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Space Tourism – A New Field for Space Law

Derek Webber, Director, Spaceport Associates, Bethesda, MD

1. INTRODUCTION

Some aspects of space tourism have been in operation for almost two decades, since the first space tourist was arguably the Japanese journalist Toyohiro Akiyama who was launched into space in a Russian Soyuz craft in December 1990. However, until now, the number of paying commercial civilian space flights has remained low (still less than ten in total), and all of them have been conducted from launch sites abroad. A change is about to occur in these circumstances. Starting in 2009, space tourists will be launched into space from the US. And the quantities of travelers will thereafter be more significant, with up to 15,000 a year being given rides into space within the next two decades. This paper describes these developments, and discusses the legal framework that is being put in place to regulate this new industry by the Federal Aviation Authority (FAA). For the purposes of this paper, no distinction is made between alternative terms to describe the new developments, eg space tourism, public space travel, commercial aerospace passengers, space flight participants, etc., although there may well be minor regulatory implications of exact choice of nomenclature. In this paper, the terms space tourism and space tourist will be used throughout.

2. SPACE TOURISM MARKET SEGMENTS, SIZE and TIMING

There are two main market segments to be considered with regard to space tourism. For perhaps surprising yet historic reasons, the harder and more expensive sector developed first. This sector is known as *orbital space tourism*, and allows the passenger to circle the globe once every 90 minutes. Akiyama was an orbital space tourist. And he has been followed by the following orbital space tourists - Helen Sharman (UK), Denis Tito (US), Mark Shuttleworth (South African), Greg Olsen (US), Anousheh Ansari (US/Iranian), Charles Simonyi (US). In each case, the ride cost around $20M and involved a trip of about two weeks at an orbiting space station (originally to MIR, then later to the International Space Station, ISS).

The second major segment of space tourism is called *sub-orbital tourism*. These sub-orbital trips will be much shorter, only allowing about 5 minutes in space at the topmost point of a parabolic lob, but will be significantly less expensive, at around $100K. This much lower cost is the main reason that the projections of numbers of travelers reach up to 15,000 per year. The sub-orbital space tourism industry has not yet started, but it is anticipated that the first flights will take place in 2009, from Mojave, California.

Over the next decades, there will be more sophisticated space tourism opportunities, some involving trips around the Moon (indeed one such trip has already been advertised by a major player in this industry), and eventually staying on the lunar surface in a Moon hotel. Reference 4 gives a good overview of the likely pace of developments in the space tourism business.

How big are these markets, and consequently how many people will be subject to the new regulations? And how do we know that people both want, and can afford to take, these expensive trips? Indeed does this sector have any significance beyond being merely a rich person's plaything? A series of studies, starting around 2002, have addressed these questions. NASA, in 2002, was concerned about the eventual demise of the Space Shuttle, and wanted to know how to design its successor. How many and what cargos would it need to carry? The ASCENT Study (Ref 1) was commissioned, and the findings were that there was no expectation of an increase in global launch requirements for traditional (eg satcoms) payloads over a twenty year horizon, even with a major price reduction for launches. The total global number would remain between 60 and 80 launches per year for the foreseeable future. However, the study found that "human payloads" in the form of space tourists could dramatically change the picture, particularly since they were indeed price sensitive. The Futron/Zogby Survey (Ref 2) explored this phenomenon by interviewing a statistically valid sample of millionaires, and the findings were dramatic. It turns out that **there are enough rich people in the world, and their interest in flying into space is so high, that a prediction of 15,000 a year *sub-orbital* flights could be made (at a $100K price), and up to 50/year *orbital* flights (at $20M)**. The implication of these findings for the wider picture is that such numbers make the economics of a new class of launch vehicle, the Reusable Launch Vehicle (RLV), viable. Therefore, **developing RLV's for the space tourism markets will have ramifications for all other space launches, and will usher in an era when getting into space becomes more akin to the airline business. Reliability and launch readiness will improve.**

More detail about the expectations of the future space tourists is included in the Adventurers' Survey (Ref 3). Some of these factors will have regulatory implications, discussed later. In that survey, we find that the future tourists have distinct preferences about the way they want to get into space, about the way they want to return from space, about the duration of their stay at space hotels, and about training, amongst many other factors. The training aspect is one such area of regulatory involvement, and is addressed in Ref 5 and 6, where it is pointed out that up to now, *orbital* space tourists have needed at least 6 months of training before their flights, and that this period will need to be reduced if the full market potential is to be realized. For the upcoming *sub-orbital* space tourism flights, the training period is liable to be reduced to about three days. Another important consideration that is still to be determined and regulated is the medical screening requirement for potential passengers of space flights. Even the sub-orbital flights will involve periods of alternating high-g and weightlessness that might be problematic for persons with some kinds of medical condition. Entrepreneurial companies are emerging to address the likely future training and medical screening needs of space tourism.

