

The Lurio Report

News and Analysis of the 'New Space' Enterprise

“Thanks for all YOU do for the industry -- you cover it all, very well and very thoughtfully ... [and] you probably have the best mailing list of all.”

-- Mr. Rick Homans, *Former New Mexico Secretary of Economic Development, former head of the New Mexico Spaceport Authority*

“Thanks...for the great work you do with your newsletter keeping us up to date on private enterprise in space.”

-- Mr. John Tierney, *Columnist, "The New York Times"*

New or Adapted for New Space?, COTS (Re)-Selection, VA Legislation

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Quick Updates:

COTS (Re)-Selection - Orbital Sciences Wins: On February 20th NASA announced Orbital Sciences as the winner of the leftover funds from the discontinued Space Act Agreement (SAA) with Rocketplane-Kistler. Under Orbital's own SAA, they will receive \$170 million from NASA, and will raise \$150 million from the private sector. Orbital's system uses their already - planned 'Taurus II' booster (designed as a substitute for the out-of-production Delta II), a maneuvering craft called 'Cygnus' and has several options for pressurized and unpressurized payload modules (<<http://www.orbital.com/AdvancedSpace/COTS/index.shtml>>).

Orbital actually beat out *four* other finalists, despite earlier reports of three others; I was told that Boeing had 'muscle into' the competition a few months ago. That very quiet proposal was confirmed in several places, and by an alert (in case of a win) that was sent out by the Boeing PR department the day of the selection announcement.

As noted at the press conference and in press reports, Orbital has no present plans to developed a crewed version of the system, though it does have a reentry vehicle capability (<<http://dsc.discovery.com/news/2008/02/20/orbital-sciences.html>>). It also has a lower payload resupply capacity than SpaceX's Falcon 9/Dragon.

From a New Space perspective I find the Orbital selection a bit disturbing. They've been around since 1982, and among forward-looking space professionals were known as the company that wanted to become a firm in what we'd now call the 'Old-Space' mold. To be fair, because of attitudes in past decades, startups with notions of being something like what we'd now call 'New Space' almost inevitably ended up dead.

Though it's not clear that any of the other finalists in this second round competition would have included crew capability, the lack of consideration of that by the winner puts the field in something of an awkward position. I hold SpaceX in a great deal of esteem, but they are now the *only* New Space firm plausibly planning for orbital human access for the time period in question. Having but one such effort in the vanguard inevitably magnifies it into a hugely important symbol of the New Space enterprise as a whole.

Of course, it remains questionable just how much NASA will end up using the products of COTS, even if both SpaceX and Orbital succeed. First, we have the sort of continuing actions by Mr. Griffin noted below ("Griffin Undermines COTS"). Second, a new Administration that reduces NASA's lunar exploration funding *without changing its fundamentals to use lower cost New Space systems* could leave the Agency with a very fancy Orion capsule and no use for it for several years other than...servicing the space station in place of COTS systems.

COTS (Re)-Selection - Virginia Spaceport and Zero-G Tax Breaks Win Too: Perhaps the most interesting part of Orbital's COTS win was that they are to perform their Taurus II launches from the Mid-Atlantic Regional Spaceport (MARS, <<http://www.marsspaceport.com/>>). My congratulations to the Virginia Commercial Space Flight Authority, its Executive Director, Dr. Billie Reed and the Commonwealth of Virginia.

Dr. Reed told me on February 20th that some news accounts had been confused about the arrangements at MARS. The land for it is leased by the Space Flight Authority from NASA and its Wallops Flight Facility. MARS (with state support) has developed the support equipment for the largest vehicles that can be launched from Wallops. The pad to be used by Taurus II requires some upgrading using state funds and the prospects obtaining them are good (<<http://hamptonroads.com/2008/02/wallops-big-role-firms-nasa-contract>>).

Another item that Dr. Reed highlighted was the 'Zero-G, Zero [state] -Tax' legislation on flights originating from Virginia. He said that it had passed and was expected to be signed shortly by Gov. Tim Kaine, taking effect on the first of July. (See <<http://spaceports.blogspot.com/2008/02/zerog-zero-tax-passes-in-virginia.html>>.) The summary text of the bill as referenced is at <<http://leg1.state.va.us/cgi-bin/legp504.exe?081+sum+SB286>>.

The legislation applies:

-- to people taking suborbital flights to experience zero-g or aircraft parabolic flights for the same;

-- to resupply services for the COTS program, or for, "[an]other space flight entity." I presume this would include Bigelow's stations.

