U.S. Human Exploration Goals and Commerce Space Competitiveness
Testimony of Walter Cunningham, 24 Feb 2015

I appreciate the opportunity to share my opinion on where I believe our space program has been slipping and some of the things I believe NASA must do to maintain America's lead in space exploration. This is my personal opinion but it is shared by many of my contemporaries.

Humans have always been driven to explore the unknown, to discover new worlds, to push our boundaries and then reach out for the next new world. The technological breakthroughs and scientific discoveries from opening new frontiers have benefitted our society for centuries. We have the responsibility and the opportunity to explore the next frontier.

In the 15th and 16th centuries the frontier was in the new world and England, Spain and Portugal were crossing the seas in search of their country's greatness. In 1519, Ferdinand Magellan set sail on one of the most famous voyages of exploration in history—the first voyage around the world. He set out with five ships and 270 sailors. Three years later, only one of the original ships returned with only 18 of the original crewmen still alive.

In the 1960s, we set sail on another ocean; one whose farthest shores we can never reach. This new ocean was more pristine than was the new world before voyages of Columbus and Magellan. As exploration of the new world was inevitable 500 years ago, so too is our exploration of space.

Any project as complex as Apollo requires three things: resources, technology, and—most important—the will to do it. In 1961, America was willing to take the risk of going to the Moon. It was human risk, and technical risk, economic risk and political risk. The Apollo Program took initiative and leadership. When President Kennedy made his commitment to land a man on the Moon not a single American had yet been in orbit!

With the Apollo Program, America took the historical role of opening the next frontier. Astronauts were at the tip of the spear and we got the glory but the success of the Apollo program was due to the collective efforts of 400,000 members of the team—engineers, operators, managers and contractors. With the whole world watching, we accepted the challenge, took the risk and changed the way we all perceived our world.

During Apollo, the American space program was unique. Over the past 40 years, NASA has enjoyed many great accomplishments. But as the agency evolved the management culture has changed and it has not always been for the better.

Space is the most hostile environment into which man has ever ventured. NASA should work to prevent mishaps but those efforts should be balanced against the objectives they are trying to accomplish. Spaceflight will always be expensive and manned spaceflight will always involve risk and the chance of failure. Exploration is not about eliminating risk; it's about managing risk!

Motivated by the Cold War and a national commitment, we accomplished a landing on the Moon in eight years. Today, after 50 years of experience and technology development, a manned mission to the next frontier—Mars, seems decades out of reach, primarily because we do not have a national commitment.

Our Apollo Program made America pre-eminent in space and the world's most technologically advanced nation. It led to such things as the Space Shuttle—the greatest flying machine ever built by man, the International Space Station (ISS) and the Hubble space telescope. The technology that made this possible was funded by the American people and it has infiltrated virtually all areas of industry.

NASA's portion of the federal budget peaked at 4 percent in 1965. For the past 40 years it has remained below one percent and for the last 15 years it has been driving toward 0.4 percent of the federal budget.

While NASA has accomplished many things and made manned spaceflight much more routine, we have not challenged the next frontier—the Manned exploration of Mars. Manned exploration is the most expensive space venture and, consequently, the most difficult for which to obtain political support. Manned exploration of Mars will only be possible if our government initiates and funds such a program.

While our world has been changing and space technology improving, NASA management has been aging, layers have been added and politics plays an ever growing role. NASA seems less capable and less interested in pushing out the space frontier and focusing more on eliminating risk and looking for absolute assurance that something can be done before committing to do it. This leaves NASA less attractive to the best and brightest of today's young professionals.

Over the years, NASA has grown increasingly political. There was a time when personnel at all levels contributed to success by freely expressing their completely candid opinions on design, testing, operations and management issues. Management today seems less and less likely to speak out because of their concerns about the political repercussions. NASA needs to find a way to return to the environment

where people contributed to success by freely expressing what they thought about the issue being addressed.

NASA has also been subjected to politic pressure from outside the agency. Examples:

NASA has tried for decades to reduce their overhead by reducing the number of Space Centers they have around the country. Congress and local politicians have always won out and saved the one in their district. NASA is still burdened with the same 10 Space Centers and a half dozen other facilities. This reduces the funds available for science and space applications. When our military faced a similar problem with too many bases spread around the country, it was resolved when Congress passed the Base Realignment and Closure Act of 1990 to screen and close facilities.

NASA should also be focused more on their science obligations and avoid any associated political issues. Goddard Space Center has been involved in global environmental science for many years. For the past 20 years, instead of just sharing the climate science data they collect, they have joined the political argument that humans are the cause of global warming.

At the United Nations Climate Change Conference in Lima, Peru, last December, virtually all of the data available, the presentations and the handouts in the American Pavilion were material furnished by NASA. NASA personnel were making the presentations and the data shown was selected to make the case that humans were the cause of global warming. The American Pavilion was virtually a NASA pavilion. The space agency compromises its scientific credibility by participating in the politics surrounding one of the great scientific hoaxes in history.

To get NASA back to the posture where they excelled, we should commit once more to pushing back the space frontier with a manned landing on Mars. Such a mission will become much more feasible when, and if, we overcome the problem of radiation exposure and/or shorten the time of travel.

