ESPI

European Space Policy Institute

SPACE POLICY, ISSUES AND TRENDS IN 2006/2007

Report 6, September 2007

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Introduction

Background

The European Space Agency (ESA) publishes since 2002 a report providing an overview of the European space sector in a global context. This annual report entitled "The European Space Sector in a Global Context" takes into account the geopolitical and economic changes that occurred in a given year that are of importance to the European space sector to put it in a boarder context. ESA's annual analysis provides also facts and figures of the other space powers to put the development of the European space sector into perspective.

Objectives of this Study

Under a Framework Contract, the European Space Policy Institute (ESPI) has been contracted by ESA's DG Policy Office to undertake a 9-month study to prepare an assessment of the current space sector in a broad context. The ESPI study "Space Policy, Issues and Trends in 2006/2007" aims to present in a single document, comprehensive data and analysis characterizing global space activities in 2006 and the first half of 2007.

This report "Space Policy, Issues and Trends in 2006/2007" provides an overview of the European space sector in a global context. It takes into account the geopolitical and economic changes that occurred in the World from 1 January 2006 to 30 June 2007 that are of relevance and importance to current and future developments of the European space sector. It provides therefore facts and figures with regard to the latest European activities while putting them into perspective with the situation of other major space faring countries, notably the United States, Russia, Japan, China and India.

Approach taken by the study

The study "Space Policy, Issues and Trends in 2006/2007" was divided into five phases involving eight tasks that were performed between fall 2006 and winter 2007. The data used in this study are derived from a variety of sources of publicly available information and are expressed at current economic conditions either in euros or in U.S. dollars and when possible data in original currency. The sources used in this report are, in order of priority: primary sources, that is, official data provided by national governments or companies in their official publications, as well as secondary sources which quote primary data. ESPI estimations draw on many sources of publicly available information from published sources of industry trade associations, articles in mainstream business press and industry magazines and, when available private information sources, as well as interviews with space leaders from industries.

1. Global political and economic trends

2006 and the first half of 2007 was a period of transition. Visible change in the economic balance of power occurred with the confirmation of the rise of China and India and the recovery of Russia while other major economies witnessed limited growth. Transnational security treats such as climate change, and particularly global warming, as well as terrorist attacks have toped the agenda of leading countries worldwide.

1.1 The global economic outlook

The world economy has once more confirmed its ability to withstand shocks and maintain momentum. The global expansion remained robust in 2006, as well as in the first half of 2007 with activity in most regions meeting or exceeding expectations. In overall, the world economy expanded vigorously in 2006, growing by 5.4 %[1] despite the surge in energy prices and other natural resources in the first half of the year. According to the International Monetary Fund (IMF), the world economy still looks well set for continued robust growth in 2007 and 2008, although at a somewhat more moderate pace than in 2006 (Table 1.1).

Country	2006	2007	2008
United States	3.3	2.2	2.8
Germany	2.7	1.8	1.9
France	2.0	2.0	2.4
Italy	1.9	1.8	1.7
Spain	3.9	3.6	3.4
United Kingdom	2.7	2.9	2.7
Euro Area	2.6	2.3	2.3
European Union	3.2	2.8	2.7
Japan	2.2	2.3	1.9
Russia	6.7	6.4	5.9
China	10.7	10.0	9.5
India	9.2	8.4	7.8
Brazil	3.7	4.4	4.2
World output	**5.4**	**4.9**	**4.9**

Table 1.1 Overview of the World Economic Outlook Projections (Source IMF)

The United States represented still the core of world economic growth in 2006 and early 2007. Nevertheless, the economy has slowed with the maturing of the economic cycle, the two devastating hurricanes along with the associated spikes in energy prices. Japan kept up its pace of economic recovery (Table 1.1). The Japanese economy has now sustained an expansion, however modest, for about 5 years suggesting a convincing end to its long period of stagnation. The European economies in 2006 showed robustness and stayed on a low but consistent economic growth path. In the euro area, growth accelerated to its fastest pace in six years as domestic demanded strengthened[2]. The expansion is projected to sustain its momentum in 2007 (Table 1.1). Asia has forged ahead, with China enjoying double-digit expansion and India growing very rapidly as well (Table 1.1). Other emerging markets in Asia (notably Russia), Latin America (particularly Brazil) and in Africa have also grown rapidly, and several low-income countries have maintained an impressive growth performance, helped by strong commodity prices.

1.2 Political developments

2006/07 was marked by several on-going and new conflicts, as well as significant military events threatening world peace and stability.

Prospects for peace and stability in the Middle East dimmed significantly with a military conflict with Israel in summer 2006 and a conflict in the in July and August 2006 in Lebanon and northern Israel between the Israeli military and Hezbollah paramilitary forces. The on-going Iraq War that started on 20 March 2003 with the United States-led invasion has also evolved as an asymmetric warfare with the Iraqi insurgency and a civil war between Sunni and Shia Iraqis.

In Asia, the Taliban continued their resurgence in Afghanistan, making 2006 the deadliest year of fighting since the 2001 war. On 9 October 2006, North Korea announced that it had conducted its first nuclear test, which was later confirmed by the United States on 16 October 2006. The blast was less than one kiloton, but triggered major international reactions and complaints over this nuclear test.

The Horn of Africa has also witnessed increasing conflicts with combats in Somalia and an escalation of the three-year old civil war in Sudan. In spring 2007 a series of terrorist bombings in Morocco and Algeria

[1] International Monetary Fund: "World Economic Outlook". April 2007

[2] Ibid

claimed by local Al Qaeda branches reinforced the threat of terrorist attacks in Europe and North America as witnessed by the terrorist plots in London and Scotland in late June 2007.

1.3 Major scientific events

In 2006/07 global warming and climate change have being a major topic of debate, and are increasingly being perceived as a serious global threat that demands an urgent global response.

A high-level report, the "Stern Review on the Economics of Climate Change", on the effect of climate change and global warming on the world economy compiled by the economist Sir Nicholas Stern for the government of the United Kingdom was released on 30 October 2006. Stern's report suggests that climate change threatens to be the greatest and widest-ranging market failure ever seen, and it provides prescriptions including environmental taxes to minimize the economic and social disruptions. Using the results from formal economic models, its main conclusions are that 1 % of a global GDP is required to be invested in order to mitigate the effects of climate change, and that failure to do so could risk a recession worth up to 20 % of global GDP by 2050. The report argues also that without action, up to 200 million people by the middle of the century could become refugees as their homes are hit by drought or flood. The Stern Review attracted a great deal of positive attention, but is also often criticized due to among others the failure to acknowledge the scope for long-term adaptation to possible global warming.

In early 2007, the Intergovernmental Panel on Climate Change (IPCC)[3], published its new Summary for Policymakers (SPM) discussing current climate change science. Its first SPM released on 2 February 2007 concluded in terms somewhat stronger than its predecessor published in 2001, that it is "very likely" that observed changes in climate are human-caused, rather than just "likely". The report indicates also that climate system warming is "unequivocal". This SPM gave also updated estimates for temperature and sea level changes by the end of the century. In particular, the IPCC's range of predictions of the rise in the temperature by 2100 has increased from 1.4-5.8°C in the 2001 report to 1.1-6.4°C in the 2007 report[4].

The second SPM report on "Climate Change 2007: Impacts, Adaptation and Vulnerability" was presented on 6 April 2007. It described the specific effects of climate changes and described options for limiting risks. According to the report, some of the changes could be beneficial. Areas that now have cold climates will experience longer growing seasons and a greater variety of crops, as well as becoming more attractive to tourists. Nonetheless, most changes will prove harmful in the long run, and most regions are likely to be more harmed than helped by the changes. The expected damage of global warming range from worsening floods and water shortages principally in the developing world to damage to rich countries' wild life, as well as infrastructure, such as road and rail networks, water and energy systems, and healthcare.

The third volume of the IPCC Fourth Assessment Report on "Mitigation of Climate Change" was released on 4 May 2007. This SPM report focuses on mitigation of climate change through limiting or preventing greenhouse gas emissions and enhancing activities that remove them from the atmosphere. It analysed mitigation options for the main sectors in the near-term, addressing also cross-sectorial matters such as synergies, co-benefits and trade-offs. It also provided information on long-term mitigation strategies for various concentration stabilization levels. Finally, the Synthesis report on "Climate Change 2007" is expected to be released in mid-November 2007 in Valencia, Spain

In 2007 two year-long scientific programme relevant to space started. The international scientific community launched, on 1 March 2007, the International Polar Year (IPY) that is a large scientific programme focused on studying both the Arctic and Antarctic from March 2007 to March 2009. This initiative constitutes the most intensive period of research on the polar regions in half a century[5]. Because of the remoteness and harshness of these regions and because infrastructure is sparse space-based assets are

[3] The IPCC was established in 1988 by two United Nations organizations, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), to evaluate periodically the current understanding of climate change and its relationship to society, based mainly on peer reviewed and published scientific and technical literature

[4] Despite the general consensus on this first SPM, several experts are criticizing the findings of this report as new developments might have been missed since there was a set cut-off date for submission of scientific paper and other data in December 2005. Moreover, the extent and consequences of the rise of sea level is considered by many has being underestimated in this SPM

[5] There have been three IPYs over the last 125 years: 1882-1883, 1932-1933 and 1957-1958. The last IPY provided the foundation for much of the polar science knowledge existing today

particularly beneficial to support this frontier research. And, for the first time during an IPY, the scientific community has at its disposal satellite data of the polar regions.

Another year-long scientific programme that started in 2007 is the UN sponsored, but scientifically driven, International Heliophysical Year (IHY) which is an international programme of scientific cooperation aiming to understand external drivers of planetary environments and universal processes in solar- terrestrial- planetary- heliospheric physics. The IHY has been planned to coincide with the 50th anniversary of the International Geophysical Year (IGY), one of the most successful international science programme of all time that started also the "Space Age" with the successful launch of Sputnik I on 4 October 1957.

1.4 Selected focus

Europe in 2006/07

Energy was one of the major topics of discussion in Europe in 2006/07. Rising oil and gas prices, Europe's increasing dependency on a few external suppliers and the emergency of global warming have restarted the debate on the need for a European energy policy[6]. The European Commission (EC) opened the debate on a future common European Energy Policy with the publication of a "Green Paper" on 8 March 2006 and spelled out options to achieve "sustainable, competitive and secure" energy supplies in the EU[7]. It unveiled subsequently its energy proposals on 10 January 2007 calling for a comprehensive package of measures to establish a new Energy Policy for Europe to combat climate change and boost the EU's energy security and competitiveness. The Commission's new "Action Plan" ask EU member states to start work on a "new industrial revolution" that would see Europe contribute to reducing world greenhouse gas emissions and to reduce overall EU energy use dramatically by 2020[8]. The revolution envisages also the EU to rely increasingly on alternative energy.

Besides energy, science and technology (S&T) has been on top of the agenda in Europe. Following the October 2005 Hampton Court Summit where Heads of State and Government decided to give higher priority to the key issues on which Europe needs to act to address the challenges of globalisation and particularly research and innovation. The EC asked a small independent group of high-level experts, chaired by former Prime Minister of Finland Esko Aho, to assess the situation and make proposals to boost Europe's research and innovation performance. The Aho group issued its report on 20 January 2006 entitled "Creating an Innovative Europe". This report presented a strategy to create a more innovative Europe and called for a "Pact for Research and Innovation" to be signed by political, business and social leaders to show their commitment to creating such "Innovative Europe". Following this report, at a Council meeting in Brussels in March 2006, it was recognised at the highest political level that Europe should invest more in knowledge and growth. And, at the Competitiveness Council meeting in February 2007, the Council adopted a contribution entitled "Strengthening Europe's Competitiveness". Moreover, while Germany hold the Council Presidency of the EU for the first half of 2007 this term coincided also with the start of 7th Framework Programme (FP7) for Research, Technological Development for the period (2007-13)[9], the establishment of the European Research Council (ERC) and other important funding programmes such as the Competitiveness and Innovation Programme and the new programming period of the structural funds.