What is the likely **time-frame** of the industry developments? Orbital tourism, using Russian vehicles, already exists, and will continue. Unfortunately the flight opportunities are very limited, because the Soyuz vehicles are needed to take astronauts (soon to include US astronauts) up to the International Space Station (ISS). Only an occasional spare seat is made available for the waiting list of billionaires to occupy (note that there are about 1,000 billionaires, in the world today, and 10 million millionaires). It may take some time for a US alternative vehicle to be developed to replace the Soyuz for orbital space tourism. Some possibilities are discussed in Section 3 below, but for our purposes it seems **unlikely that *orbital* space tourism numbers will increase beyond around about 1 per year before about 2015, due to the supply constraints**. This will have implications for some developers of space hotels. There is an entirely different story with

regards to *sub-orbital* space tourism, however. In the year 2004, a competition called the Ansari X-Prize took place. $10M was awarded to the company that was first able to launch a civilian above 100,000km, and repeat the feat within two weeks. Scaled Composites' SpaceShipOne, designed by Burt Rutan, was successful, and thus made possible the new sub-orbital space tourism industry. Several operators (see Section 3 below) are now at various stages of developing spacecraft to offer the experience, and it is **expected that the first sub-orbital space tourists will start flying from Mojave, in California, in 2009.**

3. DOMESTIC AND INTERNATIONAL OPERATORS

Some space tourism travel agencies have emerged, and are already operating successfully. Both *Space Adventures* and *Incredible Adventures* offer space tourism packages, starting with some basic Zero-g flights and covering everything up to the Russian orbital Soyuz experience.

In the realm of *sub-orbital* space tourism, the following firms are developing offerings: *Virgin Galactic* has licensed Burt Rutan's X-Prize technology and is having a fleet of SpaceShipTwo craft manufactured by Scaled Composites in Mojave, CA. Virgin Galactic intends to start operations in 2009 from Mojave and subsequently move to a new spaceport to be constructed in New Mexico. The spacecraft takes off horizontally slung underneath a mother plane which takes it to 40,000 feet before it ignites its rocket motor for the flight into space. It lands as a glider. The company *Rocketplane* is developing a different kind of vehicle, which looks like a corporate jet. It takes off using conventional jet engines, then switches to rocket motors for the vertical flight into space, landing again horizontally under normal jet engines. Rocketplane will fly from Oklahoma. Other sub-orbital offerings are being proposed by *XCOR* (US), *Benson Space* (US), *Starchaser* (UK), *Blue Origin* (US), *PlanetSpace* (US), and *EADS/Astrium* (UK), amongst others.

For *orbital* space tourism, the technological task is much greater, and so the developers need to find much more funding. Several of them are trying to fund their operation using the NASA COTS contract system, designed to provide for transportation to the ISS once the Shuttle is no longer flying after 2010. The idea is to use the craft to fly US astronauts and cargo to the ISS, and to use the spare seats for orbital space tourism when it is not needed by NASA. At present, *SpaceX* (US) is developing its Dragon capsule to go into space via its Falcon 9 rocket. The Falcon 1 rocket has already demonstrated partial success. SpaceX is working on a schedule to demonstrate its abilities to NASA to deliver cargo and/or passengers to the ISS by September 2009. *Kistler (US)* is struggling financially to do the same thing as SpaceX with its Kistler 1 reusable launch vehicle. Others waiting in the wings for the remaining COTS funds include *CSI (US), t/Space (US), Planetspace (US), Armadillo (US),* as well as *Blue Origin* (from the sub-orbital sector). An unusual offering in this sector is *Bigelow (US),* who offers an orbiting space hotel and/or space station as a destination for the orbital space tourists. Bigelow has already successfully placed in orbit two prototype scaled-down space hotels.

Several training firms are already being established, in anticipation of regulation, and *Zero-G Corporation,* for example, offers a very successful parabolic jet experience. *Wyle Labs* is ready to offer the space tourism medical screening that may be required by regulation.

