Commercial Space

Indicator Description

This indicator assesses trends and development in the commercial space sector, including the *builders and users of space hardware such as rockets and satellite components, and space information technologies such as telecommunications, data relay, remote sensing, and imaging.* It also examines the *space insurance sector*, which underwrites the space industry for the inherent risks and liabilities associated with space systems operations.

Key Trends

TREND 4.1: Continued overall growth in the global commercial space industry – Commercial spending dominates the space industry: in 2005 it accounted for $110-billion of the $180-billion in worldwide space turnover.[1] This is a significant increase from 1980, when the commercial space sector, including manufacturing, launch services, space products, and operating insurance, accounted for an estimated $2.1-billion in revenues. This growth is being driven by the satellite services industry, including telecommunications, which accounted for 60 percent of 2003 commercial space revenues in spite of some decline within the manufacturing and launch sectors. Major commercial satellite telecommunications companies today include PanAmSat, Loral, SES Americom, Intelsat, and News Corporation.

TREND 4.2: Declining commercial launch costs support increased commercial access to space – Commercial space launches now account for about one-third of the 60 to 70 annual space launches. The costs to launch a satellite into GEO have declined from an average of about $40,000/kilogram in 1990 to $26,000/kilogram in 2000, with prices still falling. In 2000, payloads could be placed into LEO for as little as $5,000/kilogram. Russian and European space launch enterprises are the most active space launch providers. Today's top commercial launch providers include Lockheed Martin and Boeing Launch Services in the US, Arianespace in Europe, Energia in Russia, and two international consortia — Sea Launch and International Launch Service. With the launch of Mojave Aerospace Ventures' SpaceShipOne in 2004, the private sector entered the suborbital manned spaceflight sector. This is predicated on the potentially very large emerging market of space tourism. Cheaper space access has also been key to the growth of high-resolution commercial satellite imagery.

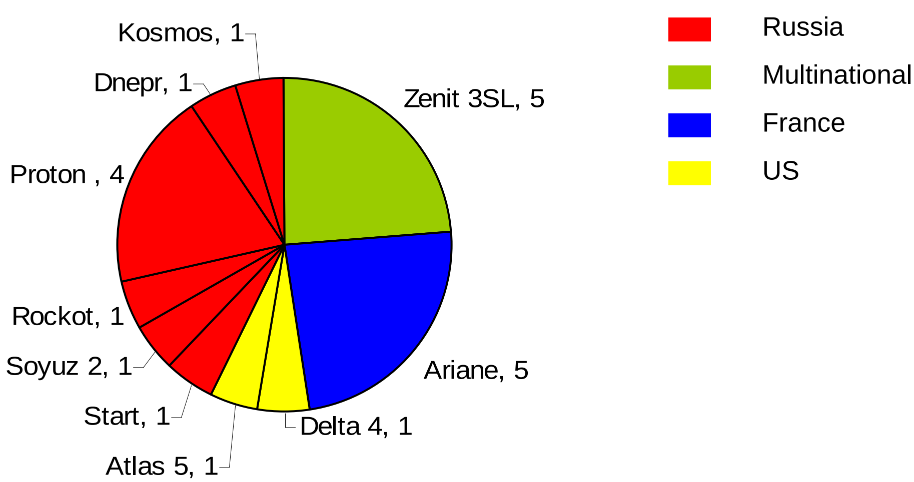
TREND 4.3: Government subsidies and national security concerns continue to play an important role in the commercial space sector – Space industry in some states relies heavily on government space spending: this is particularly true in the US and to a lesser extent the EU and Russia. The 1998 US Space Launch Cost Reduction Act and the 2003 European Guaranteed Access to Space program provide for significant government subsidization of the space launch and manufacturing markets, including insurance costs. In 1999, the US placed satellite export licensing on the State Department's US Munitions List, bringing satellite product export licensing under the International Traffic in Arms Regulations (ITAR) regime and significantly complicating the way US companies participate in international collaborative satellite launch and manufacturing ventures. Ironically, ITAR has encouraged actors outside the regime to develop space systems using components that are restricted by the regime itself.

2006 Developments

TREND 4.1: Continued overall growth in global commercial space industry

2006: Growth in commercial space industry largely driven by expanding consumer base – Overall growth in the global commercial space industry continued in 2005. Demand for commercial space transportation services which is directly linked to activities in the global satellite market, increased in 2006.[2] Of the 63 successful orbital launches in 2006, 21 were commercial launches,[3] greater than in 2005 when 17 of 55 launches were commercial.[4] Russia continued to lead the industry with 5 successful launches split between the Proton and Dnepr vehicles followed by Europe with 8 Ariane launches, there were 4 launches by international consortia and one by the US (see Figure 1).[5] An annual average of 23.6 commercial orbital launches is predicted for the period 2006 to 2015, with the majority going to geostationary orbit.[6] While government payloads still account for the majority of launch revenues, the proportion of commercial launches and associated revenues is increasing.[7]

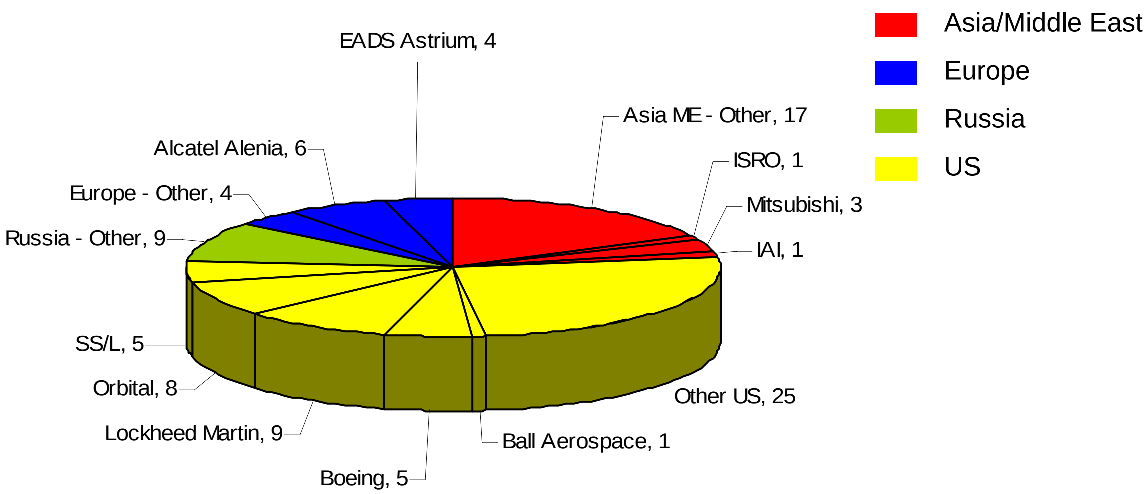
FIGURE 1: Commercial launches in 2006 by launch vehicle[8]



