

THE EVOLVING PRIVATE SPACEFLIGHT INDUSTRY: SPACE TOURISM AND CARGO TRANSPORT

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ABSTRACT

This paper examines the emerging, twenty-first century private spaceflight industry. It focuses on the main companies in this industry and their entrepreneurs, many of whom have been highly successful in other business ventures. The industry is part of the global initiative to commercialize space with an increasingly important role for the private sector, especially for sub-orbital and orbital activities. Space tourism seems to be the consumer service of choice for many of these pioneer organizations. Cargo transport to the International Space Station is another niche market that has emerged since NASA has suspended its shuttle program.

INTRODUCTION

October of 2012 has seen two space-related events that captured media attention and have implications for the future of the private spaceflight industry. Early in the month, SpaceX Corporation successfully launched its Falcon 9 spacecraft on its Dragon rocket for a re-supply mission to the International Space Station (Foust 2012). This was the first of twelve such re-supply missions for which NASA has contracted SpaceX. Though this involved public funding through NASA, it was a breakthrough for the private spaceflight industry that created the spacecraft and launch vehicle. It signaled the capability of the industry to undertake such missions.

The other involved the announcement by renowned singer, Sarah Brightman, that she contracted through Space Adventures, to take a trip to the International Space Station in the near future. Space Adventures is a U.S. travel agency that uniquely specializes in such trips in conjunction with Russia's space agency, Roscosmos. Some seven persons will have preceded her in this adventure but she intends to be the first to sing in outer space. Like the others, she will pay between \$20 and \$35 million to ride with two Russian astronauts to the ISS. Obviously, with such a price tag, demand for these flights is not overwhelming. However, there is an emerging industry that is exploring the potential for space tourism, albeit on a more modest basis and at a much lower price point. Whether Brightman ever makes the space journey, this announcement has sparked considerable interest in the subject of space travel. Thus, the month of October 2012 has given both cargo transport and space tourism a tremendous boost.

Thorpe (2003) outlined the potential for the commercialization of space and Moring (2007) reported that private spending on space-related activities has surpassed that of governments. Giacalone (2008) reviewed many of the more recent developments in space commercialization, including the first efforts of private spaceflight in the United States. The capture of the \$10,000,000 Ansari Foundation X-Prize by Burt Rutan's SpaceShipOne in 2004 seems to have raised the confidence of those entrepreneurs determined to make private spaceflight a commercial reality. A unique aspect of these activities is that many of the founders and investors in the private spaceflight industry have been quite successful in other business ventures (2006). They seem

committed to using their personal wealth to become pioneers in an emerging twenty-first century industry. In her 2007 *Time* magazine article, Cathy Booth Thomas has dubbed them “the space cowboys”. It is not that these individuals are engaging in hazardous, rodeo-like, personal exploits so much as that they are risking parts of their personal fortunes in a very early stage of an industry.

U.S. NATIONAL SPACE POLICY IN THE TWENTY-FIRST CENTURY

Since the presidential administration of Dwight D. Eisenhower, each administration has had a space policy. The early policies focused on the cold war competition between the United and the former USSR for space supremacy. These policies had both technological and security objectives. However, the first decade of the 21st century has seen national space policy evolve to a much less adversarial relationship though still quite competitive. The competition extends beyond what were then the two super-powers. The high degree of cooperation involved in the sixteen-nation International Space Station is a good example of these multi-national relationships.

It is in this context that the private spaceflight industry has emerged. Both the Bush and Obama administrations have clearly identified a role for such activities (OSTP 2006, 2010). These policies reaffirmed the U.S. commitment to the peaceful uses of space, the advancement of commercial space activities, and the promotion of international cooperation in various space-related endeavors. The policies delineated a series of key principles one of which explicitly commits the country to “encouraging and facilitating a growing entrepreneurial U.S. commercial space sector” and “...the use of U.S. commercial space capabilities to the maximum practical extent, consistent with national security.” A fundamental goal will be to “enable a dynamic, globally competitive commercial space sector in order to promote innovation, strengthen U.S. leadership, and protect national, homeland, and economic security” (OSTP 2006, 2010).