4. SPACEPORTS

Traditional spaceports, such as Cape Canaveral, White Sands, and Wallops, are generally military establishments. The new industry of space tourism will call for a more customer-friendly environment. Friends and families of space tourists will want to be present during training and launch activities, and will want to be entertained. Ref 8 addresses this point, providing lists of the kind of features that will be needed in a spaceport to help make this industry successful. Furthermore, the technologies of the vehicles themselves have advanced to the point where they are much safer than the traditional launch vehicle. Fuel and oxidizer in the SpaceShipOne craft consisted of rubber and laughing gas, for instance. The Regulatory authority for approving the new spaceports, and protecting the general public from their operation, is the FAA, under a regime described in Section 6.

Mojave was the first of this new breed of spaceport approved by the FAA. It is basically an ordinary airport with remote areas for rocket engine test. Virgin Galactic intends to start its operations there, and will be starting its test flights of SpaceShipTwo from there during 2008. **Oklahoma** Spaceport was the second such converted airport to obtain a spaceport license, and is the chosen base of the Rocketplane team. But the first spaceport to be designed and built from scratch to serve the needs of the new space tourism industry in the **New Mexico** facility known as Spaceport America. Virgin Galactic will move there, once the spaceport and its infrastructure has been completed.

5. RISK

As indicated above, technology developments have enabled a much safer form of spaceflight than was the case for early government astronauts. However, spaceflight is always going to be a relatively risky endeavor. Indeed that is one of its attractions for at least some of the potential space tourists. Adventure tourists these days regularly undertake risky endeavors such as mountain climbing, skydiving and shark watching. Ref 7 addresses the risk question, with the implications for insurance availability. Clearly, risk is a matter that is also a consideration for potential investors in space tourism operator companies. We shall see below that the government has decided that its own responsibility is limited to ensuring the safety of the **uninvolved** public.

6. OUTLINE OF REGULATORY FRAMEWORK

Some aspects of space tourism come under the auspices of international law. Some come under US law, with the FAA Office of Commercial Space Transportation (FAA-AST) as the main legislator (although the provisions of ITAR apply, of course). And some aspects will depend upon state law. FAA-AST has created the COMSTAC body (Commercial Space Transportation Advisory Committee) to provide non-governmental guidance on all aspects of commercial space operations. That body has itself created several working groups, including the Launch Operations Support Working Group (LOSWG) and the Reusable Launch Vehicles Working Group (RLVWG) to provide specialized guidance and regulatory language. Ref 9 provides a good discussion on relevant space law, particularly with regard to the international regulatory regime, and Ref 10 provides a commentary on the effectiveness of the Outer Space Treaty, 40 years after its inception.

At the level of International Law, the following considerations apply:

- 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (The Outer Space Treaty). It is essentially a "wilderness preservation" statute for the entire universe, and this Treaty has been signed by the US.

- 1968 Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space (Rescue of Astronauts Agreement). This will clearly be applicable when an orbital spaceflight has to make an emergency landing outside the territory of the launching state.

- 1972 Convention on International Liability for Damage Caused by Space Objects (Liability Convention). The Convention has a procedure for claims to be made on a country-to-country basis on behalf of victims of damage caused by space objects, but it is not clear if this covers every aspect of space tourism. There will be legal responsibilities under private national law, but these will vary depending on which country is involved.

- 1975 Convention on Registration of Objects Launched into Outer Space (Registration Convention). Not clear how this will apply for regularly scheduled sub-orbital space tourism flights.

- 1979 Treaty Governing the Activities of States on the Moon and Other Celestial Bodies (the Moon Treaty). The treaty continues such concepts as "common heritage of mankind" which would prevent exploitation of the Moon for its mineral wealth and any other private purposes. When space tourism extends to the Moon, and asteroids, then this Treaty would apply; but the US has *not* signed.

- 1994 Law of the Sea Treaty (LoST) – could have some implications for the space tourism industry in the long term. Although President Clinton signed it, the Treaty was never agreed by the Senate. The Russian Federation has recently claimed land under the North Pole under its provisions.

At the Federal level, the following relevant laws and regulations have been enacted:

- ITAR. This law, intended to regulate international traffic in armaments, has applicability in the space tourism business, because it is global in nature. Its operation has been alternatively the responsibility of both State and Commerce, and problems persist in its operation. For example, the UK owners of Virgin Galactic are not allowed to see some details of the design of the spacecraft they are buying from the US company Scaled Composites. It may also prove to be a problem for non-US space tourists being allowed to get access to the same information, required by regulation to be provided to potential space tourists in order to assess the risks of the venture on which they are about to embark for the price of about $100K.

