

Testimony of

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The Path from LEO to Mars

Committee on Commerce, Science and Transportation

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Chairman Nelson, Senator Hutchison, Senator Rockefeller and distinguished members of the Committee:

Thank you for the opportunity to testify on the important topic of NASA's path from LEO to Mars and their progress and challenges in developing a human spaceflight and exploration capability under the NASA Authorization Act of 2010.

Before I begin, I'd like to start by recognizing Senator Hutchison for her decades of public service. She has been a fearless and longtime champion of education and education reform which is probably the first and most critical element of preserving the future of our nation's space program. As the first woman elected to the U.S. Senate from Texas, she has served as a role model and an inspiration to others. She has been a true leader for the state of Texas and for our Nation, and I wish to thank you Senator Hutchison for your dedicated service and wish you well in your retirement.

I think it's important as a foundation for this discussion to touch on the issue of NASA's strategic direction. For some time now and especially since the end of the Space Shuttle program, NASA has seemingly suffered from a lack of an overarching, enduring vision for leadership in space science, technology exploration. The Administration cancelled Constellation and the moon mission and established new priorities and directions such as landing on an asteroid and funding a commercial space capability. This was done with what appears to be limited coordination and consent from Congress. Congress, being concerned and not necessarily in full agreement with these Administration decisions, has been compelled to be prescriptive in its legislative language with regard to NASA specific systems architectural requirements to ensure some stability in the industrial base and preservation of critical and unique skills. .

Without clear direction from the Administration, NASA has been left to juggle a multitude of tasks. NASA is very busy trying to reestablish U.S. access to the International Space Station and maximize its scientific returns and develop a Beyond Earth Orbit (BEO) launch system with no clear set of missions. NASA is working all of those efforts in conjunction with trying to develop human and robotic roadmaps with its international partners, fund a commercial space enterprise to sustain multiple competitors without clearly identifying a supporting market or demand, and accomplish meaningful results in a timely manner. Finally, they are attempting to do the many other things that keep ten NASA Centers healthy. NASA is being asked to do all of this with a flat, essentially declining budget.

As a result of these influences, NASA is left trying to fit all these priorities into a cohesive story in the face of extreme budget austerity and more political sea changes on the horizon. They are trying to consolidate and communicate a vision to fit the direction and restrictions provided by the Administration and Congress rather than executing on their original charter to explore, push the boundaries and limits of our knowledge and capabilities, serve as the leader in space technology for the rest of the world, and finally, and perhaps most importantly to inspire our nation and the world.

The Administration and Congress must reach agreement on a path forward as budgets are established rather than the current practice of the Administration putting out an entirely new direction in an uncoordinated budget, only to have Congress stall over the non sequitur funding proposals. Senators Nelson and Hutchison had to intervene last time to establish a direction and reach a plan acceptable to all, but not before a year of wasted time and uncertainty. This cannot happen again.

An enduring, stable vision for NASA should be set by the President and supported in Congress in a consistent manner that enables execution over timeframes that extend beyond a single Administration or Congressional election cycle. Budgets should be provided that are consistent with executing the direction and are stable over the timeframes required to execute the direction. It is NASA's job to define the manner in which to achieve the vision and then execute on the vision within the budget.

An enduring vision for NASA should be more focused to better align with the current constrained budget environment, and the vision should be mission-driven. A focused, mission-driven vision that endures will allow NASA to maximize the returns to the American people for the resources provided. Finally, the vision should push to accomplish feats never before achieved by mankind.

What NASA cannot afford to do is continue the trend of cancelled programs, rebaselining and seemingly random directional changes of objectives and priorities. These fits and starts have cost this nation considerable effort, time and money with tremendous disruption and with minimal return.

Maximizing the value returned from the budget provided means that NASA needs to examine how it can right-size its resources and infrastructure to efficiently execute a more focused mission. Preserving every capability NASA has acquired is simply not possible in a constrained budget environment. NASA itself must retool its infrastructure to become a "built to last" organization that doesn't sink huge amounts of money into standing monuments that don't have the ability to adapt to future missions, large staffs that are sized to be all things to all people, and a large bureaucratic management structure that is unable to move with speed and agility. While the government is the only method to continue this long-term exploration initiative, it must not be immune to the

known precepts of efficient and lean management so that the dollars being spent yield the most possible learning. Priorities must be chosen and decisions must be made on what capabilities should no longer be supported and what capabilities must be retained to accomplish the vision. We have created NASA to define the best way to achieve the vision with the budget available, not to be everything to all people.

When our nation first embarked on space exploration and leadership, the expectation was that we would incrementally and continuously expand the scope and reach of our presence over time – both robotically and with humans. As Jay Barbree said in his recent 5-part commentary, we must have “an affordable, science-driven method of learning, moving steadily outward in logical increments.” We must have clear missions and destinations – and then identify the capabilities that either already exist or need to be created in order to complete these missions. It’s that simple.

There is no one right solution to how NASA can achieve this incremental exploration and fulfill their charter – someone must choose and we as a nation have created NASA to do just that.