The satellite industry is currently in a period of growth but it has not yet recovered to levels experienced during the boom of the 1990s.[9] Satellite services account for more than 60 percent of total satellite industry revenues and is steadily increasing.[10] Individual consumers represent a significant portion of this growth. Demand for Direct Broadcast Services (DBS) drives the majority of revenue for satellite services, followed by Fixed Satellite Services for communications and broadcasts (FSS) and Mobile Satellite Services (MSS).[11] Revenue in the ground equipment sector is also increasing, largely due to the strength of sales of end user equipment, particularly for consumer services such as satellite radio and direct TV.[12]

Increasing satellite launches and a growing satellite services sector directly impacts the manufacturing industry. US satellite manufacturers dominated the industry in 2006, having manufactured 59 percent of all satellites launched in 2005, followed by Asian companies at 24 percent (see Figure 2). The five major manufacturers of commercial communications satellites are Alcatel Alenia Space, Boeing Satellite Systems, EADS Astrium, Lockheed Martin, and Space Systems/Loral, with newcomers NPO Prikladnoy Mekhaniki (Russia); the Indian Space Research Organization (ISRO) is expected to make an impact in the future.[13] In 2006 Alcatel Alenia Space became the world's leading satellite manufacturer based on orders; the company signed contracts to construct 57 new satellites.[14]

FIGURE 2: Manufacturers of satellites launched in 2006[15]



Growth in the commercial space industry is projected to continue, with satellite communications leading the way.[16] Alcatel Alenia's growth is mirrored by the industry as a whole, which is rebounding from lows earlier in the decade. Growth is due to new services such as high definition television, a decrease in oversupply with corresponding price increases, and a growing replacement market that is expected to generate 15 satellite orders per year beginning in 2006.[17] The strength of the industry is further demonstrated by the fact that September 2006 available financing had already surpassed the total for 2005.[18]

The commercial remote sensing sector is also expanding due to new market opportunities.[19] Governments world-wide constitute the major source of demand for remote sensing services, and private companies are responding to the supply gap.[20] New markets are also emerging as more civil and commercial applications are introduced.[21] Following 2005 deals between Google and DigitalGlobe, and Microsoft and Orbimage Inc., to create Internet mapping portals, Yahoo signed a deal with GeoEye (Orbimage Inc. and Space Imaging) in 2006 to acquire remote sensing imaging for its MapQuest program.[22]

2006: Continued privatization and consolidation in commercial sector; industry growth could lead to increased competition

Privatization and consolidation continued in the commercial space sector in 2006. Private equity firms now hold "controlling stakes and other significant equity positions in some of the largest satellite operators in the world," and consolidation among satellite operators "is occurring as operators are seeking complementary markets and services to offer global solutions."[23] An overview of major industry consolidations in 2006 is available in Figure 3.

FIGURE 3: Major space industry consolidations in 2006[24]

Sector	Companies	Activity	New Company	Value
Remote sensing	Orbimage and Space Imaging	Acquisition	GeoEye	$58.5 million
Communications	SES Global and New Skies Satellites	Acquisition	SES Global	$1.2 billion
Communications	Intelsat and PanAmSat	Acquisition	Intelsat	$3.42 billion
Communications	Alcatel and Lucent	Acquisition	Alcatel-Lucent	$11 billion
Launch	Rocketplane, Ltd. And Kistler Aerospace Corporation	Merger	Rocketplane-Kistler	N/A
Launch	Boeing and Lockheed Martin	Joint Venture	United Launch Alliance	$530.7 million

These consolidations have changed the layout of the space industry: GeoEye is now one of only two US satellite remote sensing companies, along with DigitalGlobe; [25] Intelsat is now the world's largest FSS provider with a fleet of 51 satellites;[26] and the United Launch Alliance consolidates US government launches on the Delta and Atlas vehicles under one company. [27] It is not yet clear what affect these developments will have on overall worldwide industry demand.[28]

In a break with the trend of consolidations Lockheed Martin finalized the sale of its interests in International Launch Services, Inc. (ILS) and Lockheed Khrunichev Energia International, Inc. (LKEI) to Space Transport, Inc., in October 2006. This brings to an end to the cooperative arrangement between the companies for the joint sales, marketing and launch support of Lockheed's Atlas and Khrunichev's Proton and Angara launchers.[29] The former allies will now compete in the commercial launch market, with Lockheed marketing and selling commercial launch services through Lockheed Martin Commercial Launch Services, Inc. and ILS continuing to market and sell the Angara and Proton launchers.[30]

Net Assessment

Continued growth in the commercial space sector, particularly the growing customer base for consumer goods and services, underlined the sector's collective benefits from space security. Growing demand for commercial space goods and services is increasing the number of stakeholders with a vested interest in the safe and secure access to and use of space, which should bode well for continued space security. Growing demand may create future tensions as competition for limited orbital slots and frequency allocations increases. Further consolidation of the space industry may provide greater space security if more efficient operations can be translated into more efficient orbital and frequency use, and a decrease in the cost of access to space. Less competition may restrict future prices decreases, though.

TREND 4.2: Declining commercial launch costs support increased commercial access to space

2006: New activity in the space tourism industry

On 18 September 2006 Anousheh Ansari became the fourth space tourist when she visited the International Space Station on board a Russian Soyuz capsule at a cost of $20-million.[31] The potential of space tourism as an industry is increasingly being recognized. In 2006 the *California Space Enterprise Strategic Plan 2007-2010* noted that suborbital space tourism is an estimated $1 billion worldwide market and that, at present, about $100 million a year is "being invested by space tourism-oriented companies."[32]

The space tourism industry received a boost from several new initiatives in 2006. On 20 July 2006 the ESA, under the auspices of its General Studies Programme, announced the "Survey of European Privately-funded Vehicles for Commercial Human Spaceflight," initiative to support the emergence of a European space tourism industry.[33] Bigelow Aerospace launched its Genesis I inflatable module prototype to LEO; Genesis II is scheduled for launch in 2007 to be followed by the launch of a module rated for human habitation in 2009 or 2010.[34] To date, Bigelow has spent over $75-million working toward the development of human-habitable modules, which are seen as being the possible first step toward orbital space tourism.[35] On 21 September 2006 Bigelow Aerospace and Lockheed Martin announced a partnership to study whether Lockheed's Atlas V booster could be rated for human launch, enabling it to deliver people to Bigelow's planned space habitats.[36] Further indicating the potential gains from private human space flight, NASA and the X-Prize Foundation signed a Space Act Agreement under which the X-Prize Foundation "will administer and execute the competitions…with NASA providing prize funding to the winning contestants."[37] The $2.5 million in prize money went unclaimed in 2006, however, as no entrant was able to fulfill the required conditions.[38]

The 2006 Wirefly X PRIZE Cup was held on October 20-21 in Las Cruces, NM, USA and represented the latest effort by the X PRIZE Foundation to continue encouraging innovation in the private sector. This Cup focused on rocketry and lunar landing technology, offering the aforementioned $2.5 million prize to teams competing in several distinct competitions related to the general theme. The exposition also featured high-powered rocket launches and exhibits intended to boost public interest in aerospace technology.

