

The US Manned Space Program and a New Tomorrow: A Response to the White House Office of Science and Technology Policy Call of October 14, 2014, “Bootstrapping a Solar System Civilization”

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Introduction

It has been over 45 years since Neil Armstrong became the first person to walk on the Moon. Would we have ever thought after that epic event that today, the United States must depend upon its Cold War competitor to launch its astronauts into Space? We as a country have lost much of our momentum as leaders in the field of rocketry, and if we continue to do business as usual, we cannot expect anything to change while collectively remaining sane. Einstein is attributed with having said, “Insanity is doing the same thing over and over again and expecting different results”.

In this article, I am presenting what I personally think is a very pragmatic view of the US manned Space program and suggesting four changes. If these changes do become a reality, I will have offered a glimpse of what I think will be “A New Tomorrow” for the country and why this vision is necessary. My comments within this open forum are intended as a contribution to a constructive dialog about the future of the US manned Space program. If such a dialog is to be truly effective, it needs to be frank and welcome diverse viewpoints, each of which will benefit from critiques by others in their own frank submissions to the forum offered by this journal.

NASA Needs to Revamp its Image

America’s once proud Space program continues to fade. As a member of a number of aerospace organizations, I often hear the frustration, the disbelief, as well as the sorrow about what has become of our once great US manned Space program. Its members are people who have dedicated their entire careers to it. As a result of hearing their disillusionment, I teamed up with several friends to create a website dedicated to providing possible solutions.

The anguish I sense in the aerospace community is in part the result of our repeating a mistake of the past by ending our only means of getting into Space before another means became operational. Before the Shuttle fleet was retired to museums, I wrote a technical paper for the AIAA-JPC, entitled “Space Transportation at a Crossroads: An Evolutionary New Future,

AIAA 2011-5503”, about several private companies who were trying to purchase the Space Shuttles and keep them flying.

In the 1960s, the American public, and indeed the entire world, was enthralled with NASA, because we as a species were going places. We were going to the Moon! There was little doubt that we would reach the Moon “before the end of the decade”, or soon thereafter. It is remarkable how far have we fallen and that we now must pay an extortionist price of over \$70 million per astronaut to our once Moon race competitor to take us into Space? Simple math shows us that the cost of seven flights per year of the seven-seat Space Shuttle (not including cargo!) would have been less than the \$3.43B the Russians would charge to transport the same number of astronauts to orbit.

To young people, manned spaceflight is something “cool” that their father or even grandfathers did. The popular image of a NASA engineer was depicted in the movie “Apollo 13” as a bunch of white guys wearing white shirts, black ties, and thick black-rimmed glasses. In contrast, today’s businesses, society, and especially young people are ever more captivated with the Internet, computer programming, and cell phones. The face of a typical aerospace engineer now is one of a Baby Boomer or even the Silent Generation, as opposed to the face of a computer programmer of Generation Y. I find it ironic that Elon Musk is the new face of the Space program, and that he initially made his fortune while being a computer programmer.

I wonder if Generation Y looks upon the Apollo program like the people of the Dark Ages looked upon the relics of the Roman Empire. I wonder if Generation Y asked themselves, “How did we fall so far?” But, hey at least we are winning our “War on Poverty” by spending one trillion dollars a year on human services. Right?

The 4 “IFs”

Dedicated aerospace engineers always look to the “glory years of NASA” 40 years in the past when we landed on the Moon. I firmly say that the best days of the America’s Space program are ahead of us, IF ...