On 24-25 March 2007 was commemorated in Berlin the 50th anniversary of the signing of the Treaties of Rome. Those festivities culminated in the signing of the Berlin Declaration, which is a celebratory text on the EU's historic achievements in terms of freedom, prosperity and solidarity. The two-page document draws attention to the fundamental principles of the "community method", such as equality of member states and transparency. The text refers also to the fundamental values upon which the EU is based, especially the inviolability of human dignity. A section of the Declaration is devoted to the challenges of the future, such as fighting climate change, foreign and security policy, internal security, civil liberties and a socially responsible society. There is also in the final section of the Declaration a reference to the June 2009 European Parliamentary Elections as a target deadline for institutional reform, without specifically mentioning what form this may take. In this context, at the June 2007 European Summit, the German Presidency reached, after tense negotiations,

[6] The external aspects of energy policy remain within the competence of EU member states' foreign ministries and a matter of national sovereignty.

[7] Green Paper "A European Strategy for Sustainable, Competitive and Secure Energy" COM(2006) 105 final. Brussels, 8.3.2006

[8] Communication from the Commission to the European Council and the European Parliament "An Energy Policy for Europe" COM(2007) 1 final. Brussels, 10.1.2007

[9] Since 1984, the Framework Programme is EU's main instrument for funding research and development

an agreement among EU leaders in the early hours on 23 June 2007 for a detailed Intergovernmental Conference (IGC) mandate to reform the EU's institutions. The European Council delivered consequently to the Portuguese Presidency the mandate to call an IGC to draw up a new EU "Reform Treaty" amending the existing Treaties with a view to enhancing the efficiency and democratic legitimacy of the enlarged Union, as well as the coherence of its external action.

Early 2007 was also marked by a new enlargement of the EU. On 1 January 2007, Bulgaria and Romania joined the EU. This fifth round of enlargement adds some 30 millions people to the EU to a total of about 492 millions. On 1 January 2007, the Euro area enlarged to include Slovenia. The Euro area encompasses now 13 countries and about 317 millions people.

United States in 2006/07

This period has been a contrasted one for the United States. While the country hit on 17 October 2006, the symbolic milestone of 300 millions of inhabitants (up from 200 millions in 1967), the housing boom ended, dragging down the pace of overall economic growth. 2006 has also been marked with national election in the U.S. Congress on 7 November for the 110th Congress (2007-2009) that led to a major political orientation of the legislative branch.

Democrats have done unexpectedly well in the November 2006 election. Not only they have captured comfortably the House of Representatives, but they have also beaten the Republicans in the Senate. The Democrats control thus a majority in both chambers for the first time since the 103rd Congress in 1993 -1995. Another hallmark with this election is the appointment of Nancy Pelosi as the first female speaker of the House of Representatives on 4 January 2007.

The most crucial issue for the U.S., however, remains the Iraq war. Democrats are now pretty united in criticizing President George W. Bush, and they have been pushing for a timetable for withdrawal of US troops. However, President George W. Bush rejected in January 2007, any potential withdrawal timetable. And despite the 3000th death of U.S. Soldiers in Iraq in January 2007, the Bush Administration announced in early January a surge of about 20,000 more troops in Iraq, and announced in April 2007 a three-month extension of duty for U.S. soldiers deployed in Iraq and Afghanistan.

Russia in 2006/07

Due to high world prices for energy, but also to clear direction of economic policies, the GDP and domestic investment are growing impressively in Russia after a long decline thanks largely to high oil prices and other natural resources. To illustrate its economic recovery Russia hosted in July 2006 a G-8 summit in St. Petersburg and is on its way of joining the World Trade Organisation (WTO) after winning critical U.S. support for its bid in 2006.

The economic recovery has led also to renewed involvement of Russia in major topics of world affairs. Russian foreign policy has grown in the last year more self-confident and assertive, fueled by its perceived status as an "energy superpower". Despite critics of Russia's behavior and its "negotiation" on energy prices with former Soviet sattes it has become again an indispensable partner for dealing with pressing geopolitical issues. Russia was the guest of honour at a meeting of the EU leaders in Finland in October 2006, and after years of sharp U.S.-Russian disagreement over Russian support for Iran's nuclear programme, Washington and Moscow appear to have found some common ground on the Iranian, as well as the North Korean nuclear concerns. But the possibility of implementing an U.S. missile shield in Europe has led Russia to take a strong political stance leading to the fear of potential new Cold War.

However, major problems remain including the high and widespread organized crime and corruption or demographic decline. Russia is also plagued by environmental degradation and ecological catastrophes of staggering proportions. But, the biggest uncertainty looming for Russia is the name and directions of the future president as Putin's second and final term runs out in 2008.

Japan in 2006/07

The year 2006 was particularly important for Japan as it confirmed it economic recovery with a growth for the fifth year in a row and witnessed also a change of leadership and directions. Shinzo Abe, the president of the ruling Liberal Democratic Party (LDP) has been elected prime minister on 26 September 2006, by the Japanese parliament to succeed to Junichiro Koizumi, the prime minister since 2001.

Japan has also evolved in recent years towards a bigger role in peacekeeping and security as demonstrated by its contribution of

non-combatant troops to the Iraq War. This involvement in the Iraq war marked the first overseas use of its military since World War II. Japan's shift in policy vis-à-vis international security issues has evolved rapidly following North Korea's outburst on 5 July 2006, when the regime of Kim Jong Il fired off seven missiles, including a long-range ballistic Taepodong-2 into neighbouring seas. While after the firings, Japan immediately called an emergency meeting of the United Nations Security Council, this missile crisis has spurred also major internal discussions about Japan's pacific stance and the ability to defend itself in case of attacks to a greater extend that the previous North Korea missile launch over Japan in 1998. On-going internal debates consider the modification of its constitution as it prohibits the use of military force to wage war against other countries[10], and North Korea nuclear test of a sub-kiloton device on 9 October 2006 has accelerated the debates (Cf. Chapter 7).

One of the biggest problems facing Japan beside the enduring decline of its population, is how to get on better with the neighbours. Japan has several territorial disputes with them. These disputes partly involve the control of marine and natural resources, such as possible reserves of crude oil and natural gas. That is why Prime Minister Abe visited both Seoul and Beijing barely a week after being appointed[11,12] and is attempting to revive the idea of a regional agreement with a proposed membership going as far to Asia's south and west as India.

China in 2006/07

Since the initiation of economic reforms in 1979, China has become one of the world's fastest-growing economies and is increasingly driving not only economic growth in East Asia, but also that of the global economy. In this context, the Chinese Government has tried to slow down the GDP growth of China below 10 % in its 11th Five-Year Plan (2006-10) following the implementation of measures to cool down investment in key sectors with excess capacity to control China's growth due to a fear of potential overheating of the economy.

Already a commercial giant, China has also increased the level of its diplomatic involvement. China is increasingly opening to the World in terms of foreign policy. And, besides traditional diplomatic visit to foreign countries and to international fora it has been increasingly using its "next superpower status" to become a major actor in all domains of international affairs. In particular, China invited leaders from 48 countries to the first Forum on China-Africa Cooperation (FOCAC) held in Beijing in 3-5 November 2006. This Summit, the first of its kind aimed at boosting further the development of bilateral ties and the establishment of a new China-Africa strategic partnership. China's principal interest in the continent is access to natural resources but also to find new markets for its expanding industries.

While economic growth has increased incomes and improved health indicators, as well as reduced overall poverty levels, growth has not been totally benign. Environmental pollution from coal combustion is damaging human health, air and water quality, agriculture and ultimately the economy. Furthermore, current gender imbalance and difference of economic developments between the East coasts and the center of the country remain challenging for China's future stability and prosperity.

India in 2006/07

India's economy has grown by an annual average of about 8% for the past three years and is increasingly establishing itself as a dominant actor of the future. 2006 was a major turning point in India's economic development as Indian companies started to take over major foreign companies such as India's Mittal Steel of the French/Luxemburg's Arcelor

With the rise of India, major countries are now pressing to engage with it and to reach deals to have access to the world's second most populous country. For instance, the U.S has recently reversed its longstanding policy of limited cooperation with India following India's nuclear test of 1974. In a major policy shift and a reversal of three decades of U.S. non-proliferation policy, President George W. Bush signed during his visit to New Delhi in early March 2006 (the first by a U.S. President in six years) a landmark agreement of cooperation in civilian-nuclear activities, illustrating the new leverage gained by India in recent years.

However, despite India's incredible economy display, an alarming number of signs are threatening its future growth. Consumer-price inflation has risen tremendously. Firms are

[10] Japan's military is restricted by Article 9 of the Constitution of Japan of 1946, which states that "Aspiring sincerely to an international peace based on justice and order, the Japanese people forever renounce war as a sovereign right of the nation and the threat or use of force as means of settling international disputes"

[11] Japan's relations with China and South Korea deteriorated badly under his predecessor, Junichiro Koizumi, as disputes over history and territory flared up

[12] The first Summit meeting between a Japanese Primer Minister and Chinese leaders since 2001

experiencing a serious shortage of skilled labour and wages are rising quickly. India has low investment rate problems, particularly in infrastructure which may in mid-term reduce India's growth or at least divert resources, as the Government is trying to reduce geographic disparities in economic development.

2. Global space sector size and developments

The objective in producing this chapter is to establish a consistent and solid baseline of figures that are reliable to the extent possible to provide an easily identifiable measure of the size of the global space sector.

Widely used references for global economic data use the U.S. dollar for their comparative analyses; ESPI used therefore the U.S. dollars as currency of reference in this chapter. While using a single currency for worldwide comparisons is a necessity, portraying national space budgets and commercial revenues in a single country causes strong distortions. What may look like a growth in space expenditure could turn out to be no more than a reflection of a strengthening of a particular currency and vice-versa.

Governmental space expenditures are not always easy to obtain as not every country and space agency publishes detailed annual expenditure on space activities. Moreover, given the opaque nature of defence budget tracking military space budget is extremely difficult since space is not identified as a separate line item in most national defence budgets. The sources for institutional space expenditure data used in this report are, in order of priority: primary sources, that is, official data provided by national governments in their official publications, as well as secondary sources which quote primary data.

Sizing the commercial space sector is also difficult due to the secrecy surrounding commercial contracts etc. ESPI estimations on the commercial space sector draw on many sources of publicly available information from published sources of industry trade associations, articles in mainstream business press and industry magazines and, when available, private information sources, as well as interviews with space leaders from industries.

Finally, when sizing the global sector there is also a definitional problem in measurement that sometimes results in "double counting" of the same expenditures (i.e., government expenditures also appear in industry sales figures). Consequently, the overall size of the space sector can simply be only approximated, and estimates will vary from one study to another.

2.1 Global space budgets and revenues

Global institutional space budgets and space revenues are estimated by ESPI to be about 177.415 billion U.S. dollars in 2006. The revenues of the total space industry are estimated to have reached 111.615 billion U.S. dollars, with the bulk of it generated by satellite services, while the institutional space budgets (including civil and military budgets) accounted for an estimated 65.8 billion U.S. dollars in 2006.

