

Augustine commission recommends commercialization

The much anticipated Augustine commission report was delivered to NASA and made public this week. The report lays out several options for NASA's space exploration focus for the next couple of decades based on a hard nosed look at budgetary resources and technical feasibility applied against national space exploration goals. I encourage all members of the space industry community to read the entire report. In short, I think the commission did an intelligent job with an almost impossible task, and came up with ten important "Key Findings" as summarized and liberally reworded below with my commentary:

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1. The right mission and the right size: Match budget dollars to missions and goals versus laying out bold vision statements unlikely to get sufficient funding. Basically, don't talk about sending humans to Mars unless you can pay for it. Also, give NASA ability to organize itself more efficiently for its new missions and funding levels. This last recommendation is great, but always runs up against the political difficulty of canceling or moving jobs from one Congressional district to another. Good luck. Will not hold breath.
2. International partnerships: Lead a bold new international effort rather than act alone or arrogantly. This is a welcomed change of national attitude and can have important foreign relation benefits and generate significant cost sharing opportunities. However, it may be hard to act as sole leader versus a co-leader if we have a 7-year human spaceflight gap. It will still be mainly our wallet at work, so worth a try.
3. Short-term Space Shuttle planning: Basically, delay Shuttle retirement by six months to allow for a realistic and safer conclusion of the current launch manifest. Makes sense although twelve months may prove more accurate.
4. The human-spaceflight gap: No credible approach to limit gap to less than six years and seven more likely. Only real option is to extend the life of the Shuttle which then creates a huge budgetary hole for exploration and systems development. In other words, we need to be nicer to the Russians.
5. Extending the International Space Station: It makes no financial sense in terms of a return on investment to spend 25 years building a facility we only use for 5 years, so we should fund an extension of ISS through 2020. The ignore sunk cost

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- argument would make sense here except for the valid point that the asset also has important contributions to developing international spaceflight partnerships.
6. Heavy-lift: We need a new heavy lift capability to adequately conduct desired future missions and it will also be useful for national security launch requirements. There are pros and cons to basing the new heavy lift capability on each of the Ares rocket family, Shuttle derived vehicles and various EELV alternatives. The commission also seems to be saying that to stay in budget, on schedule and to pay for a five year extension of ISS life we need to either move to (a) an Ares V Lite strategy or (b) use a Shuttle derived or EELV vehicle solution with in space refueling, and in both cases transfer ISS human transport to commercial providers.
 7. Commercial crew launch to low-Earth orbit: Commercial services to deliver humans to ISS and low-Earth orbit are within reach and are likely to save lots of money. The commission recommends a new open U.S. competition with adequate incentives. I agree. NASA should focus on human exploration beyond low-Earth orbit.
 8. Technology development for exploration and commercial space: It is important for NASA to increase R&D spending for the technology development necessary to enable more affordable and inspiring space exploration. This R&D spending will also benefit other U.S. government users and the U.S. commercial space industry. I can't imagine a better use of stimulus funds. It will help America stay at the forefront of an important 21st century industry, create many high skilled jobs and inspire a generation.
 9. Pathway to Mars: The commission acknowledges human exploration of Mars as NASA's ultimate goal, but suggests it is not a realistic first step given budgetary constraints and technical challenges. I know this will be heart breaking for many Mars enthusiasts, but unless our politicians have a mass epiphany and reallocate a hundred billion dollars or so, humans to Mars before 2030 just isn't likely with today's technology. Of course, they did give this amount to save AIG, but perhaps safeguarding our financial system was a higher priority.
- Options for the Human Spaceflight Program: The commission did not really address the humans versus robots debate, but did say human exploration beyond low-Earth orbit was not feasible with the 2010 fiscal year budget. However, they did believe meaningful human exploration beyond low-Earth orbit

was feasible if we grew NASA's budget to \$3 billion above 2010 baseline by 2014 and then grew at 2.4% per year for inflation versus the current 1.4% budgeted annual increase. So, for roughly the cost of a "cash for clunkers" program (that mostly just increased Japanese car sales) we could have a meaningful human space exploration program. Sounds like a good national investment to me. The real option left unanswered by the commission is whether to (a) go first to the Moon to either develop a small colony or thoroughly explore the Moon's surface at diverse sites or (b) adopt a more "Flexible Path" visiting many new sites such as asteroids and other near Earth objects, Lagrange points (i.e. orbital points of special gravitational properties), and moons of Mars, plus additional robotic exploration of the Martian surface. The two paths are not mutually exclusive, but it is clear that we do not have budget to do both. **This will not be an easy decision and based on the discussion below, perhaps one that does not need to be made if NASA is allowed to expand its support of space commercialization.**