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1: IF NASA creates a 50-year plan

We must answer a very basic question, “Where do we WANT to be as a Space-faring nation 50 years from now?” Will we have traveled beyond the solar system, establish a colony on Mars, or will we have merely returned to the Moon? Based upon this answer, NASA must create a long-term plan that is clearly understood and supported by the American public and that lets us know WHY we are going to some destination in Space and what we are going to do there once we arrive. NASA needs to establish a 50-year plan which outlines what accomplishments we need to reach in increments of 8 years to achieve that plan. The plan should include setting up a bi-partisan committee that will provide a long-term goal of where our Space faring civilization will be in 10, 25, and 50 years from now, and how we will get there. It is not enough to say we need a big rocket, unless we have a need for a big rocket that cannot be satisfied by utilizing commercial smaller rockets. It is not enough to say we are going to the Moon, Mars, or some asteroid. We must have a strategy and vision for what happens in the long term after we get there. It’s not enough to say we need an International Space Station unless investing \$100B to build and \$3B per year to maintain it provides results (information, technologies, and experience) that are vital to accomplish some long-term goal that cannot be accomplished by cheaper means. By the way, America already had a much cheaper, flexible International Space Station called the Space Shuttle. If a tenth of the funding that was spent on ISS (not to mention Constellation or SLS) was spent on improving the Space Shuttle and developing the Shuttle-C, we could have flown it much more often, it could have stayed in orbit longer, and we could have flown over 50 astronauts at one time, among other potential accomplishments.

2: IF the Federal Government changes how NASA is funded

The Space industry will not grow any larger while all vehicle development is conducted via Federal Government funding, at Federal Government facilities, for a specific Federal Government project whose ultimate funding is controlled by Congress and the White House. How many resources (including valuable taxpayer dollars and brainpower from America’s brightest specialists) have been wasted on recent dead end aerospace projects like Shuttle/Centaur, Shuttle-C, Liquid Rocket Boosters, Advanced Solid Rocket Boosters, National Launch System, Advanced Launch System, Constellation, and Space Launch System, among others not listed?

How many times have we heard that a program was justified because it “created jobs?” How many aerospace engineers have left the Space program because they have invested their careers in one dead end project after another? A devastating direct quote to me after a co-worker learned of the many dead aerospace projects I was involved in: “Is it not more productive to society to go to work at a dead-end job than to spend your career in several dead-end projects that nobody will ever hear about?” How do I answer them?

It is no secret that during the Cold War, NASA became a political tool against the Soviet Union and has been a political tool of one kind or another ever since. More recently, a powerful US Senator demanded that work on Constellation must be conducted in his home state. Before that, another politician demanded that the Space Shuttles launch Centaurs from their cargo bay. It seems almost a laughable tragedy that presidential candidates speak of what they hope to accomplish in Space during their 4-year term, only to withhold the needed funding that NASA needs to accomplish their goals once they are elected. Even worse, successors do not always want to continue the project of their predecessors. In order to eliminate the political nonsense that seems normal for funding NASA programs, would not the country be better off if progress payments were allotted to NASA when it accomplishes its objectives as stated in its 50-year plan? Surely an independent bi-partisan committee can figure out how to get the politics out of NASA’s annual funding by linking a 50 year plan with progress payments or some other technique that accomplishes the same end result. As an example, how much funding would it take to establish a colony of 1,000 pioneers on Mars? If NASA can show progress by setting intermediate goals, shouldn’t it receive increases in funding to allow the accomplishment of the end goal in 20 years?

3: IF funding for the NASA Centers is detached from their programs and they discontinue cost plus contracting, i.e., how business is conducted in the Space industry

In the past, NASA has had one grandiose program after another, such as Mercury, Gemini, Apollo, Skylab, The Space Shuttle, Constellation, and the latest, Orion and SLS. These grandiose programs are necessary because they were used to fund the NASA Space Centers operation. Although I haven’t studied the NASA budgets in great detail, you cannot help but notice that the funding for manned Space flight centers—MSFC, JSC, KSC, GSFC, and SSC—remains nearly the same no matter how many vehicles or astronauts are launched in a year. It doesn’t matter if we fly the Space Shuttle, Constellation, or SLS. NASA always seems to spend

nearly the same amount of funding each year at these centers, as long as there is a NASA. So, the amount of funding going to these five NASA centers cannot be touched by anything we proposed, but must come from other funding sources or programs.