Our Mars exploration vehicle will have to be assembled in earth orbit. Moving out of earth orbit will require heavy-lift rockets, like our Space Launch System, and the Orion deep space crew capsule. Assembling an interplanetary spacecraft may require a reusable launch vehicle similar to the space shuttle. While these are all expensive, they will be essential if we want to move out of earth orbit.

We could also explore the possibility of moving the ISS from 51.6° down to an orbital inclination where it could be/might be useful in constructing an interplanetary spacecraft and/or as a departure point for Mars.

With a national commitment for Mars exploration our space agency's budget and activities would be driven by this strategy. The timing, of course, would be controlled by the rate at which Congress funds the program. If addressed in the way we addressed a manned landing on the Moon, it would enable NASA to deal with many of the internal deficiencies that have developed over time.

Any Mars exploration program will have international partners. If it is our American program, we should take a strong leadership approach in managing that program. With Apollo, the effort was clearly led by NASA. In a Mars program we should obviously lead the way and not just be one more partner in an international effort to go to Mars. Hopefully, it would have less politics and a better structure then the international program we formed around the ISS.

The ISS, that NASA first began to work on in the 1970s, is probably the most impressive piece of space hardware ever placed in orbit. It has had "equal" partners from the beginning, even though more than 70% of the cost has been paid by the U.S.

In 1993, after NASA had evaluated and rejected what Russia might contribute to our ISS program, President Clinton insisted that Russia be included as a full partner. ISS was a convenient way for America to bail out the nearly bankrupt Russian space program. Our administration claimed that we would lift off two years earlier, it would save us $2B and it would keep Russian scientists from working on nuclear development for other countries.

Reality: After transferring $3-5B to help resurrect the Russian space industry we launched two years late. The cost to us was increased by $15-$20 billion, due primarily to changing the orbital inclination from 28.5° to 51.6° in order to accommodate the Russian launch capability. We are now totally dependent on Russia to get an American to and from the ISS—a program we gave birth to in the 1970s.

In the Apollo Program we were totally dependent on private industry. And they delivered! As NASA has grown less entrepreneurial, less efficient and more bureaucratic over the years, it has inspired new, so-called commercial space companies. While most of these new companies have been subsidized by Government funding NASA has less control over their development, operations and, consequently, the outcome.

Space exploration is far too expensive for private industry without government capital. Commercial companies have a different perspective on space exploration and operations. Commercial companies are driven by profit and return on investment.

Pushing back the frontier of space does not satisfy the business case for either of these criteria.

Government space agencies are not profit driven. Our government underwrites the exploration of space and government agencies develop and manage the technology. Our country's return on investment is the technology developed to open that next frontier and the commercialization of that technology in private industry.

Some people suggest that private space companies should collaborate with NASA for human missions beyond low Earth orbit. Collaboration means sharing the cost. Commercial companies will contract with NASA for the hardware and technology but the government will always be expected to pay the cost of exploring the next frontier—funded by tax dollars, of course.

Since commercial companies move much faster than government agencies, production by private industry will shorten the timeline to launch a mission to Mars.

In the absence of a Mars Exploration Program and limited funding, NASA has initiated the Asteroid Redirect Mission (ARM). Today, ARM is characterized as a first step in the mission to Mars. This could be fascinating for some scientists but anything it might do to support a future Mars mission could be more efficiently done with other projects.

The Japanese landed an unmanned satellite on an asteroid and returned with a surface sample 5 years ago. If ARM is funded, it should be an unmanned science mission, NOT a manned mission. Limited manned exploration funds should not be wasted on such missions.

There are manned missions we should be planning in preparation for a manned landing on Mars. While we work on overcoming the problems of radiation exposure and learning how to speed up travel, we should return to the Moon where we can perfect a crew facility for semi-permanent living. It is critical that we learn how to keep crews alive on Mars for months or even years. Crews on the Moon are only four days away from home as opposed to months and even years on a Mars mission.

Many scientists today are saying, "Send robots to Mars because humans are too costly and it's too dangerous."

NASA should continue to mix manned and unmanned missions in order to exploit both. Robots can assess risks to human exploration, determine the presence of environmental, chemical, or biological problems and help to mitigate the risks. Robots are valuable tools in preparing for exploration but they are greatly inferior to humans in terms of speed, grasping what has been observed and judging what to

do next. Humans are much, much faster and more efficient because we can think and act in real time.

The Apollo program cost $110 billion in today's dollars and the benefits to our society have been priceless. A manned landing on Mars, after 50 years of technical progress and spaceflight experience and perfecting a crew facility on the Moon, will probably take twice as long and cost 2 to 3 times that amount. That is a fraction of what our annual federal budget deficit has been running and deficits do not have a return.

A century from now, no one will care how carefully and cautiously we may have survived the 21st century, but they would certainly celebrate our willingness to make a commitment, to accept the risk, to expand our universe and to change the way we perceived our world if we commit to land a man on Mars.

We will not move our society ahead by eliminating risk. Exploration is not about eliminating risk; it's about managing risk!

The human desire to explore and settle new frontiers will be satisfied—if not by Americans, then by others. Humans, somewhere, will certainly go back to the Moon and on to Mars.

I believe we have the resources and the technology for manned exploration of Mars! Do we have the will to tackle the next frontier—Mars?