2006: Public and private financial backing for commercial space ventures

More money is becoming available for commercial space ventures from both public and private sources. While many commercial space 'start-ups' are being financed by wealthy entrepreneurs, they are receiving increasing interest from venture capitalists and bankers as well as from public institutions.[39] NASA's Commercial Orbital Transportation Services (COTS) program was initiated in response to the US Space Policy which requires the promotion of commercial participation in space, as well as the 2005 NASA Authorization Act, which directs it to advance space commerce.[40] On 18 August 2006 NASA selected two companies to share $500-million available in financing through the Commercial Orbital Transportation Services (COTS) program to promote commercial participation in space.[41]

Space Exploration Technologies (SpaceX), which will receive $278-million, and Rocketplane-Kistler (RpK), which will receive $207-million, both signed Space Act agreements "to develop and demonstrate the vehicles, systems, and operations needed to support a human facility such as ISS."[42] NASA has also entered the venture capital business in order to provide funding to commercial space ventures. Red Planet Capital is created and financed by NASA to provide public money to emerging private companies developing technologies of interest to NASA, which would not otherwise do business with the government.[43] Red Planet Capital will receive $75-million of funding per year over the next five years, and will invest up to a total of $5 million per company over several rounds of financing.[44] It may also invest jointly with other venture capitalists.

Several planned international spaceports are being backed by both government and private sources. Virgin Galactic made a deal with New Mexico to develop a spaceport near Las Cruces to support its American space tourism business, and may base its European tourism business in Sweden and/or Scotland.[45] Virgin Galactic is manufacturing its first commercial space vehicles through the Spaceship Company, a joint venture with Scaled Composites, based in Mojave, CA, USA. In the US New Mexico announced that it will contribute $110 million over a three year period toward the development of the Southwest Regional Spaceport, which Virgin Galactic will use as its U.S. base of operations.[46] The Southwest Regional Spaceport is expecting to receive its FAA licence in 2007.[47] Space Adventures has announced that it will develop commercial suborbital spaceports in Singapore and the United Arab Emirates as part of a $265-million global spaceport development project with funding from local industry and governments.[48]

On 12 June 2006 the Oklahoma Space Industry Development Authority was issued a license to operate a commercial spaceport at the Clinton-Sherman Industrial Airpark and a corridor within the national airspace has been labelled for spaceport operations.[49] In November 2006, Blue Origin conducted a test launch, from its privately owned Texas spaceport.[50] The spaceport owned and financed by Blue Origin founder Jeff Bezos, is the first private spaceport on private property.[51] Meanwhile, California is considering a bill which would provide an $11 million loan to the Mojav spaceport to build improved facilities for the growing space tourism industry to prevent businesses from being lured to spaceports in other states.[52]

NASA and the FAA are considering the possibility of allowing space tourism and commercial launch companies to use the Kennedy Space Center Space Shuttle runway after the Shuttle is retired.[53] NASA has asked the companies for data on their runway compatible vehicles and will analyze it in connection with the FAA environmental impact regulations for horizontally launched vehicles.[54] By taking this initiative NASA hopes to facilitate commercial companies to fulfill the legal requirements for launch.[55]

2006: Falcon-1 launch failure

The first Falcon-1 launch attempt was made by the California based SpaceX on the 24 March 2006 form the Kwajalein Atoll in the Pacific. It failed 25 seconds into launch. Falcon-1 aims to commercial launch services. With a current estimated launch price of just $6.7-

million, Falcon-1 could substantially reduce the launch cost compared to other US-based companies if it succeeds.

2006: Space and launch insurance market softening

The FAA Office of Space Transportation released a special report on commercial space and launch insurance in its Quarterly Launch Report for the 2nd quarter of 2006.[56] Space and launch insurance continues to be a volatile market, due to "the high risk nature of launch vehicle activities and the concentration of risk in a short period of time."[57] In 2006 the market continued to soften, bringing increases in underwriter investment and industry profits, and declines in insurance rates, although increases in market capacity are expected to be modest for the next few years.[58] Launch premium rates are approximately twenty percent, depending on launch risk and market conditions.[59] On-orbit insurance rates, which charge yearly, presently average between two and four percent.[60] Underwriter profits for 2006 are expected to be around $500 million.[61] However, the insurance industry remains small meaning that only a few "major failures could easily consume underwriter profits."[62] Commercial human spaceflight insurance remains an emerging sector of the market.[63]

2006: US government regulations to support the commercial space industry

As the trend toward increased commercial access to space continues, government regulations are increasing to support the viability of the industry. In October 2006 the U.S. Government Accountability Office (GAO) issued a report on commercial space launch safety.[64] The report focuses on the existing FAA oversight of commercial space transportation safety and illuminates challenges that may arise in the future, such as a potential conflict of interest between the FAA's dual safety and promotion roles, the need to make sure resources are adequate to support increased space tourism launches, and the need to develop safety standards that could be implemented before 2012.[65] The report also examines key competitive issues facing the U.S. commercial space industry, such as high launch costs and export regulations; notes the ways in which the government has tried to alleviate these problems; and makes suggestions to improve the export control system.[66] The report includes an overview of the responsibilities of various federal agencies with respect to commercial space activities, including those that have a responsibility to promote the industry.[67] US competitiveness in the international launch market has been a concern in recent years as it has lost market share to Russia and Europe (see Trend 4.1).

The FAA/AST commissioned the Aerospace Corporation to perform a comprehensive study of the US commercial space transportation liability risk-sharing regime aimed at protecting US competitiveness in the industry.[68] Industry claims that the liability risk-sharing regime should not be phased out because the rationale for the regime is based on the hazardous nature of the space industry rather than it being a "nascent industry;" and because it is essential for US commercial competitiveness.[69] The study determined that "it is clear that the executive and legislative branches have consistently viewed the success of the U.S. commercial launch industry as beneficial to national interests," suggesting that it is something that deserves some element of governmental protection.[70] Furthermore, the study concludes that "U.S. companies are not 'holding their own' in the market," noting that regardless of the indemnification issue, "the statutory goal of an internationally competitive U.S. industry . . . is not being met."[71] The insurance industry also believes that the risk-sharing regime should remain in place, as it has become an industry standard, and they question the ability of the insurance industry to fill the coverage gap that would be left if risk-sharing were eliminated.[72] Further, emerging technologies and increasing commercial uses of space increase both the number of entities that must be insured as well as the probability that a major claim will occur that could disrupt the liability insurance market.[73]

In October 2006 the FAA/AST released its *FY-2006 Research and Development Accomplishments* report designed to promote safety in commercial spaceflight.[74] Among the accomplishments was the completion of a project studying commercial human spaceflight biomedical data. As existing U.S. legislation requires that spaceflight participants be informed about the risks associate with spaceflight, the FAA/AST undertook the project to better understand the effects of short term exposure to microgravity on the human body.[75]

In a related development, the FAA/AST issued new regulations governing private human spaceflight requirements for crew and spaceflight participants.[76] Launch vehicle operators are required to provide passengers with safety-related information, including disclosing what the operator itself is required to do to conduct a licensed launch with a human on board.[77] Operators must also inform passengers of the general risks of space travel and the specific risks associated with the operator's particular vehicle.[78] Participants are required to receive general and security-specific training.[79]