NASA has determined that they need a heavy lift launch capability, and Space Launch System is the answer to that need. The Augustine Commission, in their review of NASA’s Human Spaceflight Program, made the following statement: *“The Committee reviewed the issue of whether exploration beyond low-Earth orbit will require a “super heavy-lift” launch vehicle, and concluded that it will.”* Regardless of the exact mission architecture that is ultimately pursued, the heavy-lift launch capability that the SLS will provide is fundamental to its execution and must be pursued with utmost priority and speed. NASA’s entire Exploration architecture is dependent upon its capabilities.

SLS will be the most capable U.S. launch vehicle and, with the Orion spacecraft and modern ground systems, will enable new missions of human exploration across the solar system, as well as benefit high-priority science missions. It leverages and builds upon past experience and technology. Now that an architecture has been established, it is imperative that it receive adequate funding and, in no way, follows the fate of the Constellation program. We have clearly seen the negative impact of inaction and indecision after the end of the Space Shuttle program: loss of momentum and direction, wasting precious financial resources, and a significant loss of critical space industrial base skills.

The objective is to establish a heavy lift capability. We know how to do that reliably now, this is not the time to once again baseline new technology, of which little has really been identified anyway. This is the time to ensure we get beyond earth orbit as fast as possible, as cost effectively as possible, and as safely as possible. Once we do that, then we can resume true exploration and the innovations and inventions necessary to push the boundaries and explore and live on other bodies.

There has been a lot of talk about returning to the moon, and SLS gives NASA the flexibility to do that, perhaps first sending robots, then humans. A continual incremental approach to exploration should be the norm. While humans explore the poles of the moon, robots should be characterizing the environments on Mars and its moons. When humans finally explore the Martian system, robots can be exploring the icy depths of the vast oceans of Jupiter's moon Europa. We must recognize there is no end to this process, no victory dance followed by the abandonment of a vital innovation engine for the country.

The hugely successful landing of the Mars Science Lab Rover Curiosity is the perfect illustration of this incremental development and exploration as well as the complimentary use of robots in space exploration. Curiosity will continue to rove around Mars in the months ahead potentially paving the way for humans, and SLS will be key to that incremental strategy for exploration.

Both robotic and human exploration have their place within an overall space exploration program. Robotic exploration must lead human exploration in order to truly understand what technological problems have to be solved and which can rely on existing technology. While the use of humans for exploration might not yield the same marginal return in scientific data for the investment, the returns on technological innovation that benefit society are. NASA's exploration programs are not simply intended to return scientific data. The technologies developed to acquire the scientific data often represent even more valuable returns. These technologies are integrated into the capabilities of the U.S. companies that participate in NASA programs and increase their productivity and global competitiveness. Successfully placing humans into the harsh, unexplored environments associated with space exploration results in benefits to people back on Earth in ways that cannot be equaled by placing a robot into the same environment. These benefits include everyday technologies such as ear thermometers, heart rate monitors and fire retardant materials to computer microchips, plasma displays and aircraft collision avoidance systems.

More intangible, but equally important, exploration is inspirational to the United States. And in this context, the returns from human exploration are far greater than robotic exploration.

So it is clear, first and foremost, that NASA must be provided with an enduring and stable vision that can and will survive any unilateral attempts to jerk the wheel around as we pass through Administrations and Congresses. Once this vision is established we need to let NASA do their job. The Agency is uniquely qualified to organize and integrate the diverse and often biased inputs from industry, academic and scientific communities, international community, etc – and look at options, establish a direction and plan of execution consistent with vision and budget, and then actually execute it.

NASA must also return to being a mission-driven organization. Technology and capability development without a clear mission use is misguided and generally inefficient in the same way that hammer and nail is useless without something to build. A clear mission provides alignment to all stakeholders and allows the most efficient use of scarce resources. NASA did not build the vehicles and technology needed to land on the Moon and then decide to go. The Nation, through the Administration and Congress, gave NASA a goal of landing on the Moon and NASA figured out how to do it. NASA did not build the space shuttle knowing what all 135 missions would entail. They knew they needed the capability to transport people and large payloads to build an international space station. We must return to that model.

Finally, I'd like to close with a quote from President John F. Kennedy's 1962 speech at Rice University. I'm sure most of you know the quote by heart. He said, "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills." I don't use this quote because I think we should live in the past or because I believe we should be reliving those glory days. I use it because as

President Kennedy said doing “the hard things” drives us to use the best of our energies and skills, which in turn creates the need and motivation to expand our boundaries. NASA’s job is to do the hard stuff – constantly pushing the boundaries. We grow as a nation because it takes the best of our people and capabilities push the limits of our creativity and abilities leading to true innovation and inspiration. As such, Innovation and Inspiration cannot be goals of what NASA does and strives to do, but rather the result. Just as Curiosity’s mission spawned innovation which inspires us all, sustained human exploration enabled by SLS and Orion will challenge us to future innovations we cannot even predict, but know from experience will keep us in a leadership position not only in space, but especially on earth.

Thank you again for the opportunity to address the committee today. I look forward to responding to any questions you may have.