

Intro to Electronic Edition of *The Rocket Company* **3 Feb 13**

Someone once told me that the most unbelievable part of *The Rocket Company* was that seven billionaires would agree to work together. Perhaps he was right. We do have a growing number of billionaires putting serious money into a variety of space projects, but most of these ventures are funded by a single entrepreneur. Other ventures are not so well funded, but interesting none the less. Some highlights of what's been happening since the book first came out:

Elon Musk's Space Exploration Technologies Corporation (SpaceX) is the most visibly successful of these ventures to date. SpaceX has apparently abandoned their small Falcon I launch vehicle, focusing instead on the much larger Falcon 9, which has now flown successfully four times, including two trips to the International Space Station with the Dragon capsule. And they have done so for total program costs that are only a fraction of what a typical NASA or DOD launch vehicle program would cost. They are also working on a Falcon Heavy, and most interestingly, they are pursuing a fully reusable version of the Falcon 9.

Jeff Bezos' Blue Origin is the most enigmatic of the new space companies; we never hear a lot about what progress they are making, but periodically some news is released. While they have yet to fly a vehicle into space, they have conducted several suborbital test flights, as well as tests of a new LOX/Hydrogen rocket engine and an escape system for their passenger capsule.

Sir Richard Branson's Virgin Galactic continues work on their SpaceShip2 suborbital passenger (and research) vehicle, but the pace of progress has been frustratingly slow, even for Sir Richard. No rocket-powered flights have been accomplished to date.

Microsoft billionaire Paul Allen, who put up most of the money for the SpaceShipOne X-Prize win, has funded a new company, Stratolaunch, that aims to build a gargantuan aircraft from which to air launch more or less conventional rockets into orbit.

The closest thing to a "Group of Seven" out there seems to be the investors in Planetary Resources, Inc., whose stated aim is to locate, analyze, prospect, and mine the near-Earth asteroids. Several very wealthy individuals are backing this venture, including Larry Page and Eric Schmidt of Google fame, and Charles Simonyi, who has already taken two trips to the ISS.

While they don't have any of their private space stations on orbit yet, Bigelow Aerospace has won a NASA contract to attach one of their inflatable modules to the ISS for test and evaluation. They seem to be crafting a strategy similar to the one used by AM&M for the DH-1, namely to sell or lease their modules to US and foreign government, and perhaps commercial, entities that wish to get into the space station business without needing to invest in all of the infrastructure required to do so from scratch. Their primary problem to date has been lack of a way to transport crews back and forth to their stations.

Other new ventures of note, while not as well funded, are not lacking in ambition: Golden Spike aims to get people back to the Moon, and Deep Space Industries has announced its plans to

prospect and mine the asteroids. Both they and Planetary Resources plan to launch swarms of small spacecraft, reminiscent of the small, low-cost planetary probes described in the book.

Other smaller companies such as Armadillo Aerospace, XCor, and Masten are, well, still small. They do seem to be making progress on the development and operation of their suborbital vehicles, but they lag far behind SpaceX in terms of serious space transportation capabilities.

And, in the background to a large extent, NASA is embarked on yet another launch vehicle development program of dubious utility - the so-called Space Launch System, which looks to be very expensive, very inflexible, and very unlikely to make much of a difference in opening the space frontier. SpaceX is already hard at work on a similar, albeit smaller, vehicle with their Falcon Heavy, that promises much lower costs of operation.

Yes, much has happened in the eight years since the publication of the book. But it could also be said that very little has happened. Not even SpaceX, with all of the success they have enjoyed with the Falcon 9/Dragon system, has yet flown any people into space. There hasn't even been a single, crewed suborbital flight into space since the X-Prize was won in 2004. So, will anybody build anytime soon the equivalent of the DH-1, a true space transport and not just another "launch vehicle?"

SpaceX seems to be the favorite in this race, if indeed there is a race. Elon Musk has abandoned his original "fish the stages out of the ocean, refurbish them, and fly again" approach to reusability in favor of what he terms "full and fast reusability." While the concepts that SpaceX has released so far do include vertical, rocket-powered touchdowns on dry land for the stages, it appears that the vehicle architecture is based closely on the current Falcon 9 configuration, with first and second stages as well as the Dragon capsule landing separately under their own rocket power. Not quite the same vehicle architecture described for the DH-1, but definitely moving in a promising direction. Blue Origin is taking a somewhat different approach, with a configuration consisting of a reusable first stage, an expendable (or so it seems) second stage, and a reusable capsule for crew, passengers, and cargo.

But many questions remain. Will SpaceX or Blue Origin, or some other company, sell their vehicles to a variety of operators and create a supply-side stimulus to reduce space transportation costs? Virgin Galactic's subsidiary The Spaceship Company (familiar ring, eh?) has indicated that they intend to sell SpaceShipTwo's to other operators, but they are a ways from being ready to do that. So far, SpaceX has been a more-or-less traditional launch vehicle company, in that they build and operate expendable launchers. And as a major participant in NASA's CCiCAP and CCDEV2 programs, much of SpaceX's funding has come from NASA, and much of SpaceX's attention has consequently been focused on meeting NASA requirements and preferences. Will that change with the advent of a fully reusable vehicle? Or will they continue to view themselves as the vehicle operators and be sole owners of a fleet of space transports? In *The Rocket Company*, AM&M builds an open-source space transportation capability, such that many owners can operate them for a variety of purposes, with a variety of custom configurations designed for specific applications. Will SpaceX or others be able to sell a broad based fleet of vehicles, even if they want to? It's not clear what the FAA/AST position on such a prospect would be.

Will private, commercial ventures finally begin to dominate the space industry? Or will NASA-led COTS-like programs be the norm for pushing beyond LEO? And if so, what effect will that have on space development? Indeed, what will it take to open a real space frontier? I gave a talk at Space Access '12 in which I called for “thinking big” and taking bold steps to give space development a kick in the pants. Elon talks regularly about settling Mars, and companies like Golden Spike and Planetary Resources have announced ambitious plans. But we still haven't seen anyone take a really bold step. Will some real-life Alexander Krempson come forward to dazzle the world with a bold and unexpected move outside the box of plodding, deliberate one-step-at-a-time projects? Will our current economic and political climate allow such a thing? Only time will tell.

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