The policy documents include guidelines for commercial space activities. Government departments and agencies are encouraged to purchase and use commercially available space capabilities or help modify existing commercial systems to meet government requirements. Importantly, agencies and departments are discouraged from deterring or competing with commercial space activities. Moreover, the government entities are encouraged to make their technology and infrastructure available for commercial use on a reimbursable basis. And, finally, the policies call for the maintenance of a “timely and responsive” regulatory environment for licensing commercial space activities. For the most part, responsibility for U.S. commercial space activities is assigned to the jurisdiction of the Department of Commerce although other government departments could be involved. Not surprisingly, though the national policy encourages international cooperation on peaceful commercial developments, it reserves all rights where national security is involved. This is pretty much the standard reservation for governments around the world (OSTP 2006, 2010).

A significant recent development was the scheduled suspension of NASA’s space shuttle program in 2010 until 2015 when a new generation of spacecraft are expected to be ready. During that period, NASA will depend on Russia to get to the International Space Station. It will purchase seats on Soyuz rockets as space tourists do. This has raised political objections given the volatile nature of U.S.-Russia relations. Moreover, the economic impact on the state of Florida generated political opposition from local officials and the 2008 presidential candidates .

THE ENTREPRENEURIAL VISION

Given the blessing of national space policy to encourage private commercial initiatives, there has emerged a commercial spaceflight movement referred to as NewSpace. A major business objective of these nascent NewSpace organizations is to service a developing space tourism

industry which has been pioneered by Virginia-based Space Adventures, a travel agency that specializes in personal space flights. Space Adventures has relied on the Russian Space Agency (Roscosmos) and its Soyuz rockets to send at least seven individuals to the International Space Station (ISS) at \$20 million or more per trip (Morring 2007)]. To the Russian space agency, this luxury tourism provides financial resources critical to the Russian space program.

As is evident in US national space policy described above, space tourism will not be an aspect of space activity supported by NASA. This has opened the door to a group of NewSpace entrepreneurs who believe that there would be sufficient consumer demand from among the world's millionaires for short, sub-orbital flights priced at around \$200,000 per trip. Beyond that is the possibility for orbital flights and even for trips to the moon that have been the object of fantasy for centuries. Of course, this demand assessment was made before the global recession.

THE CARGO TRANSPORT MARKET SEGMENT

SpaceX (Space Exploration Technology Corp.)

Based in Hawthorne, California, SpaceX was founded by Elon Musk, a co-founder of PayPal and the Chairman of Tesla Motors, a pioneering manufacturer of electric automobiles. SpaceX has set his sights on developing low-cost launch vehicles to facilitate space access (Foust 2008). The first and smaller vehicle is the Falcon I, which after three failures, was successfully launched with a dummy payload in late September 2008. The company followed with the completion of a larger spacecraft, the Falcon 9, SpaceX won several commercial and government contracts, including a funded Space Act Agreement with NASA as part of the Commercial Orbital Transportation Services program. Valued at \$278 million, SpaceX used the funding to develop its Dragon spacecraft for cargo and crew transportation to the International Space Station. The Falcon 9/Dragon combination successfully completed the first private resupply mission to the ISS in October 2012 (Foust 2008). Looking far ahead, the company sees an enhanced version of the Falcon 9 for Mars missions.

The company worked with the Air Force and Cape Canaveral to re-develop the former Titan launch complex from which it launched its October 2012 cargo mission (Florida Today.com 2008). SpaceX hopes this and future rockets can fill the gap created by the end of NASA's shuttle program. This is especially significant since NASA's planned successor space shuttle program, its Constellation program, has been terminated (NASA website).

SpaceX has delivered the goods and proven that the private sector has a significant role to play in space travel. As such, the company's achievement in a very practical endeavor, cargo transport, paves the way for the more fanciful goal of private space travel for individuals.

THE SPACE TOURISM MARKET SEGMENT

Space Adventures

Undoubtedly the leader in private space tourism, Space Adventures (Thorpe 2003), founded in 1998, has already arranged for several private individuals to take a journey to the International Space Station aboard a Russian space vehicle. The price has ranged from \$20-\$30 million per trip and clearly is not an item for the mass market. The pioneer private astronauts have been, for the most part, very successful businessmen who not only could afford the steep price but could handle the months of necessary training in Russia and endure approximately two weeks on the ISS.

Though a successful videogame entrepreneur and world-class explorer, Richard Garriott helped finance his trip by the use of sponsors and by contracting to conduct a variety of small-scale

scientific and environmental research projects while at the space station. This approach could become a viable financing arrangement for potential space tourists who might be long on courage but short on disposable income. Though Sergei Brin, co-founder of Google, placed a \$5 million deposit for a journey to the ISS, this trip has not yet transpired. As mentioned above, Sarah Brightman has joined the queue.