Expectably, Floridians expressed dismay at the launch site choice. (See, e.g. <<http://www.orlandosentinel.com/news/local/state/orl-cots2008feb20,0,1956961.story>>). SpaceX's Falcon 9 is scheduled to launch from Florida, but if the state wants to attract more private ventures perhaps it wouldn't hurt if they passed their own version of 'Zero-G, Zero - Tax.'

Griffin Undermines COTS: The NASA Administrator's actions continue to be Janus-faced regarding COTS. Griffin has requested from Congress further relief from nonproliferation law so that NASA could by the end of the year purchase more Soyuzes, for crew transportation to the International Space Station (ISS) in the period beyond 2011 (<<http://www.space.com/spacenews/spacepolicy/NASAhearingweb021308.html>>).

He stated to a Congressional committee that, "...while I believe that we will have U.S. commercial cargo transport services over the next few years along with European and Japanese capability, it is my carefully considered assessment that U.S. commercial crew transport vehicles

will not likely be available by 2012. The prospective purveyors of such services of course claim otherwise and actually I wish them all possible success. No one hopes more than I that they are right and I am wrong. No one hopes more than I that they are right and I am wrong. But our ability to sustain the station cannot be held hostage to hope."

Griffin doesn't want the ISS to be held hostage to 'hope' but apparently it's OK to hold the US taxpayer perpetual hostage to the high costs and endless delays created by our nationalized human spaceflight establishment. (His comment about Japanese and European supply capabilities also refers to government vehicles.)

Last year Griffin went out and purchased Soyuzes for a three year period, undermining US companies' ability to raise dollars in the critical early years of their own transport vehicles. Even those firms that can take advantage of individuals with very deep pockets may face the need to raise funds if they run into technical problems.

From another perspective, Griffin's action is just another vote for the doctrine unknowingly created by the '60's space race, and reinforced by public and private dependencies of NASA ever since, that space technology is perpetually so difficult that only the government can be trusted with it.

The only way to salvage any utility from national human spaceflight investments is to do exactly what Mr. Griffin wants to insure *against* doing; putting privately developed, innovative systems directly in the exalted 'critical path' of such projects.

Mr. Griffin's latest action reinforces the importance of markets not contingent upon NASA, such as Mr. Bigelow's space stations (see the essay below). It also comes just as I hear lessened unease from a skeptic of SpaceX's potential.

FAA's Commercial Space Transportation Conference: Sounds like it would have been interesting to have been at the FAA's annual Commercial Space Transportation Conference in Washington back on February 5th and 6th (<http://www.faa.gov/news/conferences_events/commercial_space/11/agenda/>). I've been in touch with some attendees.

More than one called it a very useful event. The capable Dr. George Nield is currently Acting Associate Administrator for Commercial Space Transportation, and there is other staff continuity. But there was reportedly a (likely unavoidable) degree of disequilibrium caused by the absence of Patti Grace-Smith, who'd been Associate Administrator since before the New Space enterprises got rolling.

Despite the general praise, concern was expressed at the panel on Crew Training for private spaceflight. There, a Virgin Galactic representative and Jeff Greason of XCOR both asserted that given the state of vehicle developments it was really too early (and could even be harmful) to talk about the subject in any detail. Others evidently agreed. This also mirrored an opinion expressed about the meeting of the COMSTAC - RLV (Commercial Space Transportation Advisory Committee - Reusable Launch Vehicle) Working Group task force on training standards, held the evening of the 5th. A participant drew an analogy with safety discussions that had been held even before the flights of SpaceShipOne, and felt that for the training issue the near future result would ultimately be similar to that case - broad guidelines rather than specifics.

Apropos to the essay topic below, another attendee noted the presence of more Old Space players interested in getting involved in New Space related work. This person was amused that some of the former apparently still don't 'get it' on fundamental needed shifts in assumptions required for New Space opportunities.

Insurance, Liability and Technical Development: Several perspectives on acquiring insurance for the personal spaceflight industry are reported from one of the FAA meeting panels (<<http://www.space.com/businesstechnology/080211-busmon-tourism-insurance.html>>). Linked to this issue is the concern that in the early days, accidents could trigger a cascade of legal actions fatal to the industry.

The fundamental question is: How do we get through the early gauntlet of

overblown societal fear that there is an unavoidable and perpetually ghastly risk associated with riding on rockets? These fears - among the general public, juries and potential insurers - have been stoked by the inherent inability of 'Old Space' nationalized efforts to sufficiently reduce risk. Those efforts have ducked the *_responsible_* early risks necessary to reduce risk in operational systems. They've depended upon piling one checklist on another rather than rapid-turnaround experience to reduce both cost and risk.