With respect to the safety impact of computer and software systems, in July 2006 the FAA/AST released a document entitled *Guide to Reusable Launch and Reentry Vehicle Software and Computing System Safety*.[80] The Guide is designed to aid operators "in producing safe, reliable launch vehicles through the application of a systematic and logical process for identification, analysis, and control of software and computing system safety hazards and risks."[81] The Guide, which contains significant amounts of technical material, identifies areas in which safety could be impacted by computing and software systems, offers suggestions for risk mitigation, and lists software safety requirements.[82] The Guide also contains a section listing and discussing incidents involving spacecraft and aircraft which were attributed to software or computer error.[83]

In August 2006 the FAA/AST issued final rules concerning safety aspects of commercial space transportation, adding procedures for obtaining approval for a safety element and for including a safety approval in a license application.[84] It will now be possible for launch vehicle designers and operators to obtain approved safety elements from third parties for use in their launch vehicles; the operators will no longer have to obtain safety approvals themselves prior to each launch.[85] Operators will be able to include the safety approval in their license applications, thus reducing the overall amount of paperwork required for a license.[86]

Net Assessment

The development of a legislative regime in the US pertaining to liability, safety and financing combined with growing investment in the commercial space industry and more accessible insurance options are creating stronger market conditions for emerging entrepreneurial space travel. The eventual entry of new commercial launchers into both orbital and suborbital space may be a positive development for space security, increasing the competition necessary to decrease prices and the number of stakeholders with interests in secure, direct access to space. On the other hand, this may to reduce space security by increasing demand on limited space resources.

TREND 4.3: Government subsidies and national security concerns continue to play an important role in the commercial space sector

2006: National security places constraints on the commercial space market

In 2006 national security concerns placed constraints on commercial providers of satellite imagery. In response to detailed satellite images of what the Indian government referred to as strategic locations were made available on Google Earth, the company was asked to mask or blur sensitive images. Other countries have made similar requests, including Australia, Russia, South Korea and Thailand, citing fear of terrorist attacks.[87]

The US International Traffic in Arms Regulations (ITAR) remained a contentious issue in 2006. US aerospace industry groups and trade associations oppose the restrictive export controls placed on space technology, claiming that it hinders their ability to compete on a global scale.[88] Foreign companies also continue to voice opposition to ITAR, citing complaints against inconsistent application, overly broad coverage, and difficulties with respect to dual-use technologies.[89] Consequently, many foreign organizations including ESA and CNES are trying to reduce or possibly eliminate American components from some aerospace projects, as happened with the European Galileo navigation system.[90]

In 2006 ITAR was also cited as an obstacle to safe business practices. The NASA Mishap Investigation Board report on the 2005 failure of the DART mission placed partial blame on ITAR.[91] According to the report, which was itself redacted because it contained satellite navigation data covered by ITAR, the U.S. prime contractor and a British parts supplier were unable to hold open discussions because of perceived ITAR requirements, resulting in "insufficient technical communication."[92] The British company, Surrey Satellite Technology, Ltd., supplied the primary GPS receiver, which "played a prominent role in the guidance, navigation and control" and that the lack of communication possible with SSTL led DART to collide with its target.[93]

In its 2006 Commercial Space Transportation Forecasts, the FAA/AST also pointed to ITAR as a source of difficulty for the US commercial space industry, claiming that "[t]he U.S. Government policy regarding satellite and launch vehicle export control is hampering U.S. satellite suppliers and launch vehicle providers in their efforts to work with their international customers. This has caused both delays and cancellations of programs."[94] Current US regulations are viewed as a factor in moving the market share toward international competitors, as "traditional U.S. market operators/customers such as Telesat Canada, INMARSAT, and Space Communications Corporation (SCC) of Japan have recently ordered Alcatel, Astrium, and Mitsubishi Electric Company (Melco) built satellites."[95] On the other hand, the European satellite industry believes itself to be at a disadvantage to the US industry which is bolstered by steady Department of Defense investments.[96]

US lawmakers show no signs that an ITAR policy change would be forthcoming in 2006, but instead maintained that application of the ITAR regime to space technology is vital to national security.[97] The dual use nature of much aerospace technology remains a concern, especially with regards to states or groups that pose a threat to US national security.[98] To ease ITAR constraints, however, the US has shown a willingness to facilitate international cooperation on a deal-by-deal basis, as evidenced by an agreement with India that would allow it to bid on commercial launches of US satellites and one that could streamline the ITAR process for transfer of technology to India.[99] In a separate move prompted by national security concerns, however, specifically the transfer of missile technology to Iran, the US Treasury Department froze the assets of the China Great Wall Industry Corporation responsible for brokering international deals for China's commercial space products.[100] The assets of G.W. Aerospace, Inc., its US subsidiary, and China National Precision Machinery Import/Export Corporation were also frozen.[101] All companies targeted by the asset freeze are involved in the commercial space sector.

In the spring of 2006 NASA explored potential cooperation with the international commercial space industry during a symposium on lunar exploration that was attended by over 200 global corporate representatives.[102] Commercial opportunities in lunar exploration include "'in-space fuel delivery; lunar resource prospecting; and the development and maintenance of lunar surface systems and infrastructure, including lunar habitats, power and science facilities, surface mobility units such as rovers, logistics and resupply, communications and navigation, and in situ resource utilization equipment.'"[103]

Net Assessment

The strong relationship between military and commercial uses of space, and the security dimensions of many commercial services, could have negative impacts on space security by placing restrictions on the use of space for certain commercial purposes, and blurring the distinction between military and commercial assets. Moreover, increasing military needs for commercial satellite frequencies could create stress on this resource. Trade restrictions imposed for national security purposes have a mixed effect on space security. On the one hand they have a negative effect by distorting market competition and restricting the means to access space. On the other hand, they can have a positive impact by controlling dual-use technologies that could be used for space negation purposes.

FIGURE 4: Commercial Spacecraft Launched in 2006 (by owning state)[104]

COSPAR	Launch Date	Launch Vehicle	Satellite Name	Launch State	State	Primary Function	Primary Manufacturer	Orbit Type
2006-043B	10/13/06	Ariane 5ECA	Optus D1	France	Australia	Telecoms	Orbital	GEO
2006-007A	3/11/06	Ariane 5ECA	Hot Bird 7A	France	France	Telecoms	Alcatel	MEO
2006-032A	8/4/06	Proton-M/Briz-M	Hot Bird 8	Russia	France	Telecoms	Astrium/Toul	GEO
2006-010A	4/12/06	Zenit-3SL	JCSAT 9	USA/Ukraine	Japan	Telecoms	LMCSS/Sunnyv	GEO
2006-033A	8/11/06	Ariane 5ECA	JCSAT 3A	France	Japan	Telecoms	LMCSS	GEO
2006-012A	4/20/06	Atlas V 411	Astra 1KR	USA	Luxembourg	Telecoms	LMMS/Sunnyva	MEO
2006-056A	12/11/06	Proton-M/Briz-M	Measat 3	Russia	Malaysia	Telecoms	Boeing	HEO
2006-020A	5/27/06	Ariane 5ECA	Satmex 6	France	Mexico	Telecoms	Loral	GEO

