

Recent Topics on Space Tourism

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Prologue

The situation of space tourism has changed dramatically in the last few years. In the U.S., vehicle development for space tourism has been driven by investment capital from other industrial areas, especially IT. Also, entrepreneurs, what is called New Space, whose space development for the next generation vehicles with unique and innovative methods, leads space tourism. They contribute not only R&D, but also work on policy and regulatory matters to realize space tourism. More than 70 New Space companies have joined the Space Frontier Foundation. After SpaceShipOne's successful flight up to the edge of space to win the X Prize, each New Space company's hot race has been continued toward the realization of space tourism as an industry.

New Investment Funds

As a characteristic phenomenon for the last five years, no space oriented funds nor no NASA budget, but instead pure private funds from other industrial fields have been pouring into the space area including space tourism firms. These include Paul Allen who invested \$20M with Scaled Composites Corporation, Jeff Bezos of Amazon.Com who established Blue Origin, John Carmack who made millions of dollars in the computer game industry, and Elon Musk who succeeded in IT industry, Richard Branson who established Virgin Galactic and bought the next generation SpaceShipTwo from Scaled Composites and so on. Also, Robert Bigelow, a highly successful U.S. hotel developer, established Bigelow Aerospace Corporation and he has invested \$500M over the next 15 years to build a space hotel on orbit. Though the space business is difficult to have profits generally speaking, space business is the last frontier of dreams and enthusiasm which charms investors even in other industrial fields.

There is a new direction in Japan, too. Takafumi Horie, CEO of Livedoor, has invested his private fund to start a space business named Japan Space Dream which will realize economical orbital space tourism by using existing Russian manned space capsules. Also, Daisuke Enomoto who plans to visit to the ISS as the fourth space tourist points out space tourism is getting to be a kind of PRODUCT. He talked with business sense that \$23M for an ISS space tourism flight is not expensive if commercial markets will be moved depending on his comments and endorsements after his space flight. Thus, space tourism is starting to become a field into which investors and venture capital will invest.

Regulatory Issues Which Enable the Realization of the Space Tourism Industry

Thus, the space tourism business can be said that it is accomplishing unique, innovative and challenging activities through the investment of private funds. In addition to the availability of funds, space tourism will be realized by deregulation which is the following wind for these activities.

On 23rd December, 2004, a legislation H.R.5382 was passed by the U.S. Congress and signed by President George Bush. This legislation is the Commercial Space Launch Amendments Act of 2004 which will make safety standards reasonable by taking the self risk method for passengers so that the space tourism industry will be able to grow and prosper. This is the legislation which will specifically promote the space tourism industry for the first time in the whole world. In February 2005 shortly after the legislation passed, FAA/AST published two drafts of guidelines for commercial space tourism, which are for space tourism passengers and flight crews. According to the guidelines, there is the fundamental understanding that space tourism operators should be providing informed consent, and should explain the risks of space tourism before the space flight and that space tourism should be done with the passenger's assumption of their own risk. These draft regulations are under review by specialists as well as the general public and they will be published officially at the end of June, 2006.

Furthermore, an Industry Consensus Standards Organization has been established in February 2005 to have common rules for the suborbital space tourism business which will be started within a few years by entrepreneurs leading New Space companies.

In addition to deregulation, there are other elements which are a following wind to New Space companies, which cultivate the way to space tourism. For example, each of the New Space projects has been downsizing compared to former big size of projects which can be realized only after accomplishment of expensive technology innovations. The hurdle has been lower than before because existing and possible technologies of the near future can be used initially. Furthermore, state and regional tax credits, prize systems and so on have increased the momentum of the development race toward space tourism.

Benefiting from these following winds, New Space firms are taking steps with good speed to build the next space age by flexible and simple organization with clear vision which will be realized in the very near future.

Exciting Development Stages of Each Space Tourism Company

SpaceShipOne, which had been developed by Burt Rutan who leads Scaled Composites, has been the most famous private space vehicle all over the world since it won the X Prize in October 2004. Scaled Composites is now developing SpaceShip2, called Enterprise, and its mother ship, Eve, for Virgin Galactic. Scaled Composites and Virgin announced the formation of the Spaceship Company in 2005 to produce these ships.

XCOR is well known for its excellent propulsion systems for space vehicles and has several contracts from NASA. It also received FAA approval of its Launch Operators License in May 2004 and has a contract with Space Adventure as a vehicle supplier. XERUS is horizontal takeoff and landing type of suborbital space plane which will be able to be built within 18 months if they will get funding.