As aforementioned, sizing the institutional sector is particularly difficult given the secrecy of most military space budgets. However, while the estimates of the overall military investment vary depending principally of the evaluation of the size of the U.S. space military budget and Chinese investment in this domain, it is nonetheless unequivocally considered that military space expenditures are growing worldwide and are driving public investments in many countries[13]. Estimating the overall size of the commercial space sector is also difficult since it depends upon the definition of the sector adopted and the data source selected. However, there is a consensus that the annual revenues of the commercial space sector keep increasing in overall terms from one year to another due on the one hand of the higher institutional investments in space, and on the other hand because of the sustained demand for new applications and services.

[13] In this study only the direct unclassified space activities of the U.S. Missile Defense Agency (MDA) are included at the difference for instance of the Space Report published by the Space Foundation which include the overall MDA budget (9 billion U.S. dollars) to the space sector

2.2 Overview of institutional space budgets

Public spending for space programmes at a global level remained robust in 2006 following the expansion of the U.S. space budget, as well as continued growth in space expenditure in space agencies in Asia and a renewed increase of the investment in Russian space activities. World institutional space expenditures are estimated at about 65.8 billion U.S. dollars for the year 2006.

Military/intelligence applications represent the biggest part of public allocations to space activities with an estimated 56% of the world space budget. The remaining is dedicated to civil space programmes, about 29 billion U.S. dollars.

In recent years, the space military/intelligence institutional sector has seen a bigger growth than the space civil sector. However it has to be underlined that the growth of the U.S. military space budget is creating a distortion of the overall space military sector. Nonetheless, it is also important to note that the budget allocated to military/intelligence space activities is certainly underestimated due to the secrecy of defence budgets in general, and particularly for Russia and China.

Although total space military/intelligence budgets are higher than the total budgets of civil space programmes, those latter are more commonly implemented throughout the world than military space programmes. Furthermore, the continuing internationalization of space activities witnessed in recent years[14] is leading to an increasing level of institutional budget allocated to civilian space activities at a global level. However, while the number of countries investing in space is growing, the difference of investment among countries remain high, with the major space faring countries representing an overwhelming majority of the world's institutional expenditures in space activities (and particularly military ones). ESPI has identified about 60 countries with national space programmes and activities, but only about half of them are estimated as investing substantial amounts (more than 10 millions U.S. dollars) per year in their domestic activities.

In general, it can be observed that North America, Europe and Asia are the main regions investing in institutional space activities. North America invested around 81 % of all public funding in space followed by Europe with about 11%, Asia with about 5% and ex-U.S.S.R. countries about 2% while the investments of the rest of the world were very limited. However, there is a clear difference in dynamics when comparing North America under the impulsion of the United States, Asia and the ex-U.S.S.R. countries that are increasing their space efforts, and Europe institutional investment in space that remains somewhat constant (Cf. Chapter 5).

In 2006, three main space powers dominated the institutional sector concentrating about 95% of world public funding for space activities. The United States with a budget estimated at about 53.13 billions U.S. dollars, Europe when considering its consolidated budgets with about 7.644 billion U.S. dollars and Japan with about 1.53 billions U.S. dollars[15] were the main space powers by their budgets.

Looking at individual countries, the United States was by far the biggest investor in space followed distantly by France, Japan, Russia, Germany and Italy that spend all more than 1 billion U.S. in 2006 on public space activities (Figure 2.1).

This hierarchy has been very stable in recent years. However actors like Russia, China, India and South Korea are increasingly investing in space and are foreseen to rapidly catch-up with European space powers like Italy and Germany. However, for those economies (Russia, India and China) relying solely on absolute volume of institutional investment is misleading to assess their national space efforts because of the significant differences in production cost from one country to another, as well as in the local standard of living and local purchasing power. In light of those methodological problems other metrics must be used to be able to have a more accurate snapshot of the investment of a country in the space sector, as well as the hierarchy of space powers.

[14] Peter N.: "The changing geopolitics of space activities" Space Policy, Volume 22, Issue 2, Pages 100-109 May 2006

[15] The data for Japan comprise only the JAXA budgets

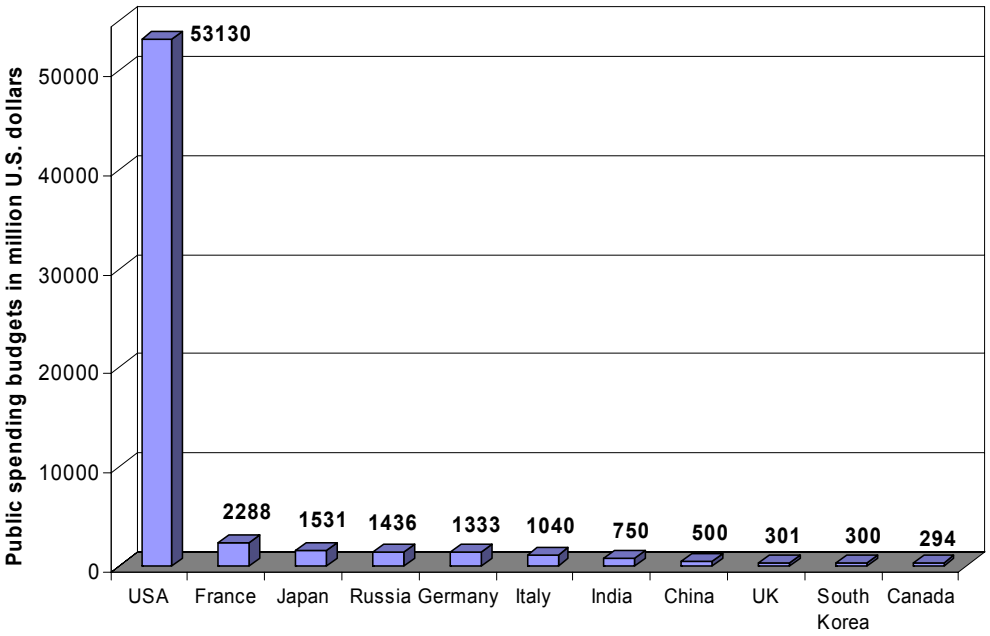

Figure 2.1 Estimation of the public space budgets in 2006 of the major space powers

One of the traditional indicators used to compare the effort of countries in space is the share of gross domestic product (GDP) devoted to institutional space activities in a country. This metric is used as a rough indicator to show a country's effort to support domestic institutional space activities.

With about 0.433 % of their GDP dedicated to public space budgets in 2006, the United States was the leading country with regard to the priority given to space activities followed distantly by France and Russia (Figure 2.2). When using this metric it is interesting to note the relatively good performance of non-traditional space powers such as Belgium, Switzerland, Sweden, Norway, the Netherlands or Austria that are investing a significant share of public funding to space activities (Figure 2.2).

Nonetheless, when looking only at the countries investing about 300 millions U.S. dollars and more in 2006, we can observe that besides the United States, the other space powers invested between 0.125% and 0.005% of their GDP into public space activities (Figure 2.3). A first cluster of countries investing between 0.125% and 0.09% of their GDP into public space activities composed of France and Russia can be seen. A second cluster of countries investing between 0.062% and 0.053% of their GDP for public space expenditures composed of Italy and Germany can be observed. A third cluster of countries investing between 0.04% and 0.016% of their GDP in public space activities is made up of Spain, South Korea, Canada, India and the UK. Finally, at the end of the spectrum is China with an estimated investment of 0.005% of its GDP for public space activities. This figure has however to be considered with care as there is undoubtedly an underestimation of the Chinese public space investments (Cf. Chapter 3).

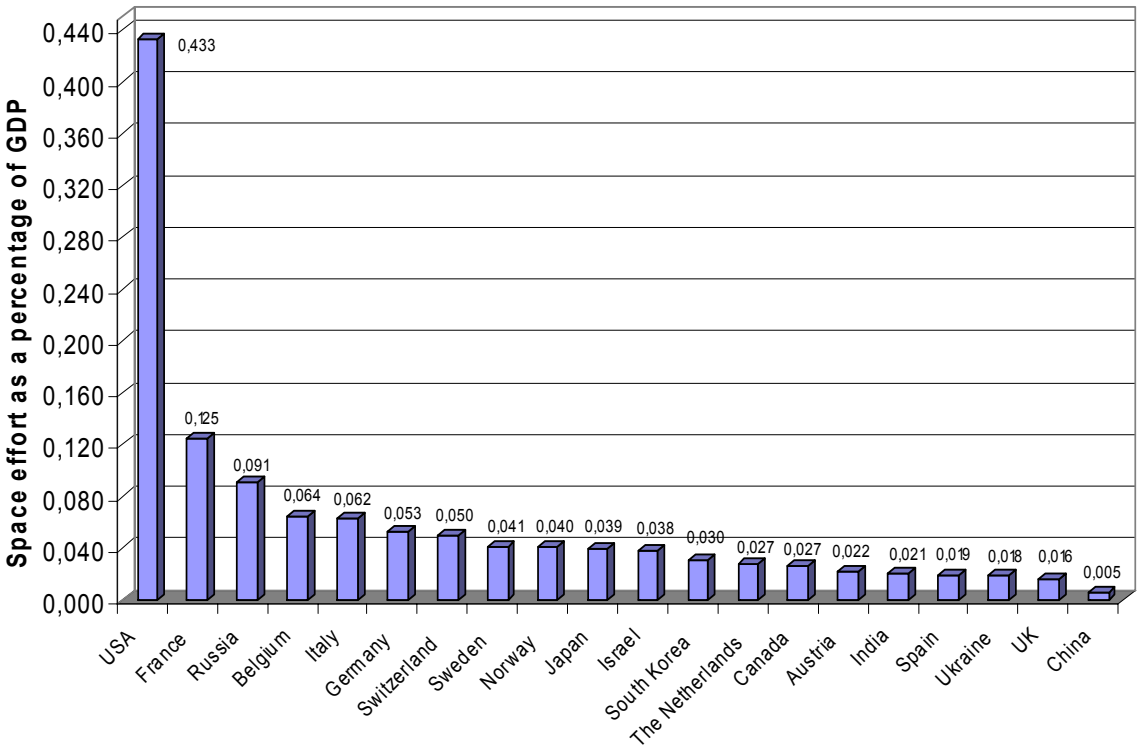

Figure 2.2 Estimation of the major 20 public space budgets as % of GDP in 2006

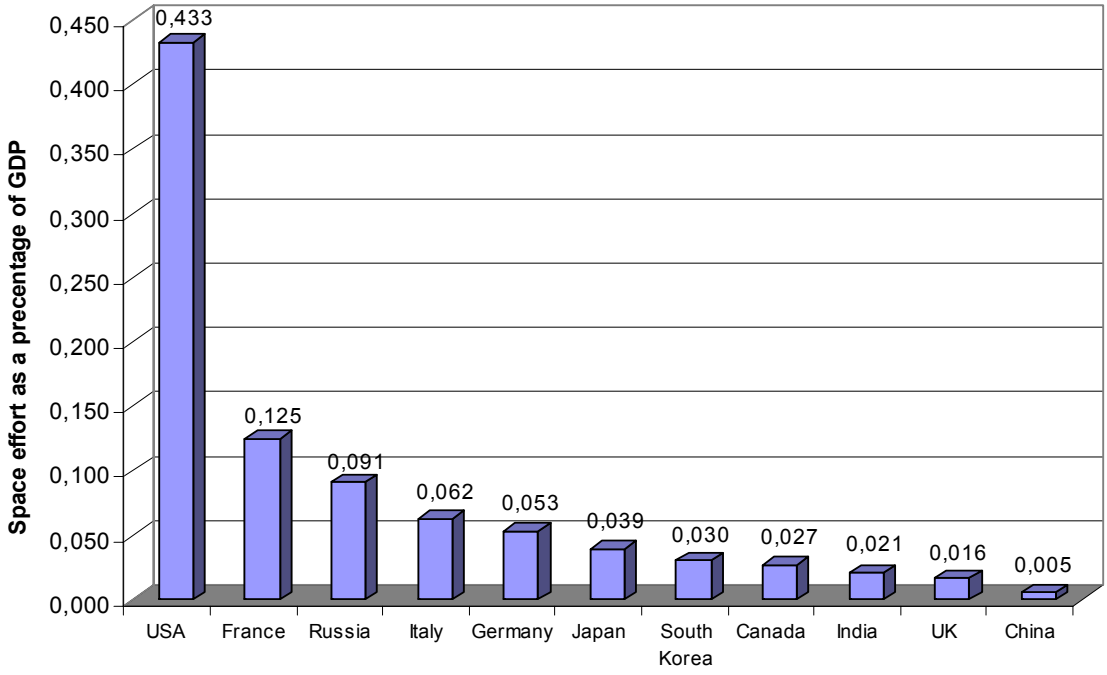

Figure 2.3 Estimation of the public space budgets as % of GDP for the major space powers in 2006

