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and ourselves*

A boost for commercial human spaceflight



THE VISION FOR SPACE EXPLORATION (VSE), first announced to the public by President George W. Bush on January 14, 2004, officially ended on February 1, 2010, with the cancellation of its cornerstone program, Constellation.

The VSE, which envisioned returning astronauts to the Moon and eventually using the lunar surface as a launch site for manned missions to Mars, was intended as a way to rebuild slumping morale at NASA and provide a road map for the future after the 2003 loss of the shuttle Columbia. Another goal of the strategy was to reenergize the public's interest in human spaceflight and recapture the sense of excitement and national pride felt during the Apollo era of the late 1960s and early 1970s.

Six years and \$9 billion later, the Obama administration has decided to terminate Constellation by canceling work on its core elements—the Orion crew exploration vehicle and Ares I rocket. Orion/Ares I would have been the follow-on system to the space shuttle fleet, scheduled for retirement by the end of this year. It would also have served as the basis for development of a more powerful system designed to transport astronauts and supplies to the Moon by 2020.

The decision to terminate Constellation will essentially leave NASA without its own manned space transportation system for the first time in half a century. Some within government and industry are interpreting this as the beginning of a marked decline in America's space leadership and the start of a trend that will see countries such as China and India catch and even surpass the U.S. in the area of human spaceflight. We see the exact opposite.

The root cause

The reality is that the VSE has never been adequately funded, and was never going to succeed without a massive infusion of funding for NASA, a move that was not going to happen anytime in the

near future given the immense demands on the federal budget (including two wars), the growing U.S. budget deficits, mounting debt and the continuing stagnation of the economy. So the choice was between funding an increasingly expensive R&D program with insufficient budgets, in hopes of eventually producing an Orion/Ares I system, or deciding to radically change the strategy for the way NASA conducts human spaceflight.

In a report submitted to Congress in October, a U.S. human spaceflight policy review panel headed by Norman Augustine noted, "The U.S. human spaceflight program appears to be on an unsustainable trajectory. It is perpetuating the perilous practice of pursuing goals that do not match allocated resources." We think that this observation goes to the heart of why the current administration felt it had to end Orion/Ares I and change course.

The Augustine panel concluded that the budget for Orion/Ares I would have to be increased by at least \$3 billion a year to keep the program relatively on track. The Obama administration was only willing to grow NASA's overall budget from \$18.7 billion in FY10 to \$19 billion in FY11, which means the agency was simply not going to be given anywhere close to the amount of money needed to keep Orion/Ares I alive.

In addition, the panel's recommendation that the administration allocate \$11 billion more for manned space exploration than it had previously budgeted for FY11 through FY15 reflects a common-sense realization that there will be program delays that add to costs.

The point is that the U.S. has finally arrived at a crossroads where there is a vast disconnect between the country's human spaceflight goals, as broadly outlined by the VSE and Constellation, and the financial investment the U.S. government is willing and able to make. It is a crossroads that could easily have been foreseen by the Bush administration and

the industry in 2004, but at that time there was an inherent unwillingness to discuss the question of what the vision would end up costing U.S. taxpayers.

As part of an effort to collect feedback on the VSE from industry and academia, the Bush administration established a nine-member space policy advisory panel of scientists and business leaders. The President's Commission on Moon, Mars and Beyond, chaired by former astronaut Pete Aldridge, held a series of public hearings in 2004 to help formulate a blueprint for the vision.

Ultimately, the commission published an extremely superficial report, more a collection of vague ideas and possibilities in support of the vision than a detailed plan for how that vision would be implemented and funded and how it would benefit the U.S. It was an exercise in rubber stamping the VSE rather than determining whether or not the strategy was realistically possible and why it was worthwhile to undertake.

From the start of the VSE, our sense was that no one in the Bush administration wanted to talk about its potential cost, because estimates that ranged in the hundreds of billions of dollars would be politically unpalatable and would derail the program before it ever got off the ground. But everyone knew that to make even the first phase of the VSE happen, NASA's budget, which at that time was still less than \$16 billion, would have to grow at a pace significantly higher than the annual rates of inflation over the course of at least a decade.

The silver lining

It was determined that the details of how to come up with the funding needed for the VSE would be left up to future administrations. It was also decided that a detailed rationale for why the effort was so important to the U.S. would eventually become self-evident. After the loss of the shuttle Columbia, morale at NASA was low. The VSE was designed

more as a morale booster, and to give the agency a new sense of purpose and direction. It succeeded—and in the process, the strategy stimulated the U.S. civil space industry and funded some billions of dollars of R&D work. However, as a vision for attaining a specific goal, it was a dead-end strategy.

The good news about the VSE and Constellation is that they highlighted a reality fast becoming apparent under the tenure of NASA Administrator Michael Griffin, from April 2005 through January 2009: that the U.S. civil space pro-

gram as it has always existed had to be overhauled. There was growing talk about NASA becoming less the dominant player and gradually allowing commercial industry to lead.

In 2008, NASA awarded contracts to Orbital Sciences (OSC) and Space Exploration Technologies (SpaceX) to provide cargo launch services to and from ISS through 2016. This was a major step toward the agency growing more dependent on the commercial spaceflight industry and thus becoming more of a facilitator of the industry's growth rather than a competitor. The contracts, worth a total of \$3.5 billion, have fueled the development of SpaceX's Falcon 9 rocket and Dragon capsule and

OSC's Taurus II and Cygnus capsule. They not only have provided development funding for the systems but also have sent a clear signal to industry that there is now a new and potentially lucrative market for ISS cargo transport services.