Eventually there will be enough successful private flights and enterprises to quiet the excess fears, but that day is not yet here. Yet there will inevitably be accidents both before and after that. Today's challenge is to assist the public to understand New Space development as part of a *_normal and tolerable_* industry maturation process. That process will sharply reduce risk in the fundamentally best systems, eliminate systems truly impractical to make safe, and excise those enterprises that are truly acting irresponsibly.

Different stratagems are appropriate to different companies, depending upon such factors as financial resources and reputations. A company with the resources of a Virgin Galactic may, indeed, already have been having, "'positive discussions with insurers.' ...that the business model for the insurance seems sustainable," (from the space.com item). They've certainly been taking every opportunity to emphasize their goal of proving safe flight before the passengers start stepping into the vehicles.

But even for them, only a significant trail of experience can ultimately measure safety. As I said in my last issue, perhaps Scaled Composites should consider switching oxidizer from nitrous to liquid oxygen (LOX) to reduce some uncertainties; yet neither should they (when avoidable) be punished merely to satisfy what may be a bureaucracy's own need for 'CYA.' So despite the relatively small fines imposed by Cal-OSHA, perhaps it's good that Scaled is protesting them (e.g. <<http://www.space.com/news/080208-scaled-blast-fine-appeal.html>>).

In an opinion item in the February 4th issue of Space News, LA based lawyer Doug Griffith argued that catastrophic litigation is not nearly so likely as some suggest. ("The NewSpace Liability Myth: Why Lawyers Will Not Scuttle the Industry," p19.)

Along with "Don't Panic!" he suggests 'modules' of actions that the new enterprises can use to prevent disabling legal attack:

- **Documenting Safety Measures:** Quoting, "*Invariably...the absolutely safest course [must at times] yield to...engineering or economic realities. The main thing is that the company be able to establish that the...decision...was reasonable based on what was known at the time.*"

- **Disclosure-Oriented Communications with Customers:** Essentially, this is the ability to prove the customer was aware of risks, as allowed by FAA's present, "fly at your own risk" doctrine and "*...protective statutes such as the one recently enacted in Virginia.*"

- **Choosing a State in Which to Base Operations:** There is no guarantee that liability cannot be shifted from one state's to another's courts given (for example) that a vehicle will not be produced from one state's products alone. But as Griffith says, if other big factors are, "*...a close call...*" one should take relevant local liability law into consideration.

- **Responsible Public Relations:** Griffith suggests that if before accidents a company has been capitalizing on a 'daredevil persona,' that hype may undermine juries' ability to accept it as sober-minded afterwards. As well, airline experience shows the importance of not evading or trying to shut out public, families and press, but of having a, "*...preplanned response procedure that elevates concerns for emotional well-being of the victims over any fear of litigation.*"

Griffith finally suggests liability insurance ...the individual availability of which will of course depend on just how well the industry and the company performs in these and other ways.

Footnote: I'd suggest that one way to add flights to a test program *_and_* get paid for it would be by starting out with commercial flights not requiring passengers, such as carrying sounding-rocket analogue experiments.

Dear Acquaintances,

- Falcon 9/Dragon vs. Atlas V For Bigelow's Needs -

“More Fur On The Dinosaurs”

That pithy phrase headlined a recent item on Rand Simberg’s “Transferrestrial Musings,” alluding to the continually growing interest among Old Space firms in getting pieces of the New Space pie, <http://www.transferrestrial.com/archives/2008/02/more_fur_on_the_1.html>. Of course, the idea is that if you’re one of the ‘dinosaurs,’ maybe you want to start looking more like an upstart mammal by adding new tools to your survival strategy.

What assets and capabilities do the ‘dinosaurs’ have that can be adapted for the development of new space markets, and how do they compare with the approaches being taken by the entrepreneurs? Given the discussions between Bigelow and Lockheed about supplying his stations with people and supplies, a topical comparison is between using the Atlas V and the SpaceX Falcon 9/Dragon booster/capsule system (<<http://www.bigelowaerospace.com/news/>> February 2, 2008).

One must admit that if one’s not an insider in more than one of the companies involved, making this comparison is a murky process at best. All of the actors want to protect proprietary capabilities; for the New Space participants those may be make-or-break items. On the Old Space side of the ledger, there is a particularly tangled web of closely guarded private and public costs, relationships with Federal agencies, and even court rulings. Will the established companies seeking new market participation be trapped in that web?

Seemingly straightforward figures may hide seas of incompatible assumptions. But the example chosen here can spotlight complications and uncertainties that typify analogous New Space/Old Space comparisons.