When looking at the national public investment per capita, the United States spent about 178 U.S. dollars per citizen in 2006, while the second biggest spender, France, spent just about 37 U.S. dollars per citizen for public space activities for the same period (Figure 2.4). Like for the previous indicator, the important space effort of Belgium, Norway, Switzerland and Sweden relative to their overall investments in space are also noteworthy (Figure 2.4).

Besides the aforementioned investment of the United States and France, the major space powers that invested more than 300 millions U.S. dollars on public space affairs invested between 18 and 9 U.S. dollars per inhabitant in 2006 (Figure 2.5).

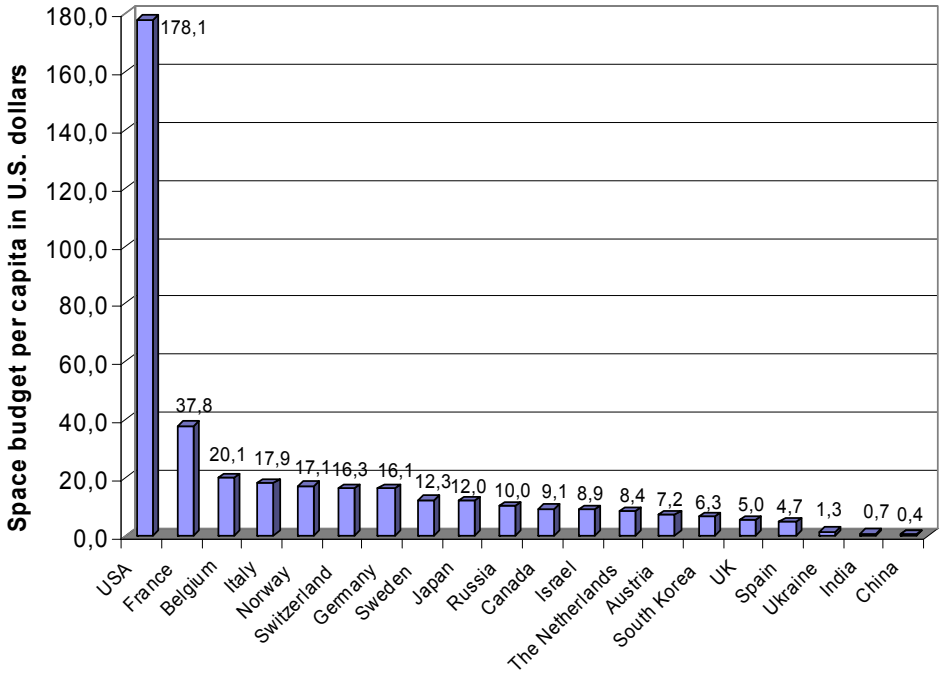

Figure 2.4 Estimation of the public space budgets per capita for the major 20 space powers in 2006 in U.S. dollars

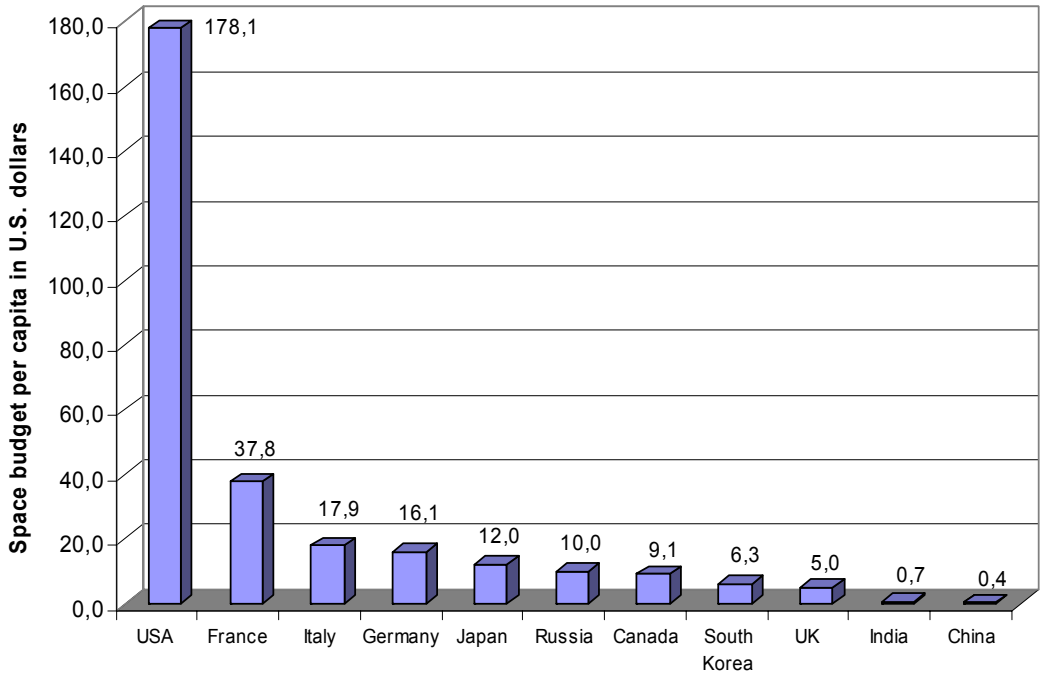

Figure 2.5 Estimation of the institutional space budgets per capita for the major space powers in 2006 in U.S. dollars

It has however to be underlined when using this metric the relatively bad performance of India and China due to the size of their population.

An innovative and new indicator to assess the budgetary space effort of major space powers is to plot the share of the budget devoted to space affairs as a percentage of GDP compared with the space budget per capita. It appears when using this metric that the United States is clearly unique in the space sector and apart from the other space powers.The United States is the only country in 2006 spending more than 0.13 % of its GDP on public space activities and more than 38 U.S. dollars per citizen on public space activities (Figure 2.6).

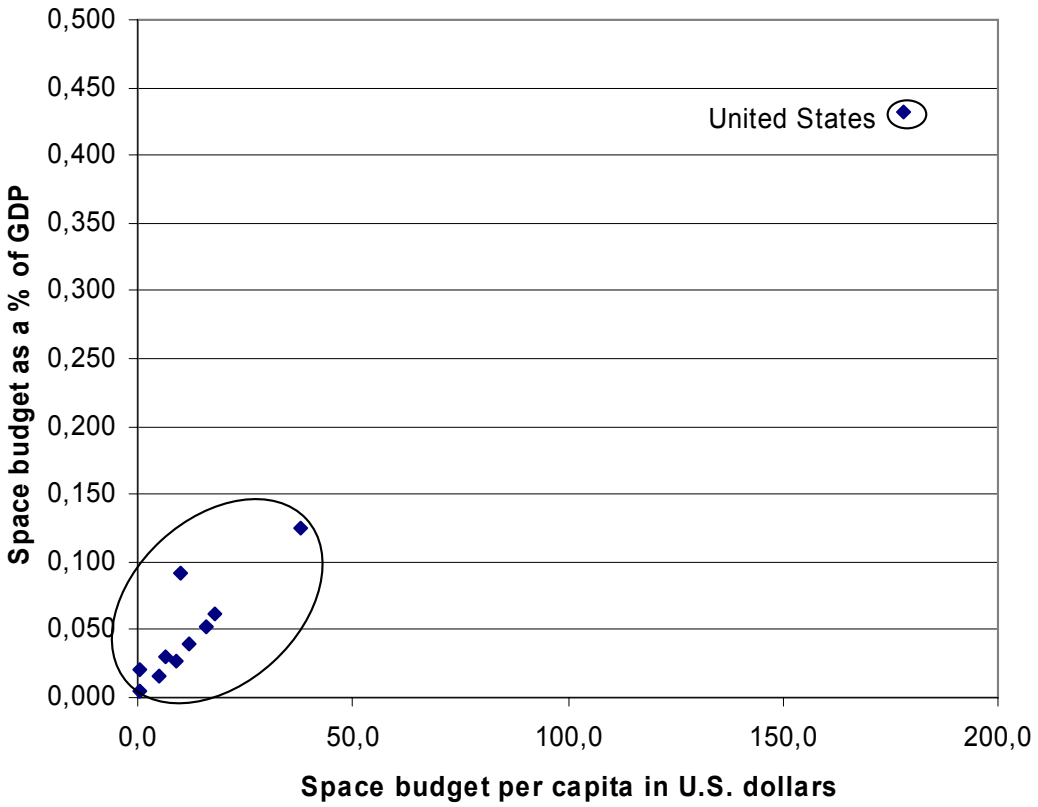

Figure 2.6 Mapping of the share of GDP institutional space expenditure compared to the spending per capita of the major space powers in 2006

When removing the United States it appears that several clusters of countries can be observed (Figure 2.7). A first cluster composed of France and Russia, two countries that invested in 2006 more than 0.09% of their GDP on public space activities and at least 10 U.S. dollars per capita can be observed (Figure 2.7). A second cluster made up of countries that invested between 0.039% and 0.062% of their GDP and 10 U.S. dollars per citizens in 2006 can be seen. This cluster is made up of Italy, Germany and Japan. A last cluster made up of South Korea, Canada, India, the United Kingdom and China that invested less than 0.03 % of their GDP on public space activities and less than 10 U.S. dollars per inhabitants on domestic public space affairs in 2006 can be observed (Figure 2.7).