The company mission extends well beyond these trips to the ISS. It expects to enter the sub-orbital and orbital flight market as it becomes feasible and is taking reservations for such. Its price point for a sub-orbital flight is \$102,000, about half of the \$200,000 price tag being mentioned by Richard Branson of Virgin Galactic. The company is also promoting a lunar mission projected to cost \$100 million per person, a very long-term project.

Other services offered by the company include launch tours in Russia, zero-gravity flights, spaceflight training, and space-related corporate incentive programs. However, there seems to be no quantitative data available on sales of these services. Additionally, for \$980 a year, applicable to a future space flight, Space Adventures offers membership in its Spaceflight Club which features a variety of space-related events and activities and promises members will “belong to the most exclusive and elite network of space enthusiasts and explorers.” No membership numbers are available.

Space Adventures is privately held and there is little in the way of financial or other business metrics publicly reported. However, in an April 2006 press release, the company reported \$120 million in spaceflight sales in its first five years of such services. Since there have been three additional space tourists since then, we can assume that there are several million more revenue dollars. Profit and loss information has not been reported.

Scaled Composites, Virgin Galactic, and The Spaceship Company

Paul Allen, co-founder of Microsoft, financed the construction of SpaceShipOne by Burt Rutan's company, Scaled Composites, in the competition to win the \$10 million Ansari X-Prize. Space Composites won that prize with SpaceShipOne by reaching a height of 62 kilometers with the capability of carrying two passengers on two separate flights within a period of 14 days. The company is now working on SpaceShipTwo under contract to Virgin Galactic, founded by Richard Branson of Virgin Airways and other ventures in the Virgin Group. The target altitude for SpaceShipTwo is at least 100 kilometers and the capability of carrying the pilots and three paying passengers (Morrison 2007). WhiteKnightTwo is the name of the carrier aircraft from which SpaceShipTwo will deploy with its pilots and passenger complement. The carrier aircraft was completed in July 2008 while the spaceship is still under construction. After, completion, at least twelve to eighteen months of testing will still be needed before it is ready to carry paying passengers.

In 2005, Rutan and Branson formed The Spaceship Company to manufacture spaceships and their launch vehicles and to market personal sub-orbital spaceflights through Virgin Galactic. Virgin Galactic ordered five spaceships and two launch aircraft with an option for additional units. It envisions a flight to about 80 miles above the earth at which point the passenger-astronauts will be able to float weightless around the cabin for four minutes or so. The passengers will enjoy a spectacular view of the planet Earth and then cascade back to the planet, experiencing forces of up to 6Gs, before re-entry and the glide back to the spaceport. The total flight time is estimated at two and one-half hours. An estimated 250 persons have made reservations and paid deposits on the \$200,000 spaceflight.

Virgin Galactic has committed \$250 million to the project of which \$100 million has already been spent. In 2007, Scaled Composites was acquired by Northrup Grumman, a leading aerospace company. This gives an additional amount of credibility to these NewSpace ventures.

Although Virgin Galactic has numerous deposits for its space travel adventure, it has yet to blast off with any passengers. For several years now, it has always been “next year.”

Bigelow Aerospace

Robert Bigelow, successful founder of Budget Suites of America, created Bigelow Aerospace with the intention of developing inflatable habitats for earth orbit. BA has successfully launched two space vehicles, Genesis I and Genesis II in 2006 and 2007. They were launched from a Russian spaceport and controlled from its Mission Control Center in North Las Vegas. Because of rising launch costs, the company has decided to pass on another path finding vehicle and is proceeding to its Sundancer project, its first habitable spacecraft (Thomas 2007). Bigelow offered a \$50 million prize (America’s Space Prize) to the first U.S. team to build a vehicle that can successfully dock with the Bigelow Space Habitat and remain for six months. There were several other constraints for claiming the prize (Morring 2007). The competition expired on January 10, 2010 with no winner.