I think the Augustine commission is correct that there is not sufficient national will given competing fiscal needs to do more than what the report lays out. Ultimately, the decision lies with the Obama Administration and Congress, but with between 9.7% and 16.8% of Americans unemployed, depending on your definition, substantially increasing funding for space exploration seems less likely to garner a political consensus when times are tough. On the one hand, there are many jobs at stake and in key states; high paying, high technology jobs in one of the few industries in which we still lead the world, the kind of jobs we are supposed to be protecting and growing.

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Most likely, while NASA may not be asked to hunker down for a cold winter, it is also far from likely to enjoy a balmy summer at the beach. The best that can be hoped for is a Springtime of green shoots with lots of hands to help with the planting and the weeding, but not a whole lot of fertilizer to spread around. In short, the answer will most likely involve some significant requirement to do more with less. In other words, do things differently. Do things smarter. Get more bang for the tax payers' bucks.

Here is how we look at the "different and smarter" problem at Near Earth. The Augustine commission options, and others, can all be broken down along three major axes creating in each case clear

dichotomies of policy choices. The first axis is manned versus unmanned / robotic. That debate has been raging since before John Glenn and the Mercury program with manned being obviously more expensive and technically challenging, but of course far more rewarding both scientifically and emotionally. On the other hand, there has been an amazing amount of progress with robotics and telepresence in the last 20 years in some cases replacing the need for humans and in other cases clearly surpassing human capabilities (e.g. multispectral sensing and ability to tolerate extreme environments).

The second axis is near versus far with near meaning Earth orbit focused and perhaps the Moon and Lagrange points and far generally meaning Mars, one of its moons or the asteroids or other planets or their moons. We have sent several probes and landers to explore solar system bodies further than the Moon, but never a human. Many believe it is time to send out our best assets and really expand the envelope of human experience and achievement. Others believe phenomena like global warming demand we stick closer to home and better understand our own planet first. As the Augustine commission recommended, we should forget humans on Mars anytime soon, but their Flexible Path does include many destinations of interest that are far from Earth.

The third axis is whether the mission involves a deep gravity well or a shallow gravity well with a massive body like Mars and to a lesser extent the Moon representing deep gravity wells (i.e. harder to land on and take off from). Other destinations like low Earth orbit, Lagrange points and the smaller moons of Mars represent shallower gravity wells. Deep gravity wells are more expensive and technically challenging, especially for return missions for either humans or samples. Note, all missions involve getting out of the Earth's deep gravity well, so we are ignoring that aspect.

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Having laid out the three dichotomies, what does that suggest for smart policy choices? Well clearly, to both return humans to the Moon in force and go down the Flexible Path in style will require more money than NASA is likely to be appropriated. That means a major key to solving the problem of doing both is attracting large amounts of private capital. Private capital is notoriously risk adverse and so it will have to be enticed and allowed a chance to earn an appropriate risk adjusted reward for its investments. The good news is that there is plenty of private capital looking to be deployed if we can just get the private / public model right.

An example of NASA and the government getting the private / public model right is COTS (for an excellent article on COTS see: [“COTS-like”: the future of space procurement](#) by Max Vozoff at thespacereview.com), so naturally one logical first step would be to create a similar program for other avenues of commercializing NASA’s space exploration agenda. A Lunar COTS program is already being discussed within the space community, but there could be others as well like a Flexible COTS. Another good idea is for NASA to sponsor large prize awards for commercial achievements of particular missions or technology developments. Large meaning potentially hundreds of millions of dollars. Zero-G, zero-tax is also a very good idea.