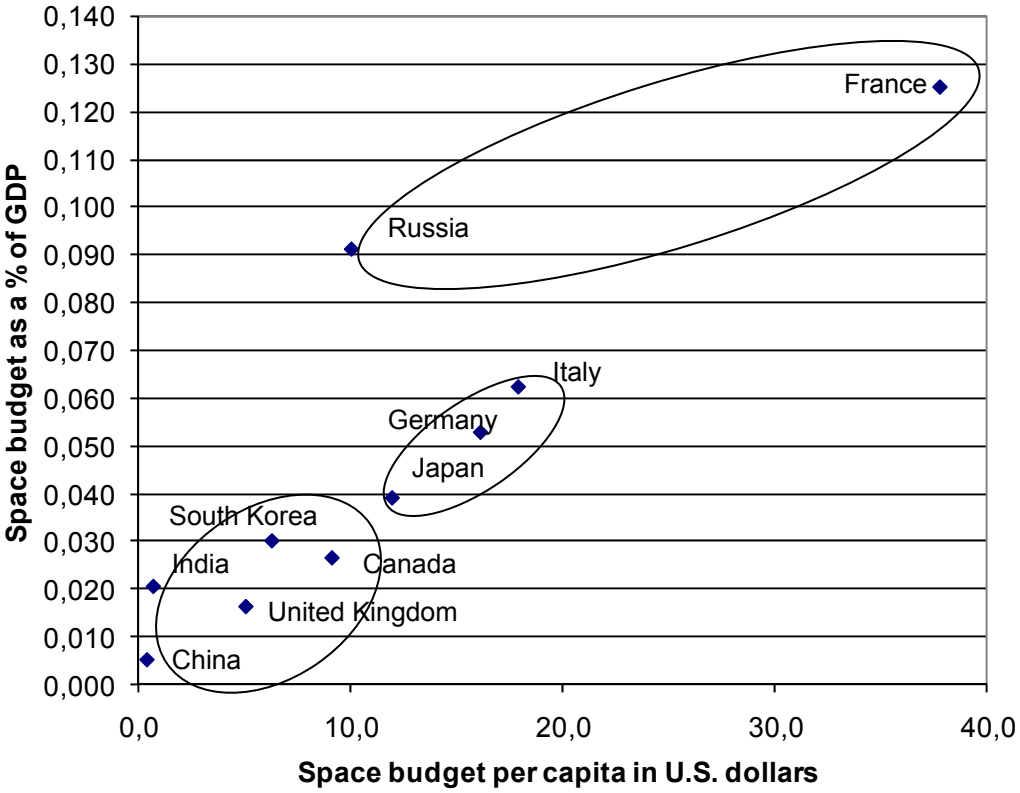

Figure 2.7 Mapping of the share of GDP public space expenditure compared to the spending per capita of the major space powers in 2006 without the United States

This new indicator allows therefore mapping the overall institutional investment in space affairs of major space powers, and outlines the singular position of the United States as hegemon in terms of public investment, but also the relative good performance of major European space powers.

When looking at the top 10 space institutions according to their budget, this list is unsurprisingly dominated by a series of U.S. agencies, with 5 out of 10 (Table 2.1). The Department of Defense (DoD) is the biggest space agency in the world with an estimated budget of more than 22 billion U.S. dollars for 2006 followed by the National Aeronautics and Space Administration (NASA) with more than 16 billion U.S. dollars. When taken together those two organizations concentrate over 60 % of all institutional budgets spent on space in the world (39 billion U.S. dollars in 2006). The United States has also two intelligence-related agencies in the top 5, one in charge of developing and operating dedicated space assets, the National Reconnaissance Office (NRO) and another one to exploit the data gathered, the National Geospatial-Intelligence Agency (NGA) (Table 2.1). ESA is the second civilian space agency in the world after NASA, but preceding JAXA, CNES, Roskosmos and ISRO (Table 2.1).

Rank	Agency	Country	Value in billion U.S. dollars
1	DoD	USA	22.50
2	NASA	USA	16.62
3	NRO	USA	9.90
4	ESA	Europe	3.77
5	NGA	USA	2.67
6	JAXA	Japan	1.53
7	CNES	France	1.39
8	NOAA	USA	0.96
9	Roskosmos	Russia	0.84
10	ISRO	India	0.75

Table 2.1 Estimation of the top 10 space institutions according to their space budget in 2006

2.3 Overview of commercial space markets

Space economic activities are difficult to estimate as they do not have a unique industrial category in the statistical classification system. The hardest part of preparing an overview of the space industry is therefore defining it, as the space sector is composed of a diverse range of industries and businesses providing products and services to various stakeholders. Furthermore, due to the secrecy associated with commercial deals sizing the commercial space sector is particularly difficult.

This section looks at the global economic activity associated with space infrastructures and space products and services. There are many estimates of revenues available in the literature, but in order to ensure consistency and to eliminate double counting, principally the Satellite Industry Association's (SIA) Satellite Industry Survey data are being used, despite several approximations[16]. This data set has however also been completed with other information.

ESPI estimates the overall commercial space sector at about 111.615 billion U.S. dollars in 2006. Satellite-based products and services represent the greatest portion of commercial global revenues and particularly Digital Broadcast Services (DBS) and Ground Station and equipment (Table 2.2). However, DBS revenues include revenues that are often not considered by many analysts as being space related as they provide just content. Nonetheless DBS use satellite assets and drive both the satellite manufacturing sector as well as the demand of launch services. Furthermore, one of the fast growing market that is often excluded from many analysis, the localisation/navigation market for products and services has been included in this study.

Type	Value in billion U.S. dollars
Satellite manufacturing (commercial)	2.92
Launch industry (commercial)	1.42
Ground Stations and equipment	28.80
Digital Broadcast Services (DBS)	48.50
Fixed Satellite Services (FSS)	12.10
Mobile Satellite Services (MSS)	2
GPS equipment	15.0
Insurance	0.85
Orbital tourism	0.025
Total	**111.615**

Table 2.2 Estimated breakdowns of global space revenues in 2006

[16] The results of the study "State of the Satellite Industry Report" released in June 2007 sponsored by the SIA and prepared by Futron Corporation covers four satellite industry segments (satellites services, launch industry, satellite manufacturing and ground equipment). This study is based on questionnaire targeting large companies operating on the satellite industry. The data is augmented with publicly available data and other industry research to calculate total industry revenues. All launch industry and satellite manufacturing revenues are recognized in the year of launch, not the year the contract is awarded. And, all revenues are in then-year dollars (not adjusted for inflation)

After few difficult years, the satellite industry has begun to rebound as new applications are driving services demand such as High Definition Television or online web mapping. These factors flow through the space industry as new user solutions drive demand for more innovative satellites (particularly direct-to-home television broadcasting and two-way internet services). Nonetheless, world satellite-industry revenues when broken down by sectors of the industry: satellites services, launch industry, satellite manufacturing and ground equipment show that not every space industry sector experienced growth in 2006 (Figure 2.8).

When looking at the Figure 2.8, it appears that satellite services are becoming increasingly important and in 2006 it reached 59% of total space revenues, from 45 % in 2000. Ground equipment represented about 27% of the world space revenues and grew by 14% from 2005. Launch revenues in 2006 represented 3% of worldwide satellite industry revenues and are at a level similar that of 2004 (Figure 2.8). It was however the only sector that experienced a decline over 2005. Finally, satellite manufacturing revenues increased by more than 50% to 12 billion U.S. dollars in 2006.

Satellite services

Satellite services had a sustained growth with revenues reaching about 62.6 billion U.S. dollars in 2006. Space-based telecommunications (including, voice and data) are the major source of revenues in this value-added services sector. However, the development of new services linked to space-based positioning and new business models in Earth observation with the development of web-based portal using satellites imagery are becoming increasingly important for space industry. In broad terms, the satellite services market is being made up of three sectors: Digital Broadcast Services (DBS), the Fixed Satellite Services (FSS), and Mobile Satellite Services (MSS). DBS represented 78 % of the total satellites services revenues in 2006 from 63 % in 2000. DBS is followed by FSS that represented 19 % of world satellite revenues in 2006, from 31 % in 2000. MSS represented in 2006 only 3 % down from 5 % in 2000 (Figure 2.9).

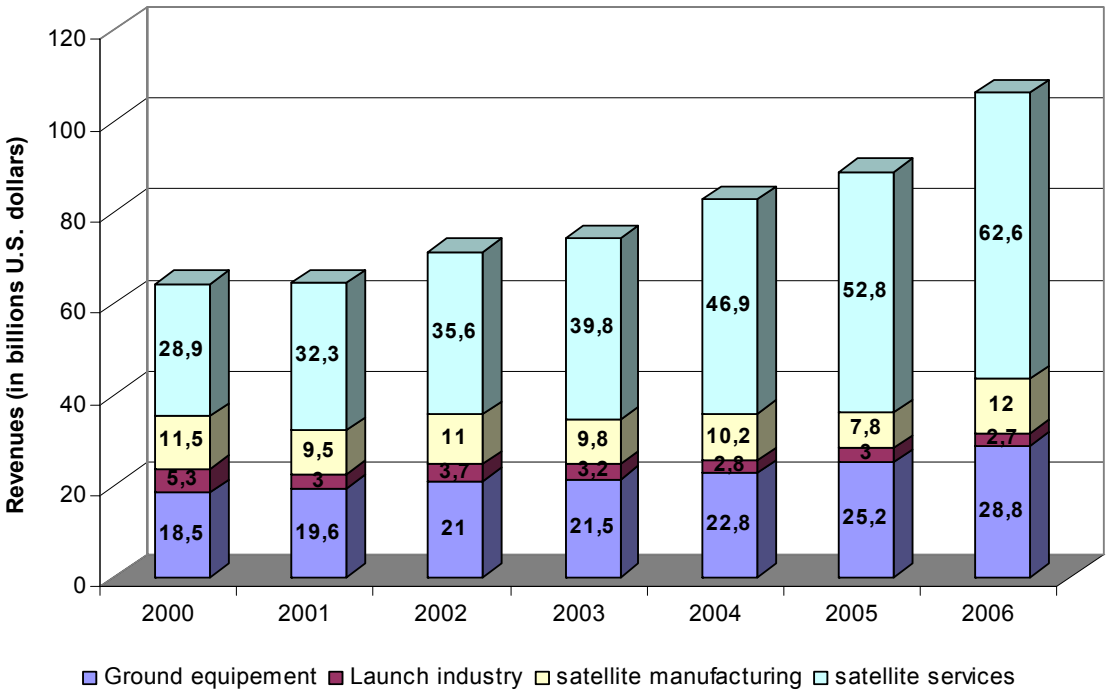

Figure 2.8 World satellite industry revenues by sector (Source Futron/SIA)

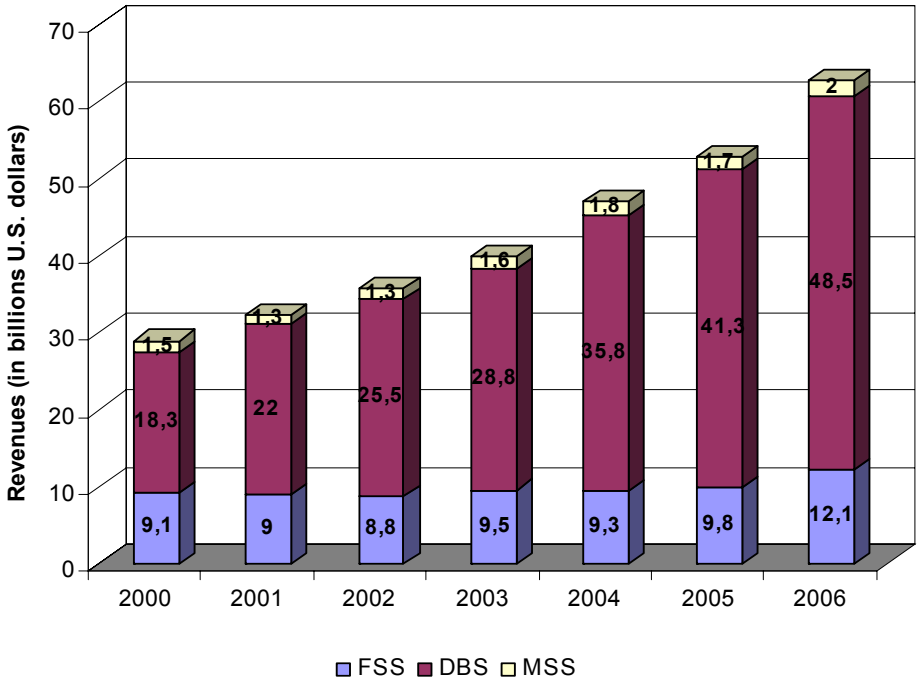

Figure 2.9 World satellite services revenues (Source Futron/SIA)

Digital Broadcast Services (DBS)

DBS is principally made up of direct-to-home television and satellite radio services. The SIA estimated that in 2006, DBS revenues were about 48.5 billion U.S. dollars with direct-to-home television services representing the largest portion of satellite services revenues compared to 18.3 billions U.S. dollars in 2000.