2006-006A	2/28/06	Proton-M/Briz-M	Arabsat 4A (BADR-ONE)	Russia	Saudi Arabia	Telecoms	Astrium	HEO
2006-051A	11/8/06	Proton-M/Briz-M	Badr 4	Russia	Saudi Arabia	Telecoms	Astrium	GEO
2006-020B	5/27/06	Ariane 5ECA	Thaicom 5	France	Thailand	Telecoms	Alcatel	GEO
2006-003A	2/15/06	Zenit-3SL	Echostar 10	USA/Ukrain e	USA	Telecoms	LMCSS/Sunnyv	GEO
2006-023A	6/18/06	Zenit-3SL	Galaxy 16	USA/Ukrain e	USA	Telecoms	Loral	GEO
2006-029A	7/12/06	Dnepr	Genesis-1	Russia	USA	Human	Bigelow	LEO
2006-043A	10/13/06	Ariane 5ECA	DirecTV 9S	France	USA	Telecoms	Loral	GEO
2006-049A	10/30/06	Zenit-3SL	XM Radio 4 (Blues)	USA/Ukrain e	USA	Telecoms	Boeing/ES	GEO
2006-054B	12/8/06	Ariane 5ECA	AMC 18	France	USA	Telecoms	LMCSS/Sunnyv	MEO
2006-054A	12/8/06	Ariane 5ECA	WildBlue 1	France	USA	Telecoms	Loral	GEO

ENDNOTES

[1] Frank Morring, Jr., "'New Space': Market For Private Spaceflight Seen Supporting - Maybe Even Surpassing - Government Customers" 165 (23) Aviation Week & Space Technology (11 December 2006) at 44.
[2] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[3] Futron Corporation, "Launch Report" (January 2007), online: Futron Corporation <http://www.futron.com/pdf/friends_of_futron_reports/launch_reports/FutronLR2007-01.pdf> (date accessed: 8 February 2007).
[4] Futron Corporation, "Launch Report" (January 2006), online: Futron Corporation <http://www.futron.com/pdf/friends_of_futron_reports/launch_reports/FutronLR2006-01.pdf> (date accessed: 8 February 2007).
[5] Futron Corporation, "Launch Report" (January 2007), online: Futron Corporation <http://www.futron.com/pdf/friends_of_futron_reports/launch_reports/FutronLR2007-01.pdf> (date accessed: 8 February 2007).
[6] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[7] Futron Corporation, "State of the Satellite Industry Report" (June 2006), online: Futron Corporation <http://www.futron.com/pdf/resource_center/reports/SIA_2005_ Indicators.pdf> (date accessed: 8 February 2007).
[8] Futron Corporation, "Launch Report" (January 2007), online: Futron Corporation <http://www.futron.com/pdf/friends_of_futron_reports/launch_reports/FutronLR2007-01.pdf> (date accessed: 8 February 2007).
[9] Futron Corporation, "Satellite Services Demand – The Future in High Def" (9 June 2006), online: Futron Corporation <http://www.futron.com/pdf/resource_center/white_papers/ 2006_Forecast_Whitepaper.pdf> (date accessed: 8 February 2007).
[10] Futron Corporation, "State of the Satellite Industry Report" (June 2006), online: Futron Corporation <http://www.futron.com/pdf/resource_center/reports/SIA_2005_

Indicators.pdf> (date accessed: 8 February 2007).
[11] Futron Corporation, "State of the Satellite Industry Report" (June 2006), online: Futron Corporation <http://www.futron.com/pdf/resource_center/reports/SIA_2005_ Indicators.pdf> (date accessed: 8 February 2007).
[12] Futron Corporation, "State of the Satellite Industry Report" (June 2006), online: Futron Corporation <http://www.futron.com/pdf/resource_center/reports/SIA_2005_ Indicators.pdf> (date accessed: 8 February 2007).
[13] John S. Edwards, "Waiting for the Rebound; Commercial Communications Satellite Makers and Their Suppliers Eye Moderate Market Growth" 164(3) Aviation Week & Space Technology (16 January 2006) at 161.
[14] Alcatel Alenia Space, Press Release, "Alcatel Alenia Space, Record Orders in 2006" (25 January 2007), online: Alcatel Alenia Space <http://www1.alcatel-lucent.com/space/pdf/ pressereleases/AAS_Bilan_2006_EN.pdf> (date accessed: 8 February 2007).
[15] Futron Corporation Manufacturing Report (Janaury 2007).
[16] Robert Wall & Michael A. Taverna, "Signs of Life: Launcher, Satellite Orders Inching Up, But Long-Term Outlook Still Unclear" 165(10) Aviation Week & Space Technology (11 September 2006) at 20.
[17] John S. Edwards, "Waiting for the Rebound; Commercial Communications Satellite Makers and Their Suppliers Eye Moderate Market Growth" 164(3) Aviation Week & Space Technology (16 January 2006) at 161; Robert Wall & Michael A. Taverna, "Signs of Life: Launcher, Satellite Orders Inching Up, But Long-Term Outlook Still Unclear" 165(10) Aviation Week & Space Technology (11 September 2006) at 20.
[18] Robert Wall & Michael A. Taverna, "Signs of Life: Launcher, Satellite Orders Inching Up, But Long-Term Outlook Still Unclear" 165(10) Aviation Week & Space Technology (11 September 2006) at 20.
[19] Futron Corporation, "State of the Satellite Industry Report" (June 2006), online: Futron Corporation <http://www.futron.com/pdf/resource_center/reports/SIA_2005_ Indicators.pdf> (date accessed: 8 February 2007).
[20] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[21] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[22] Missy Frederick, "Internet Portal Mapping Competition Benefits Satellite Imagery Business," Space News (24 April 2006).
[23] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[24] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquartersoffices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007); GeoEye Corporation, "Corporate," online: GeoEye Corporation <http://www.geoeye.com/corporate/default.htm> (date accessed: 8 February 2007). SES Global, Press Release, "SES Global Completes Acquisition of New Skies Satellites" (30 March 2006), online: SES Global <http://www.ses-global.com/ses-global/siteSections/mediaroom/Latest_News/06_03_30/index.php> (date accessed: 8 February 2007). Intelsat, News Release, "Intelsat Completes Acquisition of PanAmSat" (3 July 2006), online: Intelsat <http://www.intelsat.com/_files/press_releases/2006/20060703.pdf> (date accessed: 8 February 2007). Telesat, Press Release, "Telesat to be acquired by Canadian Pension Fund PSP Investments and Loral" (18 December 2006), online: Telesat <http://www.telesat.ca/news/2006/06-13.htm> (date accessed: 8 February 2007). Rocketplane-Kistler, "Two Commercial Space Companies Join Forces" (7 March 2006), online: Rocketplane-Kistler <http://www.rocketplanekistler.com>; Frank Morring, Jr., "In Orbit" 164(13) Aviation Week & Space Technology (27 March 2006) at 19. Boeing, News Release, "Boeing and Lockheed Martin Complete United Launch Alliance Transaction" (1 December 2006), online: Boeing <http://www.boeing.com/news/releases/2006/q4/061201a_nr.html> (date accessed: 8 February 2007). Lockheed Martin, Press Release, "Lockheed Martin and Boeing Complete United Launch Alliance Transaction" (1 December 2006), online: Lockheed Martin <http://www.lockheedmartin.com/wms/findPage.do?dsp=fec&ci=18050&rsbci=0&fti=112&ti=0&sc=400> (date accessed: 8 February 2007). "News Breaks" 165(14) Aviation Week & Space Technology (9 October 2006) at 21; Michael A. Dornheim, "Back to Basics: Government Abandons Commercial Practices on EELV"