- 1984 Commercial Space Launch Act

  The purpose of this law was to make possible private rocket launches, such as Conestoga, and more recently Falcon 1, within the US. Under its provisions, a RLV launch license was approved, for SpaceShipOne, in April 2004, in order that it could be flown above Mojave and enter into space.

- Dec 2004 Commercial Space Launch Amendments Act (CSLAA)

  This new law made possible the space tourism industry, by making clear that government responsibility was limited to protection of the uninvolved general public, the requirement that space tourists need to be "fully informed" of the risks they are about to undertake, and that they indemnify the government financially in the event of any misadventure. New operators are currently exploring what "fully informed" implies, and some have indicated that they may even introduce a written comprehension test before asking tourists to sign the waiver form. An industry forum The Personal Spaceflight Federation has been established to try to achieve consensus, and to represent the interests of the space tourism companies in regulatory matters. A series of *Guidelines* have been introduced by the FAA-AST, in Feb 2005 (for both crew and passengers) and May 2005 (for RLV operations and maintenance). In December 2005, a *Proposed Rule* was announced for Crew and Passengers, and in January 2006 guidance was issued on medical screening for space tourists. The *Final Rule* on Requirements for Crew and Passengers was issued December 2006, and became effective June 5 2007. The rule contains limited requirements on training for sub-orbital flights, mainly the need to be trained for emergency situations, smoke, fire, depressurization, emergency exits, etc. It also includes a strict rule (imposed by the Security interests) about not boarding with explosives, firearms, knives, etc. In the Final Rule, the only medical requirements are for the crew to carry an FAA second-class airman medical certificate. Nothing is in the rule about medical requirements for passengers.

- June 2007 RLV Experimental Permits

  This regime was introduced to streamline the legislative paperwork required during the test and demonstration phase of creating spacecraft for the new industry. Under this regime, multiple flights may be flown without the need for separate notification, provided that certain safeguards are met (such as flying in a designated safety zone operating area, performing a hazard analysis, tracking anomalies, providing a CONOPS, a flight test plan, and a crew training plan, as well as a mishap response plan). The Final Rule for the Experimental Permits was issued December 2006, and it became effective June 2007. The first Permits were granted to Blue Origin and Armadillo. It is expected to be a valuable means to enable training of crews to take place. Permits are valid for 1 year, renewable. No revenue generation is permitted under the Permit regime.

- Launch Site Operators' Licenses

  The first such license was granted to Mojave, CA in June 2004, followed by a license for Oklahoma Spaceport in June 2006. To obtain licenses, (which took 6 years in the case of Oklahoma to obtain) it is necessary to provide Environmental Reviews (including public hearings), a System Safety Process, including Expected Casualty Analysis, a Quantitative Risk Analysis, and full Operating Requirements (including Air Traffic agreements, explosives siting, accident plan, launch site boundaries, flight corridors, and control of public access, etc.).

At the state level, the main considerations are related to tax laws enabling spaceports and their enterprise zones, and to the applicability of various insurance waivers. Oklahoma Spaceport, for example, was created in parallel with a tax exemption funding measure that enabled Rocketplane to be established within the state, providing employment and other advantages to the state. Virginia has just passed legislation that allowed insurance waivers to apply for space tourism ventures in the state.

7. CONCLUSION

Change is about to make itself felt in the new industry of space tourism, as sub-orbital spaceflights begin to be launched from US soil in around 2009. The basic legal regime is in place, but there are a number of regulatory issues that will still need to be addressed as the industry develops.

Space tourism is a new industry which taps into something of the pioneer spirit that went into creating this country. It is a potential multi-billion dollar industry, with positive benefits in terms of employment opportunities particularly in some of the less well-served and relatively deserted regions of the US, yet with some risk attached. If successful, the industry will co-incidentally transform the technology, and the cost and reliability, of getting into space. And this last fact will ultimately bring benefits to all mankind. The wealth of the few will eventually make possible benefits for the many, just as was the case with the early years of aviation.

This represents a new field where space lawyers can contribute their expertise to help bring about the birth of the new space tourism business.

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9. CONTACT INFORMATION

Several of the above documents are available for download from the web site of the author:

Derek Webber, Director
Spaceport Associates
5909 Rolston Road
Bethesda, MD 20817

DWspace@aol.com
www.SpaceportAssociates.com