Until recently, High Definition Television (HDTV) seemed relegated to being a niche market service, however, it is now widely accepted that HDTV is emerging as mass-market product and has become a major driver in terms of the demand for satellite capacity for new services. In the United States, which is the biggest market, there are two major direct-to-home television services providers: DIRECTV and Echostar. Both companies have seen double digit revenues growth principally fuelled by subscriber growth (Table 2.3)

Company	Revenue in 2006 in billions US dollars	Revenue increase 2005/06	Subscribers
DIRECTV	13.744	+ 13%	15 950 000
Echostar	9.82	+ 16.2%	13 105 000
Total	**23.564**	**-**	**29 055 000**

Table 2.3 Direct-to-home revenues in the United States in 2006

The other main segment of the DBS sector is satellite radio, and this segment is an increasing domain of revenues growth for the space industry. Satellite radio revenues in 2006 were about 1.586 billion U.S. dollars, from three firms. XM Radio, Sirius Satellite Radio and WorldSpace (Table 2.4)[17]

Company	Revenue in 2006 in millions US dollars	Revenue increase 2005/06	Subscribers
XM Radio	637.2	+163%	6 024 555
Sirirus Satellite Radio	933.4	+67%	7 629 000
WorldSpace	15.6	+34%	199 105
Total	**1586.2**	**-**	**13 852 660**

Table 2.4 satellite radio services revenues in 2006

Fixed Satellite Services (FSS)

FSS revenues were estimated at about 12.1 billion U.S. dollars in 2006 up from 9.8 billion U.S. dollars in 2005. For the SIA the FSS market includes telephone, data, and video transponder leasing, as well as remote sensing.

In 2006, Intelsat has become the world's largest operator in FSS in front of SES Global and Eutelsat. It reported for the year 2006 revenues of 2.1 billion U.S. dollars[18]. Despite the purchase of New Skies Satellites by SES Global, the Luxembourg-based company has fall to the second rank in 2006 with revenues of about 1.9 billion U.S. dollars. The third FSS provider, Eutlesat, posted revenues of about 1.05 billion U.S. dollars[19] in 2006.

In the SIA study, remote sensing revenues are included in the FSS data. Revenues for global commercial space-based Earth observation grew by 16% from 2005 to 2006 driven by new and continuing military and intelligence imagery contracts, as well as expanding civil and commercial imagery markets, including online mapping services[20].

Currently, there are only a limited number of commercial providers of satellite imaging and collectively they represent only a small portion of the space industry. But the commercial satellite imagery is becoming an increasing input in a larger sector: the geospatial industry. The market of optical Earth observation can be split in two main segments: the Very High Resolution (VHR) satellite imagery market (less than 2 meters) and the Medium Resolution (MR) satellite imagery market (2-5 meters)[21].

DigitalGlobe, and GeoEye are the leaders for the VHR satellite imagery segment with ImageSat being also a player in this market. Following the Orbimage acquisition of Space Imaging, which was completed in January 2006, GeoEye is now the largest commercial remote sensing company in the world. Its revenues for the year ended 31 December 2006 were 151.2 million U.S. dollars[22]. All of the 110.5 million U.S. dollars increase in 2006 revenues over 2005 resulted from the operations acquired from Space Imaging[23,24] The U.S. government, and particularly the NGA, is GeoEye's single biggest customer. In 2006, it recognized revenues of 70.6 million U.S. dollars from the U.S. Government. It reported also that international customers represented a substantial portion of its revenues in 2006 at about 70.2 million U.S. dollars[25]. The second provider of VHR satellite imagery is the U.S. company, DigitalGlobe that markets the imagery of its QuickBird satellite launched in 2001. The third main provider of VHR satellite imagery is ImageSat International N.V. which is a Netherlands Antilles company with offices in Limassol, Cyprus and Tel Aviv, Israel and markets the satellite imagery collected by its Earth Remote Observation Satellite (EROS) satellites.

The MR satellite imagery market is dominated by Spot Image of France with other actors selling extra capacities like India or Japan.

[17] XM Radio and Sirius Satellite Radio operate mainly in North America, while WorldSpace is a global satellite radio

[18] de Selding P.: "Top Fixed Satellite Service Operators" Space News 25/6/2007

[19] Ibid

[20] Companies active in the global commercial space-based Earth observation market can be divided into two segments: companies marketing satellite imagery, and companies processing the data and producing value-added services for various markets such as for instance precision farming. This analysis focuses on the first segment, the companies marketing satellite imagery

[21] So far, the commercial satellite imagery business consists mainly of optical imagery, however in the upcoming months new space assets will complement the only operating Radar satellite (Canada's Radarsat-1): TerraSAR-X from Germany, CosmoSkyMed from Italy, RadarSat-2 from Canada and RapidEye's 5 satellites from Germany.

[22] GeoEye/Inc 10-K For 12/31/06 released on 15/3/07

[23] Ibid

[24] It is believed by many analysts that, with this acquisition, GeoEye has become the number one VHR imagery provider and that its 2006 annual revenues exceeded those of DigitalGlobe

[25] GeoEye/Inc 10-K For 12/31/06 released on 15/3/07

Spot Image[26] sells products and services derived from the Spot Earth observation satellites (Spot 5 and 4). In 2006, Spot Image had revenues estimated at about 95 million U.S. dollars (+30% in two years). Spot Image, like its U.S. counterpart depends principally on institutional contracts, but like GeoEye and DigitalGlobe, an increasing source of revenues is also as a supplier of commercial satellite imagery for mapping services. On 22 January 2007 it has entered into an agreement with Google in order to improve the available resolution of Google Earth products over wide areas of the world. Under a multi-year agreement, Spot Image will provide Google Earth with 2.5 meter resolution imagery taken from the SPOT 5 satellite[27].

Mobile Satellite Services (MSS)

Following the crisis created by the fiasco subsequent to the deployment of the LEO constellations at the end of the last decade, MSS is now a mature market segment enjoying healthy growth and with good prospects with the introduction of the latest generation of mobile satellites and services[28]. SIA estimated in 2006 that MSS revenues were about 2 billion U.S. dollars, up from 1.7 billion U.S. dollars in 2005. The MSS market is dominated by three MSS providers: Iridium Satellite LLC, Globalstar and Inmarsat, as well as several regional operators.

Iridium Satellite LLC which operates a constellation of 66 cross-linked satellites (plus multiple in-orbit spares) for commercial mobile satellite services for voice announced that it has 175 000 subscribers worldwide as of 31 December 2006[29]. The new figure represents a 23.2 % increase over last year's subscriber total. Iridium's revenues for the full year 2006 were about 212.4 million U.S. dollars[30].

Globalstar, which is another global LEO satellite constellation providing voice and data service to businesses, government and individuals announced an increase during the past 12 months of 34% of its subscriber base to approximately 263 000 with operating income of 15.7 million U.S. dollars for the full year[31]. The third global MSS provider is the London-based Inmarsat. At the difference of the Iridium and Globalstar it operates a satellite fleet on GEO. Its total revenues in 2006 were of about 500 million U.S. dollars a 1.8 % increase from 2005, with MSS revenue up 4% to 491.8 million U.S. dollars[32]. Inmarsat reported modest growth in revenues and gross profit margins in 2006 due to an increase competition of its land-mobile services.

Several regional MSS operators operating GEO satellites are also providing satellite-based mobile telephone services to limited regions. The most successful is Thuraya that is based in the United Arab Emirates that provide coverage to principally Europe, the Middle East and Africa. According to Inmarsat 600 000 hand-held satellite phones are now in use worldwide, with Thuraya from Abu Dhabi having a 50 % market share despite its lack of global reach[33].

Satellite manufacturing

According to the SIA, in 2006 total commercial and government satellite manufacturing revenues were of about 12 billion U.S. dollars up from 7.8 billion U.S. dollars in 2005 (Figure 2.10).

[26] The major shareholders of Spot Image are the CNES (41%), EADS (40%), Telespazio (7.7%), IGN (2.7%), Banks (1%), the Belgium government (0.6%) and others (0.3%)
[27] Spot Image Press release 22/1/2007
[28] Among the 2006's highlights was the return to the stock market of Globalstar and Orbcomm as both raised sufficient capital on the U.S. Nasdaq market to permit them to move forward on second generation satellite constellations. In the mean time Inmarsat acquired ACeS and launched its new service Inmarsat BGAN
[29] Iridium Press Release 14/2/2007
[30] Ibid
[31] Globalstar Press Release 28/3/2007
[32] Inmarsat Press Release 27/02/2007
[33] de Selding P.: "Inmrasat Post Modest Gain in 2006" Space News 5/3/2007

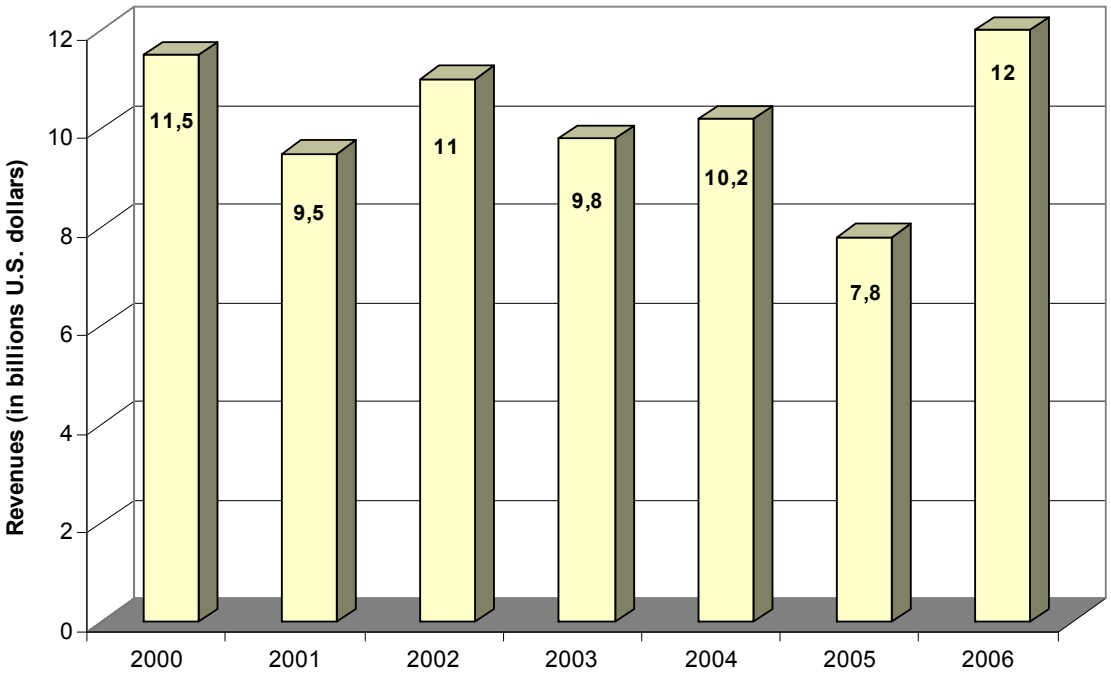

Figure 2.10 World satellite manufacturing revenues (Source Futron/SIA)

Launching sector

The SIA estimates that in 2006 the total launch vehicle industry at about 2.7 billion U.S. dollars including commercial and governmental launches (Figure 2.11), in decline from pervious year.