One of the issues Rand addressed in his “Transferrestrial” item was a meaningful definition of ‘man-rating’ for the Atlas V and other boosters previously used only to carry satellites. (I say ‘meaningful’ since NASA has too often defined that rather conveniently for its own bureaucratic interests.)

Although sufficient system robustness/redundancy may seem a top concern, Rand notes that that isn’t likely to be at the heart of the matter for a proven (though throwaway) satellite launcher, which must reliably send very high value systems into orbit.

Instead, he properly puts the spotlight on the ability of onboard systems to detect the onset of failures, something, “which doesn't currently exist on the [throwaway launchers] other than for range-safety destruct purposes.” For a human-carrying launcher of any kind, you obviously need a warning system that can lead to safe escape or safe abort of a flight. This emphasis on an ‘Emergency Detection System’ was also made in Lockheed-Martin’s initial paper on modifying an Atlas V 401 to carry humans to orbit (Patton, Jeff A and Hopkins, Joshua B., Lockheed Martin Space Systems Company, “Atlas V for Commercial Passenger Transportation,” AIAA paper, 2006(?))

I haven’t seen any data on the initial and per-flight costs of ‘man-rating’ the Atlas V, and how those might be distributed. These matters are a part of the current discussions between Bigelow and the Lockheed. (See also <<http://www.space.com/news/080204-bigelow-atlas5-spacestation.html>>.) However, Lockheed is presently saying that if the decision were taken to ‘man-rate,’ the booster modifications would thenceforth be applied to *all* vehicles coming off the assembly lines, not just to those intended for human transport. Not only does that allow thorough testing of the systems in flight, but it spreads the initial conversion cost over more boosters while allowing price per equipment-set to drop due to the larger production run. So Atlas V ‘man-rating’ price per crewed flight may end up quite low.

Seat Prices to Orbit - Soyuz, SpaceX and Bigelow's Public Offer

Some observations to aid comparisons:

-- The price of recent 'tourist' tickets on the Soyuz has been edging up to around \$25 million per rider;

-- I've been told that in the timeframe (to around 2015) for which Bigelow has recently spoken of flight rates, SpaceX foresees their price per seat as being around \$10 million; after a lot of flights, and with "reusability working well," they hope to cut this by a factor of two.

-- What range will the user find acceptable? Recall that back in October of last year, Mr. Bigelow said he was considering offering \$760 million for 8 flights to his space station. That's \$95 million per flight, or about \$12 - 14 million per person. That *could* be taken as a low end estimate of Bigelow's *maximum* tolerable price, since it may improperly assume that all these offered flights were to be crewed, and at full crew capacity. For the Dragon that's 7 persons (<<http://www.spacex.com/dragon.php>>) and for the as yet hypothetical Atlas 5 capsule, 8. (see, e.g., <http://www.nasaspaceflight.com/content/?cid=4823>>).

From what I see of SpaceX's production development progress for both Falcon 9 and Dragon I'd estimate that this contribution to seat prices is pretty well defined. Bigelow hasn't spoken of the cost of his as yet hypothetical human - carrying capsule, though it is clearly behind Dragon in development. For neither booster will the capsule development and production costs be spread over as big a production run as the boosters' respective 'man-rating' components, though capsule reusability may benefit cost for both.

Unlike the Atlas V, the Falcon 9 has been designed for human flight from the start. This 'running start' is aided by its prospective use under the COTS program. On the other hand, because it is new, problems could crop up in Falcon 9's initial flights that would affect basic booster price estimates. Also, I've always been dubious about the practicalities of reusability for the (fundamentally throwaway) SpaceX booster designs.

My evaluation of SpaceX's cost claims has to rely on instinct as well as my own and other's observations of their development process so far. As well, others who've considered first generation private systems have come up with similar cost estimates for price per seat as SpaceX. While new designs may face a higher chance of some unpredictable problem, it's also the case that 'clean sheet' products developed by highly competent engineers (such as at SpaceX) can have inherent cost advantages over older ones.

Taking the above as a whole, I'll provisionally grant SpaceX their claimed \$10 million price per seat for the period in question.

Seat Price to Orbit - Atlas V

While the Falcon 9 faces both the challenge and the promise of new engineering, the Atlas V is hostage to a tangled web of cost accounting and existing public/private agreements. Many of the implications of the latter are unclear for the Bigelow service missions when looking from the outside - and may even be so from the *inside*.