On April 10, 2007, Bigelow announced pricing information for prospective customers. For sovereign governments who want to use the inflatable orbiting modules as a training station for its astronauts, the price is \$14.95 million for four weeks of use and \$2.95 million for an additional four weeks. For companies desiring to conduct industrial research, the modules will lease for \$88 million per year for a full 350-cubic meter module. Half-modules could be leased for \$4.5 million per month. These prices were subsequently raised and such pricing information is clearly speculative. However, it reflected the company’s high degree of confidence in its ability to deliver. No prices were announced for the inflatable modules as “hotel” rooms (Morring 2007).

Orbital Outfitters

The primary goal of this company is “to develop and provide the highest quality, most advanced space suits and extreme environment survival equipment and systems for human use combined with end-to-end customer and wearer service.” Their initial target market is specified as sub-orbital commercial passenger flights (Thorpe 2003) and includes space pilots, crews, explorers, researchers, travelers, and workers. If and when the space tourism market gains traction, there will be a need for suitable garments that address the needs of spaceflight such as life support and safety. However, an operational spacesuit for sub-orbital flights is still in the development stage.

Some of the other companies

Blue Origins, the company created by Amazon.com founder Jeff Bezos, is developing a fully reusable launch vehicle with vertical takeoff and landing capability, also for suborbital space tourism (Maier 2006). It has made several test launches. The company, with Bezos as its chief spokesman, has indicated that it will try not to rush things so as to assure a safe and successful spacecraft.

Armadillo Aerospace is another company which is targeting the market for space tourism. The venture was founded by John Carmack, whose fortune was made on video games such as Doom and Quake. It is intent on developing computer-controlled liquid-oxygen rockets for launching people to over 300,000 feet where they can experience weightlessness (Maier 2006). Armadillo has partnered with Space Adventures for the purpose of sub-orbital spaceflights. Several original Space Adventures clients have signed on to travel on Armadillo spaceflights. The company is projecting such flights within two years.

SpaceDev, was founded in 1997 by Jim Benson, creator of Compusearch, one of the earliest successful computer search engines. After ten years with SpaceDev, Benson went on to found the Benson Space Company that was developing with SpaceDev a space vehicle, the Dream Chaser, for personal spaceflight missions (Thomas 2007). Benson died in October 2008 and the company was dissolved. SpaceDev continues in operation, largely in the business of producing various space technologies, rocket engines and the Dream Chaser space vehicle in four-passenger and six-passenger configurations. It is a public company which reported 2008 nine-month revenues of about \$28 million and net income of almost \$500, 000.

Also in the competitive mix for the development of suborbital launch vehicles is XCOR Aerospace, based in California. XCOR is focusing on reusable launch vehicles (RLV) aimed at carrying at least one ticketed passenger or other payload into sub-orbital space. Its entry into this market is called the Lynx.

Many of these companies and several others are members of the Commercial Spaceflight Federation (formerly Personal Spaceflight Federation). Details of each company's mission and activities can be found through links at www.commercialspaceflight.org, the federation's web site. Also at this site is the first survey of the industry that reports some very preliminary data with an unknown degree of reliability (Tauri Group 2008). Although this Tauri study is at best preliminary and not very current, it attempted to establish the economic potential of the industry.

ENTREPRENEURIAL INSIGHTS

An important characteristic that sets several of the NewSpace entrepreneurs apart from many others is that most have already been highly successful in prior ventures. These *highly successful entrepreneurs* bring to this emerging industry a great deal of experience garnered from their earlier ventures, many of which were part of the internet boom of the 1990s. They possess a fairly complete set of business skills often lacking in first-time entrepreneurs. They are less likely to be discouraged by unexpected negative developments and more likely to exhibit the motivation and patience necessary for success.

The private spaceflight industry is very *capital-intensive*. It cannot be a "shoestring" operation. In addition to sophisticated physical capital, the industry requires highly skilled and expensive human resources with both scientific and engineering backgrounds and aerospace experience. Because of their prior business ventures, these NewSpace entrepreneurs have substantial amounts of start-up capital available as well as the experience and networks that could bring in outside investors.

This is a very *high-risk* industry with no guarantee of success. There are formidable technical challenges to overcome. The financial capital requirements are very large. Consumer demand for space tourism is far from certain. Without question, there will be many company failures along the way and some personal fortunes depleted.

Finally, the industry time horizon must be *long-term*. Profitability in the short-term, say in 3-5 years, is highly unlikely. Timetables for launching the first private spaceflight tourists have already been pushed back several times. However, the recent success of SpaceX in its resupply mission to the International Space Station has generated a growing degree of optimism for commercial space operations.

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