Based on estimates form the United States Federal Administration Aviation (FAA) in 2006, the revenues of the 21 commercial launches was evaluated at about 1.4 billion U.S. dollars. The breakdown of the international commercial launch vehicle industry in 2006 was as follows: Europe had about 560 millions U.S. dollars of revenues, Russia had about 444 millions U.S. dollars of revenues, multinational revenues (Sea Launch) had about 350 millions U.S. dollars of revenues and the United States had revenues of about 70 millions U.S. dollars.

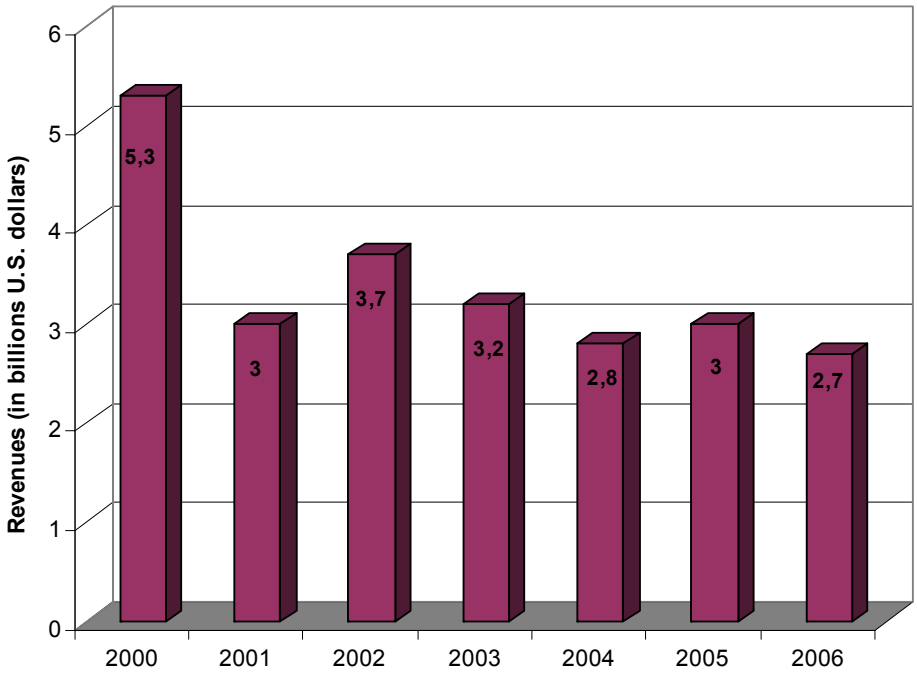

Figure 2.11 World launch industry revenues (Source Futron/SIA)

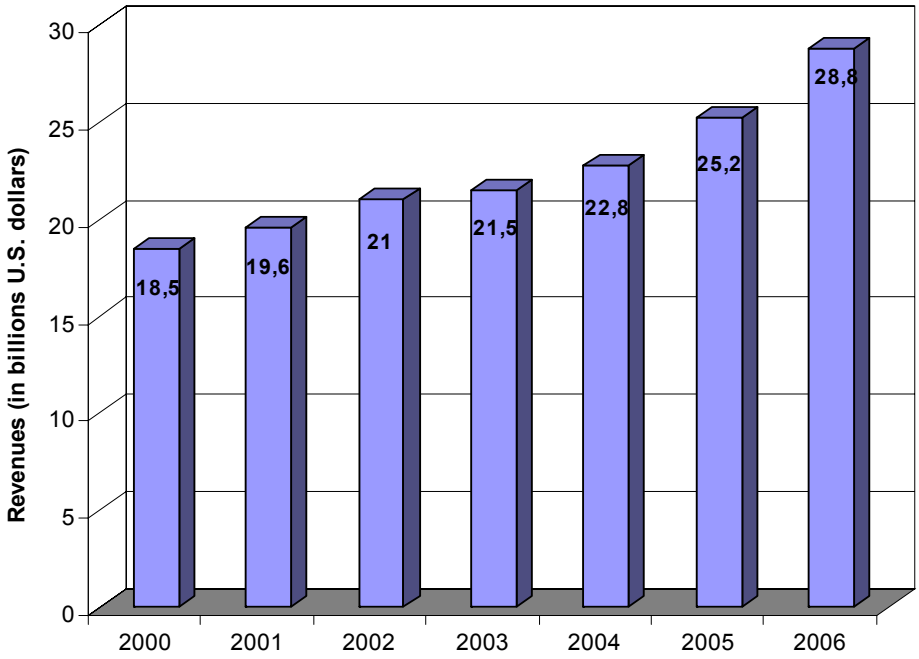

Figure 2.12 World ground equipment revenues (Source Futron/SIA)

Ground equipment

The overall revenues in ground equipment sector grew of about 14% over 2005 to reach 28.8 billion U.S. dollars in 2006 according to SIA data (Figure 2.12). The biggest driver for this revenue is end-user equipment, particularly for key consumer services such as satellite radio and direct-to-home television.
Ground equipment revenues includes infrastructure elements such as mobile terminals, gateways, control stations, as well as end-user equipment such as very small aperture terminals (VSATs) and ultra small aperture terminals (USATs), direct-to-home broadcast dishes, satellite phones and digital audio radio satellite (DARS) equipment. Therefore this number overstates the revenue associated with ground station infrastructure per se, but this number does not include revenues for end-user electronics that incorporate GPS chip sets such as Personal digital assistants (PDAs) and cell phones. However, as the potential new uses for satellite navigation devices and services are constantly expanding, the position, navigation and timing sector is a rapidly expanding market. Companies active in this sector can be divided into two segments: companies developing the hardware such as personal navigation devices (PNDs) and microchips, and companies providing localization and navigation value-added services[34].

[34] In this analysis only companies developing navigation-related hardware are considered

The global market for GPS devices hit 15 billion U.S. dollars in 2006 according to the GPS Industry Council, a trade group based in Washington. Furthermore, this global market is expanding at a rate of 25-30% annually[35]. According to the European manufacturer, TomTom, the European and North American market for PNDs will together grow to around 18 million units in 2007, up from over 10 million units in 2006. The European market for PNDs is estimated to grow to around 14 million units in 2007, up from around 8 million units in 2006, and the North American market is estimated to grow to around 4 million units, up from around 2 million units[36]. In 2006, TomTom revenues increased by 89% to 1.364 billion euros[37] or about 1.637 billion U.S. dollars, while for the other PNDs main provider, Garmin, saw its total revenue for 2006 increase by 33% to just under 1.8 billion U.S. dollars[38].

Emerging markets

Besides the traditional commercial space sectors, two emerging markets: orbital and suborbital spaceflight, have gained momentum in the last years, and 2006 was no exception.

[35] Kramer A.E.: "GPS alternatives take flight" International Herald Tribune. 3/4/07
[36] TomTom Press release February 22, 2007
[37] Ibid
[38] Garmin Press Release February 14, 2007

In September 2006, Anousheh Ansari became the fourth private astronaut to travel to the ISS followed on April 2007, by Charles Simonyi[39]. The former chief architect of Microsoft, Simonyi, booked his flight, like the others, through the U.S. firm Space Adventures, and is reported to have paid between 20 and 25 million U.S. dollars for a 13-day trip into space.

Bigelow Aerospace, the Las Vegas-based company developing inflatable orbital habitats, released new details about its business plan at the National Space Symposium in April 2007. Bigelow Aerospace announced it was planning to launch a series of inflatable modules starting around 2010 that would be capable of hosting between three and six people at a time. Several modules would be linked together to form a single space station, with multiple such stations planned. It foresees to have two distinct types of customers. One group of customers, called "sovereign clients", would be astronauts from national space agencies that would pay just under 15 million U.S. dollars for a four-week stay, transportation included. A second set of customers, called "prime clients", would be large companies interested in leasing module space for research[40]. Bigelow Aerospace launched successfully its first subscale test module, Genesis 1, on 12 July 2006. It allowed testing new technologies, as well as attitude control mechanisms. Bigelow's second test module, Genesis 2, was launched on 28 June 2007 also onboard a Dnper 1 rocket and is since operating successfully. Genesis 2 is the second pathfinder space module designed to test and confirm systems for future manned commercial space modules. It announced also during the 2007 National Space Symposium an agreement with Lockheed Martin to study the use of the Atlas V as a potential launch vehicle for its space station modules and for the prospective space tourist who may want to visit them.

In the field of suborbital flights, work on the SpaceShipTwo prototype is moving forward, as is the fabrication of the White Knight 2 mothership, and at this point spaceline operator Virgin Galactic is eyeing early 2010 as the beginning of commercial flights with paying customers. The price to buy a ticket now is 200 000 U.S. dollars which covers pre-training, the suborbital trip and post-landing activities. Virgin Galactic has been reported to have 20 million U.S. dollars in deposits, and more than 200 customers who have actually made a financial commitment[41].

On 13 June 2007 EADS Astrium disclosed the basic design of the space plane it proposes to build for suborbital space tourism venture. It intends to build a four-passenger rocket-equipped jet designed to take off from a normal runway (liquid methane and liquid oxygen engine). EADS Astrium plans to attract as many as 45 000 paying customers per year by 2020 at 267 000 U.S. dollars per ticket. The company gives itself until the end of the year to round up financial partners in the project that is estimated to cost about 1 billion euros to complete the plane's design and development and flight-qualifying the proposed vehicle.

In June 2006 was issued the sixth license for non-federal commercial launch site operator in the United States to the Oklahoma Space Industry Development Authority. 2006, was also the first year in which permitted flights for the developmental reusable suborbital rockets occurred[42]. Six such flights were conducted in 2006 and four in the first half of 2007. Armadillo Aerospace carried out seven of these permitted flights, with five of them using one of its vertical-takeoff during the Lunar Lander Challenge at the 2006 Wirefly X Prize Cup. Blue Origin conducted one flight in 2006 and two in 2007, for the tests of its vertical-takeoff, vertical-landing rocket, named Goddard, as part of the New Shepard programme. On 6 April 2007 the FAA released also new guidelines for obtaining a one-year experimental launch permits for reusable spacecraft that will give developers the opportunity to fly and test their vehicles before applying for an FAA launch license[43].