164(11) Aviation Week & Space Technology (13 March 2006) at 28. Frank Morring, Jr., "Launch Alliance Launch" 165(23) Aviation Week & Space Technology (11 December 2006) at 17. Marguerite Reardon "Shareholders approve Alcatel, Lucent merger," CNET News.com, (7 September 2006), online: <http://news.com.com/Shareholders+approve+Alcatel,+Lucent+merger/2100-1037_3-6113357.html> (date accessed: 23 February 2007).

[25] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007); GeoEye Corporation, "Corporate," online: GeoEye Corporation <http://www.geoeye.com/corporate/default.htm> (date accessed: 8 February 2007).

[26] Telesat, Press Release, "Telesat to be acquired by Canadian Pension Fund PSP Investments and Loral" (18 December 2006), online: Telesat <http://www.telesat.ca/news/2006/06-13.htm> (date accessed: 8 February 2007).

[27] "News Breaks" 165(14) Aviation Week & Space Technology (9 October 2006) at 21; Michael A. Dornheim, "Back to Basics: Government Abandons Commercial Practices on EELV" 164(11) Aviation Week & Space Technology (13 March 2006) at 28.

[28] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).

[29] Lockheed Martin, Press Releases, "Lockheed Martin Completes Sale of International Launch Services" (11 October 2006), online: Lockheed Martin <http://www.lockheedmartin.com/wms/findPage.do?dsp=fec&ci=17969&rsbci=0&fti=112&ti=0&sc=400>; "Lockheed Martin Plans to Take over Marketing" 165(10) Aviation Week & Space Technology (11 September 2006) at 16.

[30] Lockheed Martin, Press Releases, "Lockheed Martin Completes Sale of International Launch Services" (11 October 2006), online: Lockheed Martin <http://www.lockheedmartin.com/wms/findPage.do?dsp=fec&ci=17969&rsbci=0&fti=112&ti=0&sc=400>; "Lockheed Martin Plans to Take over Marketing" 165(10) Aviation Week & Space Technology (11 September 2006) at 16.

[31] Ryan Chilcote, "Female Space Tourist Blasts Off" CNN.com (18 September 2006), online: CNN.com <http://www.cnn.com/2006/TECH/space/09/18/space.female.tourist/index.html> (date accessed: 8 February 2007).

[32] California Space Authority, "California Space Enterprise Strategic Plan 2007-2010" (November 2006) at 24, online: California Space Authority <http://www.californiaspaceauthority.org/images/pdfs/strat-plan-2007.pdf> (date accessed: 8 February 2007).

[33] ESA, "ESA to Help Europe Prepare for Space Tourism" (20 July 2006), online: ESA <http://www.esa.int/SPECIALS/GSP/SEM2YABUQPE_0.html> (date accessed: 8 February 2007). As part of the initiative European private companies with plans for space tourism activities may submit proposals to ESA, which will select a maximum of three that will receive further study. Each company that submits a proposal selected by ESA will receive € 150,000 to assist in developing its ideas.

[34] Warren Ferster, "Private Space Habitat Could Launch by 2010" Space.com (21 September 2006), online: Space.com <http://www.space.com/news/060921_bigelow_plans.html> (date accessed: 8 February 2007).

[35] Leonard David, "Bigelow's Big Gamble: Building a Space Station" Space.com (21 July 2006), online: Space.com <http://www.space.com/news/060721_genesis-1_impact.html> (date accessed: 8 February 2007).

[36] Bigelow Aerospace, "News: Bigelow Aerospace and Lockheed Martin Agree to Study Human-Qualified Atlas V Rocket for Entrepreneurial Space Development" (21 September 2006), online: Bigelow Aerospace <http://www.bigelowaerospace.com/multiverse/BA_and_Lockheed.php>; Warren Ferster, "Private Space Habitat Could Launch by 2010" Space.com (21 September 2006), online: Space.com <http://www.space.com/news/060921_bigelow_plans.html> (date accessed: 8 February 2007).

[37] X-Prize Foundation, News & Events: Press Releases, "X PRIZE Foundation and NASA Offer $2.5 Million Lunar Lander Challenge Competition to Take Place at the 2006 X PRIZE Cup in Las Cruces, New Mexico" (4 May 2006), online: X-Prize Foundation <http://www.xprize.org/newsevents/press_releases_2006-05-04_Lunar_Lander.html> (date accessed: 8 February 2007).

[38] Frank Morring, Jr., "Dream Teams; Burgeoning Private Spaceflight Industry Starting to Draw Capital, NASA Interest" 165(17) Aviation Week & Space Technology (30 October 2006) at 22.

