Commercial Angle

From Point A To B Before C

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By Donald F Robertson

Advocates for the development of new launch vehicles are trying hard to ride the coat tails of NASA's new "Vision for Space Exploration." That might reduce costs in the long run, but such a project could easily run to ten billion dollars or more – money that would not be spent sending smaller payloads to Earth's moon. Meanwhile, three state-of-the-art rockets - Delta-IV and Atlas-V, developed by the United States Air Force, and Europe's Ariane-5 - sit underused. Why not exploit these existing vehicles to get NASA's "Vision for Space Exploration" off the ground?

General Dynamics Corporation

Similar thoughts occurred to the General Dynamics Corporation as far back as 1992. The company assigned a small team of engineers to develop a way to land astronauts - and the beginnings of a permanent infrastructure - on Earth's moon without building any new rockets. The team came up with a plan called "Early Lunar Access" that, in light of today's political and financial realities, is worth looking into again.

According to a brief history by Finland's Marcas Lindroos, and a contemporary article by this author, General Dynamics' goal was to reduce costs by a factor of ten compared to Apollo, or to spend no more than thirteen billion 1992 dollars to land the first post-Apollo crew on the moon. European contributions - Ariane-5 and a habitation module - were proposed to further reduce costs to the United States. Crews would spend two to three weeks on the moon, including surviving through part of the cold two-week lunar night, which was far more ambitious than Apollo's three-day stays in daylight. Other flights would be dedicated to emplacing infrastructure for use by a later lunar base, establishing a human-tended astronomical observatory, and testing factory technology to separate oxygen from the lunar soil.

General Dynamics' plan for all of this used only modest upgrades to existing or already planned rockets. In addition to Titan-IVs or Ariane-5s, the project would use single-engine Centaur upper stages for trans-lunar injection, and the Space Shuttle with Advanced Solid Rocket Boosters and an aluminum-lithium external tank. The tank and the Centaur were later developed for other projects, though the latter would need to be modified again to be able to fly for several days. The advanced booster for the Shuttle was canceled.

An Early Lunar Access mission begins with a Space Shuttle launch, placing a lunar-bound crew of two into low Earth orbit, along with a lunar excursion vehicle. The latter consists of a capsule based on the Apollo Command Module docked to a newly designed moon lander.

With the Shuttle safely in orbit, a Titan-IV launches a fully fueled, wide-body, single-engine Centaur. The Shuttle crew docks the lunar excursion vehicle with the Centaur. After the crew boards the capsule and the Shuttle backs away, the Centaur ignites to boost the complex toward the moon, leaving the Shuttle to return to Earth.

The moon's landscape was far better understood in 1992 than before Apollo. To save fuel, General Dynamics' engineers felt confident enough to attempt a direct flight to the surface without going into lunar orbit. After a fourteen to twenty-one day stay, the same lander boosts the returning capsule on a direct trajectory back toward Earth, again avoiding docking operations in lunar orbit.

The first test flight would have been a cargo mission, carrying a science payload to provide quick results and to test lunar mining technologies. Cargo missions would not need to return to Earth, so they would use all their fuel landing, enabling a heavier payload.

The second mission would also have been a cargo flight, landing a habitation module derived from the Italian space station logistics module. The first post-Apollo crew would have flown on the third mission.

Annual costs

To keep annual costs relatively low, the flight rate would have been limited to about one mission every six months, each costing about $2 billion. Some five missions, including two with crews, could have been flown simply by forgoing the cost of developing a new heavy lift rocket.

The only system developed from scratch would have been the four engine, single-staged lander, and even it would probably use existing rocket engines. The launch vehicles, upper stage, and habitation modules all had long flight histories, reducing the risk inherent in using new technology.

The capsule would have had the shape and size of an Apollo capsule, avoiding the need to re-design and re-test the aerodynamics. The interior would be fitted out with modern avionics and living quarters for the smaller crew of two, leaving room for expanded cargo holds. Being made of modern materials, the capsule would weigh less than the Apollo Command Module, making it cheaper to launch toward the moon. Upon return, it would skip more lightly into the atmosphere, reducing stresses and increasing safety margins.

Contemporary critics felt General Dynamics had significantly underestimated the weight of their design. Even if the critics were correct - and General Dynamics engineers defended their plan - the idea represents the kind of original thinking we need today. A heavy launch vehicle might well reduce costs in the long run, but ten billion dollars spent designing new rockets is $10 billion not spent on NASA's vision. The long view might make political sense were it not for the sorry history of the International Space Station.

Billions of dollars were wasted designing and redesigning paper space stations before parts of the latest iteration made it into orbit.

Congress will not tolerate a repeat of that performance. If NASA is to have any hope of establishing a permanent base on Earth's moon, it is a political imperative that something useful to such a base should land on a lunar plain in the immediate future. NASA must stay focused on the minimum development required to achieve the goal of getting from Earth's surface to the moon, A to B, and not get sidetracked into the C of heavy launch vehicle development.

It is no longer 1992, the Shuttle is being prepared for retirement, and an "Early Lunar Access" project may not be the right mission for today - although there is no reason General Dynamics' ideas could not be dusted off.

There is substantial circumstantial evidence that water from comets lies buried in the regolith in permanently dark craters at the lunar poles. An early "quick-results" mission might use a Delta-IV or Atlas-V to launch a mining experiment and try digging up some water. Or, an experimental automated factory could demonstrate the separation of lunar regolith into useful components like aluminum and oxygen, which could fuel rockets launched from the moon.

All of these ideas should have a higher priority than a new launch vehicle. Any of them would give the "Vision for Space Exploration" something to show for our public money and thus a political future. Then, and only then, will there be time and money to develop the heavy rockets that could lower the long-term costs of trading with a permanent lunar base. <<