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But, what should be commercialized and what should be left to NASA? This is where the three dichotomies come into play. As an example of a commercialization decision methodology, take each NASA mission or requirement and assign a number between zero and one for each of the three dichotomies depending on where it falls on the axis in terms of relative difficulty and expense. For instance, a manned mission to Mars would score very close to “one” on each of the three dichotomies. It would be manned versus robotic, relate to a distant target versus a near one and involve a deep gravity well. This is why the commission thinks we are not ready to go. At the other extreme, cargo transport to the International Space Station would score very close to “zero” on each of the three dichotomies. It would be unmanned, close to Earth and not involve a deep gravity well. That is perhaps why NASA chose this mission as its first to commercialize through COTS.

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To make the measurement of mission “boldness” easier to remember let’s give this scale a name. I like our new NASA Administrator, Charles Bolden, so let’s call it the Bolden Scale with particular scores on the scale referred to as the Bolden level for the mission. Clearly, missions with a ride level of 2 - 3 should be almost entirely NASA funded and executed whereas easier missions with a Bolden level of 0 – 1 could be, and probably should be, almost entirely handed over to the commercial world. New commercialized missions would thus also need respective COTS types programs or equivalently meaningful NASA sponsorship and support in the early years to literally get the commercial enterprises off the ground. Eventually, however, the expectation would be that all sponsored enterprises would need to achieve self sufficiency in a reasonable

period of time and thereafter live off of affordably priced NASA contracts and hopefully new commercial revenue streams. This commercialization strategy seems in accord with the Augustine commission which recommends transferring human spaceflight to ISS to commercial suppliers in a new heavily incented competition. If commercial providers can be trusted to get humans safely to low-Earth orbit they can perhaps also be trusted to deliver robotic landers to the Moon or even a moon of Mars like Phobos.

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Here is a table of potential space exploration missions and some relative, but arbitrary Bolden levels for illustration:

<i>Missions</i>	<i>Manned v. Robotic</i>	<i>Far v. Near</i>	<i>Deep v. Shallow Gravity Well</i>	Bolden Level
Manned Mars	1.0	1.0	1.0	3.0
Manned Phobos	1.0	1.0	0.2	2.2
Manned Lunar Landing	0.9	0.4	0.5	1.8
Robotic Phobos w/Return	0.0	1.0	0.2	1.2
Robotic Lunar Landers w/Return	0.0	0.4	0.6	1.0
Human Transport to ISS	0.8	0.0	0.0	0.8
Robotic Phobos, no Return	0.0	0.6	0.1	0.7
Robotic Lunar Landers, no Return	0.0	0.2	0.4	0.6
Unmanned Lagrange Mission	0.0	0.3	0.0	0.3
Cargo Transport to ISS	0.0	0.0	0.0	0.0

While one may argue the relative placement of the possible missions along this Bolden scale, it still remains likely that there are many missions that can now be executed partially if not wholly by the commercial sector, thereby freeing up NASA to focus on the more challenging missions and technology development efforts. The higher cost efficiencies of the commercial sector should translate into enormous budgetary savings to NASA over the long run. NASA needs a force multiplier if it is going to once again match the accomplishments of the Apollo era and leaning on the commercial sector is the best force multiplier we can imagine. As the Augustine report states, "...there is now a commercial space industry. If we craft the space architecture to provide opportunities to this industry, there is the potential – not without risk – that the costs to the government would be reduced."

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This strategy also seems to fit in with many of the Obama Administrations goals. It will save, but rationally refocus many existing NASA jobs while creating even more new jobs in the commercial sector funded largely by private capital. It will inspire many of the students the President spoke to this week about



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achieving wonderful things and contributing to their country. It also gets away from government being the whole solution or the whole problem and moves us to government being part of the solution while enabling, supporting and inspiring a powerful free market system. It also begins to move us away from a reliance on “old space” and its expensive and bureaucratic procurement system without pushing us too quickly to rely on a “new space” industry that is still developing and mostly unproven. It is in short a “smart space” strategy that uses traditional NASA and aerospace practices to make progress on the most challenging space endeavors while building up a capable entrepreneurial space industry to take us to a more affordable future in space.

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