

Viewpoint: Lunar Opportunities

BY PAUL D. SPUDIS

When NASA's Lunar Architecture Team began to review ideas submitted by the broader space community about what we should do on the moon, they had to reconcile many disparate thoughts and concepts and weld them into a coherent rationale. This process began with a workshop in April 2006 that drew together a wide spectrum of attendees, all bringing their own backgrounds and agendas to the table. Their varied ideas converged to a surprising extent, with human settlement and preparation for Mars emerging as the primary goals of lunar return.

Refinement and expansion of these two themes and four others (science, economic expansion, international cooperation, and public engagement) took the remainder of 2006, with the results being presented at the Second Space Exploration Conference held in December in Houston. In conjunction with unveiling the six themes, NASA released a list (memorably called the "spreadsheet of death" by a colleague of mine) of 181 specific lunar activities, classified and rated by discipline and theme. It was never intended that all these activities necessarily be attempted by NASA; they were meant to demonstrate the scope and breadth of *possible* activities for humans and robots on the moon. It was necessary to examine all possible tasks and events in order to assess how well the emerging architectural details fit the potential list.

The sheer scope of the listed tasks and their collection into six themes led some to the conclusion that we really have no purpose for going back to the moon and that this effort is an attempt by NASA to retrofit a rationale on a goal that in fact has none.

Nothing could be further from the truth. The report is simply the result of the Agency attempting to satisfy as many of its constituencies as possible within the overall framework provided by the Vision for Space Exploration. So what was intended as the reason for lunar return by the architects of the vision? What, if any, are the objective reasons for a return to the moon?

For answers, read the vision policy documents, including both President Bush's original speech and a strangely neglected (but highly significant) elaboration on it by Presidential Science Advisor John Marburger. The presidential speech announcing the vision three years ago is remarkably clear about our purpose in returning to the moon. President Bush said the following:



Image Credit: NASA

In this artist's concept of the future, an astronaut gathers samples on the surface of Mars while a robotic explorer stands by to help. The Vision for Space Exploration calls for aggressive human and robotic missions that will return to the moon and eventually explore Mars and beyond.

Beginning no later than 2008, we will send a series of robotic missions to the lunar surface to research and prepare for future human exploration. Using the crew exploration vehicle, we will undertake extended human missions to the moon as early as 2015, with the goal of living and working there for increasingly extended periods.

Also:

Returning to the moon is an important step for our space program. Establishing an extended human presence on the moon could vastly reduce the costs of further space exploration, making possible ever more ambitious missions. ... The moon is home to abundant resources. Its soil contains raw materials that might be harvested and processed into rocket fuel or breathable air. We can use our time on the moon to develop and test new approaches and technologies and systems that will allow us to function in other, more challenging environments. The moon is a logical step toward further progress and achievement.

These statements make clear that the purpose of going to the moon is *development*: developing new techniques, procedures, and technologies, all with the aim of making space flight easier, more routine, and more capable.

If this wasn't clear enough, John Marburger's speech (<http://www.spaceref.com/news/viewsr.html?pid=19999>) two years later clarified our ultimate objectives:

President Bush's vision also declares the will to lead in space, but it renders the ultimate goal more explicit. And that goal is even grander. The ultimate goal is not to impress others, or merely to explore our planetary system, but to *use* accessible space for the benefit of humankind. It is a goal that is not confined to a decade or a century. Nor is it confined to a single nearby destination, or to a fleeting dash to plant a flag. The idea is to begin preparing now for a future in which the material trapped in the sun's vicinity is available for incorporation into our way of life.

And:

We have known for a long time that a huge gap separates the objects trapped by the gravity of our star, the sun, and everything else. ... Phenomena on our side of the interstellar gap, in what we call the solar system, are potentially amenable to direct investigation

and manipulation through physical contact and can reasonably be described as falling within humanity's economic sphere of influence. As I see it, questions about the vision boil down to whether we want to incorporate the solar system in our economic sphere, or not.

The administration clearly stated that we are going to the moon to learn how to use what we find in space to create new space-faring capability. The goal isn't simply to return to the moon or even merely to send humans to Mars, but rather to extend human reach beyond low-Earth orbit and ultimately to all possible destinations beyond.

The Vision for Space Exploration is different from any previous space policy. By design it is incremental and cumulative. We make "steady progress" no matter how slowly we may be forced to proceed at any given time by fiscal constraints. Small steps that build upon each other create new capability over time. Our activities will teach us not merely how to survive, but how to thrive off-planet. Such a task includes inhabiting planetary surfaces, doing useful work while we are there, and extracting

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what we need from the material and energy resources we find. We will use these new skills and techniques to build a space transportation infrastructure that permits routine access to the moon and all cislunar space.

The significance of this last point should not be underestimated; access to cislunar space will revolutionize

space flight. Currently, we build disposable commercial space systems that have a specific design lifetime, after which they are simply abandoned. Combined with the high cost of getting to low-Earth orbit, this makes space flight difficult and costly. Hence, space largely has been left as the province of government, except for certain highly capitalized businesses such as global communications.

With the vision realized, satellites can be serviced, maintained, extended, and networked—space systems will be designed for an indefinite lifetime. Given existing launch costs, we cannot do this now. Even lowering such costs by an order of magnitude would still make even robotic servicing of platforms at geosynchronous orbit marginal at best. However, if we build a system that can refuel on the moon using locally produced materials, we create the capability to routinely go anywhere in cislunar space. Exporting fuel extracted from lunar resources will permit us to go anywhere, anytime, with whatever capabilities we need. This is the beginning of true space-faring capability. Such an environment would unleash imaginations, realize potential, and expand technology, science, exploration, and commerce.

In short, we are going to the moon for one clear and understandable reason: to be able to do everything else that we want to do in space. The moon is our school, laboratory, and foundry. The vision begins by building a highway through the heart of cislunar space, creating a transportation infrastructure for diverse users—scientists, miners, sellers, buyers, and, ultimately, settlers.

What is the role of NASA and the federal government in all this? It is not to industrialize space but to determine if the industrialization of space is possible. To accomplish such an expansive space vision requires us to understand exactly how difficult these tasks really are. Possible in theory is one thing; practical to implement is something else entirely. NASA must push the technical envelope to address and answer questions and develop new processes too expensive or too difficult for the private sector to tackle. Learning how to live on another world and extract what you need from it is a challenging task, one suitable for a federal research and development effort.

After understanding the technical difficulties and opening up possibilities, government should step back and let market forces work while still retaining a presence to enforce the law

and ensure that compelling national strategic interests are served. Thus, while government will never become a resource producer, it is needed to ensure that corporations respect property rights and compete fairly in an open market, subject to the same antitrust and securities regulation as any other modern American business.

So why are some still asking, “Why are we going to the moon?” Some space constituencies are clearly uncomfortable with the strategic direction outlined above. For many, the idea of a government-funded program, controlled by and operated for the benefit of the academic science community, is the “right” way to run a space program. Such a science-driven agenda has been ascendant for the past fifteen years. During the Apollo era, the marshalling of national resources by the government to carry out space goals on a wartime footing was the dominant mode of operation.

Using what we find in space to enable exploration and to create new capability has never been attempted. The vision’s goal is to extend human commerce beyond low-Earth orbit. America’s desire to explore and create new wealth has allowed our society to thrive and to prosper. The Vision for Space Exploration extends that opportunity for all humanity into the solar system and beyond. ●

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