At the 2014 AIAA-JPC (American Institute of Aeronautics and Astronautics Joint Propulsion Conference), I presented a paper entitled, "Space Billets: How to Fund a Manned Lunar Program with Current NASA budget (AIAA 2014-3652)". In that paper, I show how the commercial Space industry can be jump-started via a Federal government funding plan that we refer to as Space Billets. Space Billets are fixed contracts with a guaranteed market over a long time in the Space Industry. Space Billets is a funding means for bootstrapping Solar System Civilization. Note the recent call by the White House Office of Science Technology and Policy (www.whitehouse.gov/blog/2014/10/14/bootstrapping-solar-system-civilization). The Federal Government does not have to request ideas on how to live off Space. Private enterprise will determine the cheapest means of accomplishing their tasks.

At a maximum value of \$20M, a Space Billet can be used to transport 10 tons to LEO, or 3 astronauts to LEO, or 2.5 tons to Mars, or 10 man-weeks at a Space hotel, or 0.26 weeks at a lunar hotel, or remove 10 pieces of Space debris, etc. Space Billets can only be used on re-occurring expenses (such as Space/Moon hotels and transportation to LEO, the Moon, and beyond) and not one-of-a-kind hardware (such as rovers and Space probes). By allotting a large number of Space Billets each year over a long period, it is hoped that private enterprises will provide the innovation, the development funding, recover their investment over time, and hopefully secure a larger profit than they can achieve via the Cost Plus 9% instruments. The current cost plus contracts require most innovation and responsibility to come from the government, while private contractors are incentivized to take as much time and to use as many people as possible so their costs go up, which means more of the 9% profit to them. Because commercial enterprises are able to utilize their equipment as much as they like for commercial customers, their utilization rate will increase and they can make more profit than via the cost plus contracts.

Space Billets is funding to NASA what is above and beyond the funding for the five centers listed in the above paragraph. How much extra funding would the American taxpayer give to NASA for Space Billets if it could establish a colony of 1,000 pioneers on Mars in 20 years? It is hoped that after several successful years of operating Space Billets, that funding to the 5 NASA centers on grandiose projects will instead be used for

the one-of-a-kind hardware not obtainable via Space Billets as well as technical support.

4: IF NASA improves its communication with the public

NASA's best public relations instrument, NASA TV, is not enjoyable to watch even by the most adamant Space enthusiasts. Compare the entertainment and education value of "Mythbusters" or "Are you smarter than a 5th grader" to the dry programs on NASA TV. In addition, other TV stations have 30-minute segment programming that informs the viewer exactly what is going to be televised in the future. NASA TV uses vague terms (such as "Gallery") for large blocks of programming periods with no descriptions. How interesting would it be to have a 30-minute weekly program that showcases the activities and diversity of a department or branch at each of the NASA centers or major contractors? NASA TV should be NASA's portal to tell (in 30-minute weekly segments) the American people about NASA spin-offs, Center accomplishments, agency direction, and budget comparisons. We should be watching programs on the Hubble Space Telescope and the Big Bang Theory on NASA-TV, not NOVA. NASA news programs should be telling us when the next launch is, when the next conference is, and what the very latest Space news of that week is. How interesting would it be to show several of the presentations from the AIAA JPC or some other conference during a weekly 60-minute segment? ISS technology projects and accomplishments should be updated weekly.

To improve NASA's communication to the public, it should delineate on its website (accompanied with monthly updates on NASA-TV) its long-term Space strategy and vision and milestone that have been accomplished and are yet to be accomplished. NASA should tout its value to the American public via its website and NASA-TV, e.g., NASA spin-offs, such as kidney dialysis machines, as well as all of the great and valuable accomplishments completed on the ISS. This is the portal NASA can use to tell the American taxpayer why the \$3.2B we spend per year on the ISS is providing much more valuable research than that obtained for \$436M at the South Pole. The programs should include such items as NASA's investment in technology versus the number of jobs created and/or number of lives saved.

A New Tomorrow: What do I mean by a new tomorrow and what would happen if the 4 "IFs" become a reality?

