISS Cargo Resupply Services could be available only two to three years after the retirement of the Shuttle. A new U.S.-supplied human launch system that meets

necessary crew safety standards will take longer to achieve, and regulatory authority for passenger safety on orbit-capable space vehicles has yet to be established. In lieu of the Ares V Heavy-lift Launch Vehicle (HLV) development that was planned as part of the *Constellation* program, research is proposed into new technologies for HLV concepts. Research regarding new space vehicle propulsion and operational capabilities is also proposed to provide better means for future exploration missions. However, these newly proposed technology initiatives do not yet have any specific exploration objectives to guide their direction, and there is no timetable for achieving specific exploration goals that would drive development programs to apply new technology. Even if the aim is to follow a “flexible path” for human space exploration—one of the options provided by the U.S. Human Space Flight Plans Committee under Norman Augustine—it is important to be able to measure ongoing program success against specific achievement milestones to rate progress. Furthermore, it is unlikely that human exploration beyond Earth orbit can be efficiently accomplished without an operational HLV that could deploy large human spacecraft components and deep space transportation systems.

A significant portion of Americans in high technology careers (including national security disciplines) attribute their inspiration to pursue a challenging educational program to their childhood excitement about human space exploration programs. A recent MIT study showed that number to be 40% among current aerospace engineering undergraduates. The human space exploration program, complemented by robotic missions, is a catalyst for research and innovation, drawing youths to participate and contribute in these exciting endeavors. It kindles a spirit of discovery and wonderment that inspires the nation. The opportunity to be a part of great things shapes and incentivizes individuals entering the nation’s workforce into honing their technical skills and education, which is critical to our national security and to maintaining our country’s technical competitiveness.

Meanwhile, India, China, and Japan plan to establish human lunar bases at about the same time as had been proposed by the U.S. under the *Constellation* program (by the 2020s). Long-duration lunar surface habitation provides one path to obtaining practical operating experience and maturing in situ sustainment capabilities necessary for human space exploration beyond Earth. Explorers on the Moon can always be within five days of a return to Earth when necessary for safety early in a human space exploration program. Trajectories to asteroids or to Mars are infrequently available, and involve much longer transit times. Consequently, the Moon can provide a way station for further exploration into the solar system by providing a test bed for honing combined human and robotic skills as well as strategies for venturing on to other worlds.

Supporting commercially-supplied access for cargo and crew to Earth orbit may well create a robust new industry, and possibly more affordable access to space, but it will require a yet to be established regulatory authority to assure the safety of passengers on these vehicles. Pursuing development of a host of space exploration technologies without well-defined exploration goals is a shortcoming of the newly proposed policy basis for the NASA budget that should be redressed to provide metrics for evaluating progress as well as to prevent redirection of allocated resources for other uses. Without specific human space exploration goals and associated achievement milestones, and without clear plans for supporting the necessary system developments (e.g., HLVs), the U.S. risks becoming a nation of space exploration spectators rather than the source of world recognized exploration accomplishments.