The posited Atlas V 401 is the least complex, lowest cost version of the Atlas V boosters. One source close to SpaceX (perhaps surprisingly) suggested that the price of a “fully [government] subsidized” (this will be explained below) Atlas 401 could be as low as \$65 - 90 million; in contrast, a DoD planner stated that their ‘standard’ estimate for this same ‘subsidized’ price on a ‘medium to intermediate’ Atlas V was \$150 million. On further inquiry, that source said that the number *_might_* be pushed as low as \$100 million. A person with direct contacts to those who carefully guard the sales prices also said the standard ‘subsidized’ price was \$150 million for the 401 model.

Given Bigelow’s prospects for large, long-term purchases, and despite other complications, Lockheed may be able to offer a price around \$100 million. Indeed, judging by his offer of last fall they may have to. That would also have to include the capsule costs. **So take \$100 million as the low end estimate for an Atlas V 401 flight; with eight persons carried, that gives a price per seat of around \$12 million compared to SpaceX’s claim of \$10 million.**

At this point in the creation of either system I can’t see that as much different from a tie.

Now we come to the complications to the Atlas V story.

The Atlas and Delta EELV’s (Evolved Expendable Launch Vehicles) were developed under the aegis of DoD to obtain cost savings for government and private users. A big downturn in conventional private satellite sales invalidated the traffic model under which Lockheed and Boeing had invested in the vehicles’ development. To keep both production lines open for government needs the USAF obtained about \$1 billion in subsidies to cover fixed costs over five years.

Under present US Space Transportation policy, DoD is bearing these to 2010. By then it is hoped that DoD and other government agencies using the launchers will develop a deal to share those fixed costs. For a particular purchase under either regime the agencies only have to pay the direct cost of vehicle production. That subsidized rate apparently also applies to commercial users - at least to the 2010 transition. Based on more than one source, it’s unclear (and perhaps as yet undecided) if and under what circumstances commercial users would be expected to be charged for their portion of fixed costs *_after_* 2010. Nor is it clear whether bulk commercial purchases before then for delivery years later might allow a buyer to avoid paying part of the present subsidy.

Given the possible size of Bigelow’s purchases, it seems to me utterly implausible that a portion of the fixed cost charges wouldn’t be imposed upon him. One source asserted that this could double the booster’s price. That was dismissed by others as too high and it seems unlikely to me as well. Let’s say that one assumes the present - about 10 - government Atlas V flights/year. Add 5 for Bigelow (conservative, covering only the first projected year of Bigelow orders) and that the Atlas assembly line gets half of an about \$200 million/year subsidy for both EELV lines. Then the added price per rocket of paying the subsidy would be a bit under \$7 million, or less than \$1 million per passenger. But the scale of these numbers remains a question.

Suppose that by whatever means (bulk purchase discounts, a ‘loss leader,’ etc.) Lockheed did manage to create that \$100 million/flight package in an initial deal with Bigelow. Government agencies might then ask for their own reductions in the price of individual vehicles - particularly if they were still ‘holding the bag’ for the subsidies. So at least until Bigelow’s future market were more certain, Lockheed might have a powerful motivation to avoid a deal with such consequences in the first place. The government is the foundation of EELV business.

Whatever the resolution of the subsidy questions, there's yet another concern. The two EELV programs were merged into the United Launch Alliance (ULA) under a federal Consent Decree, despite protests of monopoly creation. There may be unforeseeable interpretations of the Decree or of parts of its 'fine print' in the face of a big commercial purchase of Atlas V's by Bigelow. (Note: The Decree prohibits ULA from direct sales of the vehicles to the private sector. Atlas V sales are conducted by the Lockheed - Martin Commercial Launch Services division.)

Conclusions: Illuminating the Questions

I set out to, "spotlight complications and uncertainties that [may] typify" comparisons of New Space systems to those Old Space ones that could be adapted to the new markets. I hope the process has done so.

Regarding attempted numerical comparisons there's had to be a lot more, 'ifs,' 'buts' and hand-waving than I'd prefer.

Falcon 1 must still fly with complete success and demonstrate the validity of SpaceX pricing over time, as must the much larger Falcon 9 and Dragon that would be suited to the Bigelow missions. Atlas V has flown successfully multiple times, but existing and impending agreements related to its 'conventional' use could produce unpredictable cost effects.

The 'best' case for the Atlas requires cutting its apparent 'normal' price per flight from \$150 million to about \$100 million by bulk purchase discounts or a similar mechanism. This is the baseline for Atlas V to be competitive. **Then its per seat cost to orbit *could* be nearly as low as for a successful Falcon 9/Dragon. Both would then cost less than half the present price per person for Soyuz.**

The absence of the EELV subsidy for Atlas V does not *appear* critical to me, but may be a 'wild card' threat to that vehicle's competitiveness.

Yours very truly,

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