If we continue to conduct business as usual at NASA, we might land an Astronaut on Mars or again

on the Moon in the next 20 years, but only if China is at likely to beat us in these endeavors. We need a fresh start. We need a new tomorrow on the direction of our Space program. We must set nearly insurmountable goals (such as 1,000 colonists on Mars within 20 years) that only the United States can achieve. Instead of asking the American public, "how can NASA "boot-strap a Solar System Civilization", NASA should be asking, "how much would the American public pay for a ticket to a Space Hotel or to establish a colony on Mars"? If NASA cannot provide a reason to establish a colony on Mars, then why do we ever need to send an astronaut there?

The American Space Program's best days are ahead of it. I presented another paper this summer at the AIAA-JPC conference that was entitled, "Affordability Advantages in Integrating the Aircraft and Space Launch Operations, Part 2: The Hybrid Sub-Orbital Aircraft (HSA)" (AIAA 2014-3651). One version of that aircraft (referred to as, HSA-ETO) would be able to launch upper stages that take payloads from Earth to low Earth orbit and the cost of operating that aircraft will be at nearly the same market value as a normal commercial aircraft which is about \$2 million per flight. The HSA should be able to fly as fast and as high as the X-15 rocket airplane before it releases an upper stage. By staging at velocities much greater than normal air-launched systems, this sub-orbital launch system could have a much smaller and reusable upper stage that would be able to deliver 10 tons of useful payload to Low Earth Orbit at a price of the upper stage to the customer of less than \$2 million per flight, or \$4M total. Besides taking 10 tons of useful payload, the same launch system would be able to take seven passengers to orbit at a price of \$4M total (\$571,000 per passenger). Since the HSA is simply a commercial aircraft with a gate-to-gate mission time of 3 hours, it should be able to fly five missions every two shifts. That means that the launch system would be able to take 35 passengers or 50 tons of payload to orbit every day. So many missions to LEO, the Moon, and Mars each year will spin off un-foreseen businesses and innovations.

Why on Earth would you want to take so much payload or passengers to orbit every day?

If astronomers see a dinosaur-killing asteroid heading to the Earth and gave Earth six months, a year, five years, or even 10 years notice today, we would only be able to take 12 passengers to the ISS; humanity would be lost. However, if we had a robust Space industry that took 35 passengers a day (per aircraft) to hotels in Space as well as hotels on the Moon, we would be able to save thousands if not millions of lives.

In the Space Billets paper, I show how it will take 87 Space Billets just to send 20 lunar explorers to the Moon each year. Establishing a colony of 1,000 people on Mars will take a very robust Earth to LEO transportation system that cannot be affordably accomplished via the normal large rocket systems. All of the innovative propulsion technologies that will dramatically reduce costs cannot be vetted until there is a large and routine demand for such services. Establishing a large number of Earth-to-orbit missions each day is the first step in creating that demand.

Conclusion

Establishing a colony of 1,000 pioneers on Mars will be extremely expensive if it is conducted with "business-as-usual contracts and flight hardware", but the America taxpayer doesn't have to keep making investments in order to establish a colony for a lucky few. If a Space industry is established correctly, there is money to be made in Space for private enterprise without continuously receiving funding from the federal government. The satellite business is extremely profitable and doesn't receive any government funding. To that end, I think Space Billets is the means to kick-start the profitable Space industry.

Will NASA, will the American public, Congress or the White House heed this message? Unless a political or social leader takes the initiative to embrace a robust Space program in the same manner as President Kennedy, it is very doubtful. Therefore, if there is no change in how NASA operates and no change in its strategic direction, and if NASA continues to fund programs that are certain to fail (i.e., Constellation and SLS) and continues to provide cost-plus contracts to the same major aerospace firms, and, perhaps more importantly, fails to excite the American taxpayer, then the NASA budget could and should be reduced. Neil deGrasse Tyson stated, "We stopped dreaming". It is very difficult to dream about Space settlements when we can't even get into Space on American made rockets, and the cost of getting into Space, no matter who builds the rockets, keeps going up, not down. The average child in the 1960s and 1970s could dream of walking on the Moon or even Mars someday. Yet today, even going into Space seems such impossible of a dream for the average person. In all earnestness, what happened and what can we do about it?

The views expressed in this paper are solely mine and do not reflect any company or organization that I am or ever have been associated with.

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Space and Evolution
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