[39] Frank Morring, Jr., "Dream Teams; Burgeoning Private Spaceflight Industry Starting to Draw Capital, NASA Interest" 165(17) Aviation Week & Space Technology (30 October 2006) at 22.
[40] NASA "NASA Invests in Private Sector Spaceflight with SpaceX, Rocketplane-Kistler" NASA: Exploration News (18 August 2006), online: NASA <http://www.nasa.gov/ mission_pages/exploration/news/COTS_selection_prt.htm> (date accessed: 8 February 2007).
[41] NASA "NASA Invests in Private Sector Spaceflight with SpaceX, Rocketplane-Kistler" NASA: Exploration News (18 August 2006), online: NASA <http://www.nasa.gov/ mission_pages/exploration/news/COTS_selection_prt.htm> (date accessed: 8 February 2007).
[42] NASA "NASA Invests in Private Sector Spaceflight with SpaceX, Rocketplane-Kistler" NASA: Exploration News (18 August 2006), online: NASA <http://www.nasa.gov/ mission_pages/exploration/news/COTS_selection_prt.htm> (date accessed: 8 February 2007); Brian Berger, "SpaceX, Rocketplane Kistler Win NASA COTS Competition" *Space.com* (18 August 2006), online: Space.com <http://www.space.com/news/060818_ nasa_cots_wrap.html> (date accessed: 8 February 2007).
[43] NASA, "NASA Forms Partnership with Red Planet Capital, Inc." Technology: Breaking News (20 September 2006), online: NASA <http://technology.jsc.nasa.gov/redplanet capital.cfm>; Red Planet Capital, "The Fund," online: Red Planet Capital <http://www. redplanetcapital.com> (date accessed: 8 February 2007).
[44] NASA, "NASA Forms Partnership with Red Planet Capital, Inc." Technology: Breaking News (20 September 2006), online: NASA <http://technology.jsc.nasa.gov/redplanet capital.cfm>; Red Planet Capital, "The Fund," online: Red Planet Capital <http://www. redplanetcapital.com> (date accessed: 8 February 2007).
[45] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007); Oliver Harvey, "Blast Resort" *The Sun [England]* (19 May 2006) (Lexis); "UK Virgin Galactic to Run Space Tourism from Swedish Kiruna" *Swedish Business Digest* (9 May 2006) (Lexis).
[46] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007); Heath Haussamen, "Richardson Signs Spaceport Bills into Law" *Las Cruces [New Mexico] Sun-News* (2 March 2006) at 1A.
[47] Leonard David, "Oklahoma Spaceport Gets AST Nod to Operate a Launch Site" Space.com (29 June 2006), online: Space.com <http://www.space.com/spacenews/ archive06/Ports_062606.html> (date accessed: 8 February 2007).
[48] Space Adventures, Press Release, "Space Adventures Announces $265 Million Spaceport Development Project" (17 February 2006), online: Space Adventures <http://www. spaceadventures.com/media/releases/2006-02/347>; FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[49] Leonard David, "Oklahoma Spaceport Gets AST Nod to Operate a Launch Site" Space.com (29 June 2006), online: Space.com <http://www.space.com/spacenews/ archive06/Ports_062606.html> (date accessed: 8 February 2007).
[50] "Private Texas Spaceport Launches Test Rocket" CNN.com (14 November 2006), online: CNN <http://www.cnn.com/2006/TECH/space/11/14/bezos.spaceport.ap/index.html> (date accessed: 8 February 2007).
[51] "Private Texas Spaceport Launches Test Rocket" CNN.com (14 November 2006), online: CNN <http://www.cnn.com/2006/TECH/space/11/14/bezos.spaceport.ap/index.html> (date accessed: 8 February 2007).
[52] Leonard David, "California Lawmakers Back Mojave Spaceport Growth" Space.com (21 April 2006), online: Space.com <http://www.space.com/news/060421_mojave_cash. html>; Judy Lin, "Bill Seeks Loan for Spaceport in South State" *Sacramento Bee* (7 May 2006) (Lexis).
[53] Craig Covault, "Kennedy Diversifying; NASA to Seek Commercial Launcher Data to Clear Space Business Environmental Hurdles" 165(12) Aviation Week & Space Technology (25 September 2006) at 34.

[54] Craig Covault, "Kennedy Diversifying; NASA to Seek Commercial Launcher Data to Clear Space Business Environmental Hurdles" 165(12) Aviation Week & Space Technology (25 September 2006) at 34.
[55] Craig Covault, "Kennedy Diversifying; NASA to Seek Commercial Launcher Data to Clear Space Business Environmental Hurdles" 165(12) Aviation Week & Space Technology (25 September 2006) at 34.
[56] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[57] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[58] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[59] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[60] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[61] Frank Morring, Jr., "Insurance Recovery" 165(11) Aviation Week & Space Technology (18 September 2006) at 15.
[62] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007).
[63] FAA Commercial Space Transportation, "Quarterly Launch Report: 2nd Quarter 2006" (2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_ offices/ast/media/2Q2006_QLR.pdf> (date accessed: 8 February 2007). Commercial human flight insurance covers risks other than third party liability which the FAA requires operators of commercial spacecraft to purchase.
[64] US Government Accountability Office, "Commercial Space Launches: FAA Needs Continued Planning and Monitoring to Oversee the Safety of the Emerging Space Tourism Industry" (20 October 2006), online: GAO <http://www.gao.gov/new.items/d0716.pdf> (date accessed: 8 February 2007).
[65] US Government Accountability Office, "Commercial Space Launches: FAA Needs Continued Planning and Monitoring to Oversee the Safety of the Emerging Space Tourism Industry" (20 October 2006), online: GAO <http://www.gao.gov/new.items/d0716.pdf> (date accessed: 8 February 2007).
[66] US Government Accountability Office, "Commercial Space Launches: FAA Needs Continued Planning and Monitoring to Oversee the Safety of the Emerging Space Tourism Industry" (20 October 2006), online: GAO <http://www.gao.gov/new.items/d0716.pdf> (date accessed: 8 February 2007).
[67] US Government Accountability Office, "Commercial Space Launches: FAA Needs Continued Planning and Monitoring to Oversee the Safety of the Emerging Space Tourism Industry" (20 October 2006), online: GAO <http://www.gao.gov/new.items/d0716.pdf> (date accessed: 8 February 2007).
[68] The Aerospace Corporation, "Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation" (1 August 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/media/Risk_Study(final).pdf> (date accessed: 8 February 2007).
[69] The Aerospace Corporation, "Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation" (1 August 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/media/Risk_Study(final).pdf> (date accessed: 8 February 2007).
[70] The Aerospace Corporation, "Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation" (1 August 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/media/Risk_Study(final).pdf> (date accessed: 8 February 2007).
[71] The Aerospace Corporation, "Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation" (1 August 2006), online: FAA/AST

<http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/media/Risk_Study(final).pdf> (date accessed: 8 February 2007).

[72] The Aerospace Corporation, "Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation" (1 August 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/media/Risk_Study(final).pdf> (date accessed: 8 February 2007).

[73] The Aerospace Corporation, "Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation" (1 August 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/media/Risk_Study(final).pdf> (date accessed: 8 February 2007).

[74] FAA Commercial Space Transportation, "FY-2006 Research and Development Accomplishments" (October 2006), online: FAA/AST <http://www.faa.gov/about/ office_org/headquarters_offices/ast/about/media/FY06Research_Develop.pdf> (date accessed: 8 February 2007).

[75] FAA Commercial Space Transportation, "FY-2006 Research and Development Accomplishments" (October 2006), online: FAA/AST <http://www.faa.gov/about/ office_org/headquarters_offices/ast/about/media/FY06Research_Develop.pdf> (date accessed: 8 February 2007).

[76] FAA Commercial Space Transportation, "New Regulations Govern Private Human Spaceflight Requirements for Crew and Spaceflight Participants" (15 December 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices /ast/human_space_flight_reqs/> (date accessed: 8 February 2007). See also *Human Spaceflight Requirements for Crew and Spaceflight Participants; Final Rule*, 71 Fed. Reg. 75616 (2006).

[77] FAA Commercial Space Transportation, "New Regulations Govern Private Human Spaceflight Requirements for Crew and Spaceflight Participants" (15 December 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices /ast/human_space_flight_reqs/> (date accessed: 8 February 2007). See also *Human Spaceflight Requirements for Crew and Spaceflight Participants; Final Rule*, 71 Fed. Reg. 75616 (2006).