This new market has been made possible precisely because in seeking a cargo transport service provider NASA has been forced to look to the commercial spaceflight industry as an alternative to Russia and its Soyuz rocket/capsule. With the shuttle fleet nearing the end of its lifetime and Orion/Ares I many years from completion, NASA was facing a gap of six to seven years without its own space transportation vehicle.

During that time, the agency would be forced to lease space aboard Russian vehicles to ferry its astronauts and cargo to and from ISS. In May 2009, NASA actually signed a contract with the Russian space agency worth \$306 million covering two Soyuz missions in 2012 to transport astronauts to ISS and two return flights in 2013.

In short, NASA was forced by circumstances beyond its control to turn to U.S. commercial industry to meet a need that the agency could no longer meet without relying on the Russian government. The question that had been lingering before the Obama administration's decision to end Constellation was, "What happens to the emerging com-

mercial space transportation services industry when Orion/Ares I is completed and NASA becomes the dominant player again?" That question has now been rendered irrelevant.

A second Moon race

A major concern of some who oppose the cancellation decision is that the U.S. is ceding its world leadership position in the area of human spaceflight and space exploration. Without its space shuttle, NASA next year will be completely reliant on the Russians for gaining access to ISS—a facility that has cost the U.S. government more than \$100 billion to build and assemble over the past quarter-

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SpaceX is developing the Dragon crew vehicle and Falcon 9 launcher.



Orbital Sciences has the Taurus II rocket and is working on its Cygnus crew vehicle.

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century. Russia will unquestionably be the premier country in this arena, followed by China, which is now spending \$2 billion annually on its human spaceflight program.

China has already launched taikonauts to LEO aboard its Long March CZ-2F/Shenzhou system. It is also aiming to launch space stations to LEO by 2015 and a manned mission to the Moon sometime between 2020 and 2022.

India could soon have a national human spaceflight capability as well. Following the successful Chandrayaan-1 unmanned lunar orbiter mission in November 2008, India is now conducting a serious effort to send a manned mission to the Moon by 2015. Earlier this year, the Indian government announced that it plans to spend \$2.7 billion on this program, with the ultimate goal of landing an Indian astronaut on the lunar surface by 2020.

It is an extremely ambitious undertaking, particularly since India has never had a human-rated space vehicle. Nonetheless, it is becoming apparent that the second race to the Moon will be between China and India.

The Russian government has expressed an interest in sending a manned mission to the Moon by 2025, but its focus seems to be less on winning the second lunar race than on eventually building a permanent lunar base. The Russian space agency has speculated that it could begin assembling a manned station on the Moon as early as 2027.

There is no doubt that this next race to the Moon will receive considerable international publicity and help advance

China has already launched taikonauts to LEO and may be aiming for the Moon next.



the human spaceflight capabilities of India and China. The technological stature of both countries will be enhanced during the coming decade, and when each country successfully completes a manned lunar landing. So is the U.S. making a mistake by giving up on the VSE?

The answer depends on whether or not you assume that repeating the Apollo program's achievements of four decades ago is a worthwhile goal. Obviously, it is worthwhile for countries that have never come close to attaining what NASA did by the end of the 1960s. It is different for the U.S. The VSE never satisfactorily answered the question, "Why are we going to the Moon again?" And it definitely did not address the question, "How does it justify the necessary financial investment?"

Getting out of the way

The cancellation of the VSE is a pragmatic decision by the Obama administration. There is just not enough money in the U.S. budget to pay for a space transportation and exploration initiative in which the tangible benefits to the nation are not clear. It is important to note, though, that the decision is pragmatic not only because of what it eliminates, but also because of what it will allow to occur as a result.

Without its own human spaceflight capability, NASA will now no longer be both the main customer for and the main provider of human spaceflight services in the U.S., as it has always been before. The agency will quickly become noncompetitive as a provider of such services and thus will gradually become less dominant as a customer.

By looking to the still-nascent U.S. commercial spaceflight industry to compete with the Russians for ISS cargo transportation services, NASA will help fund efforts by companies like SpaceX and OSC to develop human-rated space vehicles that will eventually be able to transport astronauts. These vehicles can, in turn, be adapted and offered to spur the development of new commercial markets such as space tourism. This will stimulate private capital investment in these types of space transportation programs, and before you know it you will have a growing and vibrant commercial human spaceflight industry.



The United Launch Alliance may offer a human-rated Atlas V (left) or Delta IV for future astronaut launches.

NASA's evolution from being the dominant player in human spaceflight to being a facilitator for the expansion of this commercial industry will take time, and it will not happen without the usual setbacks and delays that occur with any new industry. Neither will it occur without considerable pain to some of the agency's traditional contractors, who stood to secure lucrative long-term business by building hardware and creating software for the follow-on to the shuttle.

The good news is that you can already begin to envision the potential benefits that this sudden paradigm shift could bring to the U.S. NASA announced in February a total of \$50 million in contracts for work on "space taxis" to several aerospace companies, including Paragon Space Development, Blue Origin, Sierra Nevada, and United Launch Alliance. There also are other companies besides these—SpaceX and OSC are working on cargo and human transportation space vehicles. All they need is a consistent series of incentives and R&D investments from NASA, in much the same way that the U.S. government provided the railroad and aircraft industries in their early years.

While China and India are busy racing to the Moon to plant their respective national flags, the U.S. will be fueling the growth of a commercial industry, one that may well lead to innovations that spark the creation of countless other industries—in much the same way that the invention of the Internet permanently changed the technological landscape.

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