Rocketplane is developing a suborbital space plane XP which is horizontal takeoff with 4 passengers including a pilot. XP will be in service for commercial passenger flights in the second half in 2007 after about 50 test flights which will be started the end of 2006. Furthermore, Rocketplane has concept of a next generation space plane, ALDER and beyond to provide low cost launch services for satellites and ISS cargo. The Oklahoma Spaceport which Rocketplane is an anchor tenant for is a huge retired Air Force base which has a 4.2 km main runway. Other infrastructure for space tourism such as FAA training facilities is located nearby.

The space vehicle of Armadillo Aerospace is very unique, which launches with a single stage vertical takeoff and a powered landing using its rocket engines. Their way of development is also unique, with rapid prototyping and lots of tests that have been repeated. That is to say that they regard it more important to repeat tests than run computer simulations. They have done more than 100 tests with more than ten different architectures changing in the last four years.

SpaceX is a company to supply cheap access to space. It was founded in 2003 and now it is close to completing its first commercial launch. Though Falcon I with one engine is for launching of small satellites, Falcon IV with 5 engines and more can launch either satellites or a manned vehicle with more than 5 people to low earth orbit (LEO).

t/Space is the only venture company which got a primary CEV contract from the U.S. new NASA Vision for Space Exploration. It has more than 12 New Space partner

companies such as Scaled Composites, CSI, Air Launch, and so on. The t/Space proposal for four people into LEO now is CXV which is the second stage space vehicle carried by a mother ship, and using a Quick Reach rocket booster, built by Air Launch. t/Space aims to realize orbital space tourism on a commercial basis after ISS logistics crew and cargo missions are successful.

Bigelow Aerospace has developed an inflatable space hotel by using the Transhab technologies which had been developed by NASA. A one third scale Genesis Module will be launched for testing twice in 2006 and later, the one half scale Guardian Module will be launched for test in 2007 and later, and the full scale prototype will be launched in 2010. The Space Hotel will be completed around 2010 to 2012. The approval for the test has already been received from FAA in 2004. The cost per night in the Space Hotel is \$1M and the whole package tour is \$7.9M. As for the transportation vehicle, Bigelow Aerospace has developed the America's Space Prize which is a \$50M prize for the first vehicle which can carry at least 5 people up to a 400km altitude where the Space Hotel will be constructed.

Expanding Markets for Space Tourism

So far, it seems for a small number of cases that customers have bought tickets for space tourism directly from the vehicle manufactures, but most of the customers have bought tickets for space flights at space tourism travel agents such as Space Adventure established in 1998, Incredible Adventures, and Virgin Galactic recently founded in 2004 and others.

In Japan, Club Tourism of Kinki Travel with Virgin Galactic and JTB Travel with Space Adventure have both concluded agreements to start to sell space tourism experience packages. These two biggest travel agents that have now entered the space tourism industry have started a fire in the public's eye so that the market for space tourism is becoming more active than before.

Though tickets for space tourism are sold in a normal way at travel agents the same as terrestrial travel, it is much different in price at \$100,000 to \$200,000 for suborbital flight, \$23M for ISS visit, and \$110M for a Moon trip. Most of the general public cannot buy such things even though they are eager to go to space. There is a certain small prestige market for the rich people who can buy tickets with their own money. However, it has limitations as a market.

Recently, there has been a dramatic increase in other ways that will be available for people to travel to space without the need to buy at their own expense. For example, various kinds of prizes which offer space tourism flights as promotional activities of companies, TV programs and so on. Dedicated internet games are now also being developed where people can pay a small entry fee for a chance to win a space flight in a tournament. These new ideas can meet the huge demand of space tourism for people who eager to go to space but cannot pay the full price themselves. There have been several promotional campaigns including Oracle and Volvo recently. This is one of the ways that space tourism will expand to become a mass market activity.

Epilogue

The circumstance of space tourism has changed drastically and dramatically in the last few years. This exciting status seems to be continued dashing until the realization of commercial space tourism and success in reducing current space transportation costs. This process will lead the path to develop SPS which should be the flagship project for solutions to Earth's environmental preservation by a commercial base. Electric power, regardless of how it is supplied, is provided by private companies and should be supplied by private companies from now on, too. Low cost space transportation and the LEO industrial infrastructure developed first for tourism and exploration applications can then be used to create an orbiting SPS infrastructure at a commercially viable price.