[78] FAA Commercial Space Transportation, "New Regulations Govern Private Human Spaceflight Requirements for Crew and Spaceflight Participants" (15 December 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices /ast/human_space_flight_reqs/> (date accessed: 8 February 2007). See also *Human Spaceflight Requirements for Crew and Spaceflight Participants; Final Rule*, 71 Fed. Reg. 75616 (2006).

[79] FAA Commercial Space Transportation, "New Regulations Govern Private Human Spaceflight Requirements for Crew and Spaceflight Participants" (15 December 2006), online: FAA/AST <http://www.faa.gov/about/office_org/headquarters_offices /ast/human_space_flight_reqs/> (date accessed: 8 February 2007). See also *Human Spaceflight Requirements for Crew and Spaceflight Participants; Final Rule*, 71 Fed. Reg. 75616 (2006).

[80] FAA Commercial Space Transportation, "Guide to Reusable Launch and Reentry Vehicle Software and Computing System Safety" (July 2006), online: FAA/AST <http://www.faa. gov/about/office_org/headquarters_offices/ast/media/AST_Guide_to_Software_Safety_final_070706.pdf> (date accessed: 8 February 2007).

[81] FAA Commercial Space Transportation, "Guide to Reusable Launch and Reentry Vehicle Software and Computing System Safety" (July 2006), online: FAA/AST <http://www.faa. gov/about/office_org/headquarters_offices/ast/media/AST_Guide_to_Software_Safety_final_070706.pdf> (date accessed: 8 February 2007).

[82] FAA Commercial Space Transportation, "Guide to Reusable Launch and Reentry Vehicle Software and Computing System Safety" (July 2006), online: FAA/AST <http://www.faa. gov/about/office_org/headquarters_offices/ast/media/AST_Guide_to_Software_Safety_final_070706.pdf> (date accessed: 8 February 2007).

[83] FAA Commercial Space Transportation, "Guide to Reusable Launch and Reentry Vehicle Software and Computing System Safety" (July 2006), online: FAA/AST <http://www.faa. gov/about/office_org/headquarters_offices/ast/media/AST_Guide_to_Software_Safety_final_070706.pdf> (date accessed: 8 February 2007).

[84] *Safety Approvals; Final Rule*, 71 Fed. Reg. 46847 (2006) at 46847.

[85] *Safety Approvals; Final Rule*, 71 Fed. Reg. 46847 (2006) at 46848.
[86] *Safety Approvals; Final Rule*, 71 Fed. Reg. 46847 (2006) at 46848.
[87] "India says no to Google Earth's peering," PhysOrg.com (10 March 2006), online: PhysOrg.com <http://www.physorg.com/news11634.html> (date accessed: 8 February 2007).
[88] John M. Doyle & Michael L. Bruno, "Don't Hold Your Breath; Even if Leadership in Congress Changes Next Year, There's Little Appetite For Big Reforms in Export Control Laws" 165(3) Aviation Week & Space Technology (17 July 2006) at 100.; California Space Authority, "California Space Enterprise Strategic Plan 2007-2010" (November 2006) at 21, online: California Space Authority <http://www.californiaspaceauthority.org/images/ pdfs/strat-plan-2007.pdf> (date accessed: 8 February 2007).
[89] John M. Doyle & Michael L. Bruno, "Don't Hold Your Breath; Even if Leadership in Congress Changes Next Year, There's Little Appetite For Big Reforms in Export Control Laws" 165(3) Aviation Week & Space Technology (17 July 2006) at 100.
[90] John M. Doyle & Michael L. Bruno, "Don't Hold Your Breath; Even if Leadership in Congress Changes Next Year, There's Little Appetite For Big Reforms in Export Control Laws" 165(3) Aviation Week & Space Technology (17 July 2006) at 100.; Frank Morring, Jr., "Another Casualty; Wars in Iraq and Afghanistan, and Political Climate, Complicate Spacecraft Export-Control Reform" 165(3) Aviation Week & Space Technology (17 July 2006) at 105.
[91] Frank Morring, Jr., "Target Practice; Inexperience, Ignorance and ITAR Cited in Failure of DART Exploration Testbed" 164(21) Aviation Week & Space Technology (22 May 2006) at 37.
[92] Frank Morring, Jr., "Target Practice; Inexperience, Ignorance and ITAR Cited in Failure of DART Exploration Testbed" 164(21) Aviation Week & Space Technology (22 May 2006) at 37.
[93] Frank Morring, Jr., "Target Practice; Inexperience, Ignorance and ITAR Cited in Failure of DART Exploration Testbed" 164(21) Aviation Week & Space Technology (22 May 2006) at 37.
[94] FAA Commercial Space Transportation, "2006 Commercial Space Transportation Forecasts" (May 2006), online: FAA/AST <http://www.faa.gov/about/office_org/ headquarters_offices/ast/media/2006_Forecast_GSO_NGSO_May_24.pdf> (date accessed: 8 February 2007).
[95] FAA Commercial Space Transportation, "2006 Commercial Space Transportation Forecasts" (May 2006), online: FAA/AST <http://www.faa.gov/about/office_org/ headquarters_offices/ast/media/2006_Forecast_GSO_NGSO_May_24.pdf> (date accessed: 8 February 2007).
[96] Eurospace, "The European Space Industry in 2005. Industry Facts and Figures" (June 2006), online: Eurospace <http://www.eurospace.org/> (date accessed: 8 February 2007).
[97] John M. Doyle & Michael L. Bruno, "Don't Hold Your Breath; Even if Leadership in Congress Changes Next Year, There's Little Appetite For Big Reforms in Export Control Laws" 165(3) Aviation Week & Space Technology (17 July 2006) at 100.
[98] John M. Doyle & Michael L. Bruno, "Don't Hold Your Breath; Even if Leadership in Congress Changes Next Year, There's Little Appetite For Big Reforms in Export Control Laws" 165(3) Aviation Week & Space Technology (17 July 2006) at 100.
[99] Neelam Mathews, Michael A. Taverna & Frank Morring, Jr., "Easing Exports; New Pacts Will Simplify Launches of U.S. Spacecraft from India" 164(11) Aviation Week & Space Technology (13 March 2006) at 26.
[100] Craig Covault, "Blowing the Whistle; US Freezes Chinese Space Company Assets over Iranian Missile Aid. North Korean ICBM also Tied to Iran, China" 164(26) Aviation Week & Space Technology (26 June 2006) at 24.
[101] Craig Covault, "Blowing the Whistle; US Freezes Chinese Space Company Assets over Iranian Missile Aid. North Korean ICBM also Tied to Iran, China" 164(26) Aviation Week & Space Technology (26 June 2006) at 24.
[102] Frank Morring, Jr., "'Global Strategy'; International symposium starts work on some lunar exploration scenarios" 164(18) Aviation Week & Space Technology (1 May 2006) at 26.
[103] Frank Morring, Jr. "Moon Milestones; Industry to Have Role in Plotting Lunar Exploration; Public-Private Investment Capital Pool is Sought" 164(8) Aviation Week & Space Technology (20 February 2006) at 39.

[104] Launches whose primary payload was a commercial satellite.