[39] Both Ansari and Simonyi followed the Americans Dennis Tito (2001) and Greg Olsen (2005), and the South African Mark Shuttleworth (2002)

[40] Bigelow expects to require up to 30 launches a year by the middle of the next decade to transport customers to and from the stations

[41] David L. "Virgin Galactic Spaceliner Steps Forward" Space News 26/2/2007

[42] Under direction and delegation of the Commercial Space Launch Amendments Act of 2004 (CSLAA), enacted on December 23, 2004, the FAA has established an experimental permit regime for developmental reusable suborbital rockets. This allows for more flexibility in vehicle development and test flights prior to or instead of issuance of a commercial launch license. In contrast to licensed flights, permitted flights cannot carry property or people for compensation or hire, and any damages that may occur under permitted flights are not eligible for indemnification

[43] However, none of the flights covered by an experimental permit, like earlier permit for the developmental reusable suborbital rockets, can be flown for profit. Each permit will cover multiple vehicles of a particular design and will allow an unlimited number of launches when conducted in an area large enough to contain its trajectory that is not close to any densely populated areas, and those permits will be renewable following FAA review

3. Global space policies and strategies

Major space faring countries have been particularly active in 2006/07. This period was also marked by the increased presence of China and India, a renewal of Russia's ambitions, a policy-driven transition in Europe and Japan and a rousing of new programmatic developments in the United States, particularly in space exploration. The increasing internationalization of space activities was also a striking feature of this period with several new comers laying down the foundations of future activities and plans.

3.1 Europe

2006/07 was particularly dynamic and successful for Europe (defined as the EU, ESA, Eumetsat and their member states) in space. In particular, the first European Space Policy was adopted in spring 2007. This collective European Space Policy has a historic and symbolic value as it provides for the first time a EU dimension to space policy developed and implemented since 30 years by ESA member states collectively or individually.

In recent years, there have been a number of reports, as well as official communications by various European stakeholders leading to the development and the formalization of a European space policy. Following those peregrinations the first formalized "European Space Policy" was presented on 26 April 2007 as a joint Communication from the EC to the Council and the Parliament and as a proposal from the ESA Director General to the ESA Council[44]. It was also accompanied by an EC Staff Working Paper on the "Preliminary elements for a European Space Programme"[45]. This document establishes a comprehensive political framework for the development and exploitation of space technologies and systems in Europe and outlines the strategic guidelines for its future activities in space, defining priorities and key actions[46].

The April 2007 on European Space Policy presents the European vision for space and its related priorities and objectives, including access to space, space technology applications, industrial policy and international relations. This document is a proposal for a fully functional European Space Programme that will be a common, inclusive and flexible platform encompassing all activities and measures to be developed at national and European level in order to achieve the objectives set in the overall European Space Policy.

While the Communication on the European Space Policy and its associated Space Programme serve as a foundation in the process leading to development of the first European Space Policy, the key element in this process is the Resolution on the European Space Policy adopted unanimously by EU/ESA ministers at the Fourth Space Council on 22 May 2007 that endorses the aforementioned documents[47]. This Resolution "welcomes and supports" the aforementioned joint EC-ESA document on European Space Policy and legitimizes therefore the European space policy by being backed up by 29 European governments. The Resolution highlights the strategic nature of the space sector contributing to the independence, security and economic development of Europe and recognizes the actual and potential contributions from space activities to support EU policies. The Resolution acknowledges also the rank of Europe as a leading space-faring actor and that Europe remains committed to maintain its position via both strengthened intra-European and international cooperation. In overall terms, the Resolution clearly states the strategic importance of space for Europe in demonstrating its independence and its readiness to assume global responsibilities[48].

3.2 European Space Agency

In 2006/07, ESA was involved as aforementioned in the drafting process of the first European Space Policy. Nonetheless, ESA's Director General (DG) Jean-Jacques Dordain prepared with the ESA Directors, in

[44] Communication from the Commission to the Council and the European Parliament on "European Space Policy" COM(2007) 212 26/4/2007
[45] European Staff Working Document "European Space Programme – Preliminary elements" SEC(2007)504 26.04.2007
[46] Peter N. and Plattard S. "The European Space Policy: Europe's New Compass" Flash Report #1 May 2007
[47] Council of the European Union "Resolution on the European Space Policy" DS 471/07 16/5/2007
[48] Ibid

parallel to the development of the European Space Policy, a plan called Agenda 2011 in which he sets the objectives for ESA to be achieved during his second term.

Building on the Agenda 2007, Agenda 2011 released on 11 October 2006 "aims at defining a common framework of strategic action for achieving wide-ranging objectives of ESA Member States and for adapting the Agency to the new environment"[49]. Agenda 2011 is intended to be an overall roadmap for all ESA stakeholders, and the plan of actions associated with Agenda 2011 is detailed in the ESA Long-Term Plan 2007-16 that will be the implementing instrument of this Agenda.

The 33-page document aims to provide the overall objectives of ESA for the next five years. In particular, ESA's DG wants the Agency to evolve beyond its current core activities to become a model for underpinning the use of space in the world and specifically in the context of Europe's growing needs[50]. Three priorities driving the action of ESA are identified:

- Consolidation of steps taken at the December 2005 Ministerial Council towards new discoveries and competitiveness
- Development and promotion of integrated applications (space and non-space) and integration of the security dimension in the European Space Policy
- Evolution of ESA

The Agenda 2011 looks also at current and potential future programmes, including synergies between the civil and defence services, and gives an overall profile of expenditures of its activities. However, the major element of this document is that it acknowledges and takes into account the evolving nature of European space activities, as well as elements such as the development of the first European Space Policy and the accompanying European Space Programme, but also the increasing importance of the EC as space actor. It consequently indicates that ESA must evolve and prepare "for a situation where the role of ESA will be embedded in a European Space Policy"[51]. Several concrete steps are proposed to allow such an evolution. First, amend the ESA Convention at the next Council Meeting in 2008 in order to improve ESA's effectiveness, but also prepare for an ESA enlargement, as well as increasing institutional relationship with the EU. Secondly, to increase the number of ESA Member States to at least 22 by 2011 (particularly EU member states). Finally, by 2014 make ESA become an Agency of the EU.

To adapt and transform the Agency to the changing European space context it has seen its membership evolved in recent months. On 17 February 2006, following Hungary (2003) and the Czech Republic (November 2003), ESA and Romania signed a European Cooperating State (ECS) Agreement. Romania will now be able to participate in almost all ESA programmes and activities. Then, on 27 April 2007 Poland became the fourth ECS. Finally, on 20 June 2007 ESA and Estonia signed an agreement marking closer cooperation between the two of them. Estonia is the first of the new EU countries to sign a Cooperation Agreement with ESA. In a second step Estonia intends to become an ECS in the years ahead.

On top of these policy milestones ESA was also active in 2006/07 on the technical and scientific side.

2006 was an important year for Human spaceflight activities in Europe. ESA astronaut Thomas Reiter from Germany became the first European to undertake a long-duration mission onboard the ISS following his dispatch on the Shuttle mission (STS-121)[52]. Reiter was the first non-US, non-Russian astronaut to become a permanent crew member. With the mission dubbed "Astrolab", ESA inaugurated therefore the long-term presence of European astronauts onboard the ISS. The mission marked also the return to a three-member permanent crew operating the orbital facility and was also the first long-duration human spaceflight to the ISS to draw on the support of a European control centre. In December 2006, ESA astronaut Christer Fuglesang became the first Swedish and the first Nordic astronaut in space as Mission Specialist on flight STS-116. He met with fellow ESA astronaut Reiter, who has been a permanent crew member since 6 July 2006. It was the first time that two ESA astronauts flew together on the same ISS mission. Both returned to Earth on 22 December 2006.

In 2006, after several years of development, and the grounding of the Space Shuttle following the Columbia Shuttle accident, the Columbus module has been shipped to the Kennedy Space Center for launch to the International Space Station (ISS). The launch

[49] ESA "Agenda 2011 - A Document by the Director General and Directors". October 2006

[50] ESA "Agenda 2011 - A Document by the Director General and Directors". October 2006

[51] Ibid

[52] Reiter's 6-month mission has been conducted under an agreement between ESA and Roskosmos with Reiter taking a position originally earmarked for a Russian

from NASA's Kennedy Space Centre of the Columbus laboratory module is expected in December 2007 at the earliest. In the mean time Europe's space tug, known as the ATV (Automatic Transfer Vehicle) is getting closer to its inaugural mission to ISS after an extensive three-year test campaign. The first launch of the ATV, named Jules Verne, has slipped to January 2008 at the earliest. The ATV will be a vital ISS add-on re-supplying the station with dry and liquid cargo, periodically re-boosting it to higher orbit, and removing waste on departure.

Space science was high on ESA's agenda in the 2006/07 period. Among others, five months after its launch in November 2005 Venus Express entered into orbit around Venus and reached its 24-hour science orbit on 7 May 2006. Europe's Smart-1 lunar orbiter crashed into the moon's Sea of Excellence on 3 September 2006 as planned after almost a three-year mission that demonstrated several advanced technologies and produced valuable scientific results. In the mean time progress have been made in defining ESA's new long-term scientific programme plan dubbed the "Cosmic Vision 2015-2025" has been gaining momentum.

ESA was also active in defining future exploration activities individually or in the framework of international cooperation. For instance, on 11 June 2007 an ExoMars programme board meeting gave the go-ahead for the so-called "Enhanced Baseline" concept. ExoMars is aiming in the framework of the Aurora programme at characterising the biological environment on Mars providing also inputs for broader studies of exobiology in preparation for robotic missions and then human exploration. The ExoMars mission is scheduled for launch in 2013 on an Ariane 5. On 31 May 2007 a 25-page "Global Exploration Strategy-The Framework for Cooperation" was agreed by ESA and thirteen other agencies[53]. This strategy is designed to introduce minimum standards of interoperability to facilitate cooperation while permitting individual countries to pursue their own national strategies.

In 2006/07 the Vega light launcher programme has passed major milestones with the first ground test firings of the P80, Zephiro 23 and Zephiro 9 stages. Construction of the mobile gantry at the Guiana Space Center (GSC) is under way. The first commercial Vega launch from the GSC is planned for 2009. On 26 February 2007 the construction site of the Soyuz launch base in French Guiana was officially opened. The Russian mid-class Soyuz at the GSC, alongside the Ariane 5 heavy-lift launcher and Vega small launcher, will complete the range of launchers operated by Arianespace. A consolidated contract with NGL Prime SPA for Future Launcher Preparatory Programme (FLPP) -1 activities, including systems, experimental vehicles, propulsion and materials and structures was also signed in November 2006.

While ESA is cooperating with Russia on future launch vehicle, it is cooperating with United States on space exploration and space sciences. Besides the agreement on James Webb Space Telescope (JWST), ESA and NASA signed also on 18 June 2007 a cooperation accord on ESA's Lisa Pathfinder technology-demonstration mission, set for launch in 2010. The satellite is designed to prove technologies for a later spacecraft, called LISA (Laser Interferometer Space Antenna) that will test the theory of general relativity and look for gravity waves in space. ESA is in charge of the design manufacturing and launch while NASA will supply the Disturbance Reduction System Package for the spacecraft[54].

In the field of navigation a major development milestone was reached by the European Geostationary Navigation Overlay System (EGNOS) a joint project involving ESA, the EC and EuroControl with the transition in July 2006 from ESA's EGNOS System Test Bed (ESTB) to the "production" EGNOS system for the provision of GPS augmentation services over Europe. Furthermore, the Galileo project has also moved from a preparation and specification phase into the development phase, and ESA is conducting this development phase as "Maitre d'ouvrage" on behalf of the EC. In this context, on 19 January 2006, ESA and the European Satellite Navigation Industries (ESNI)[55] (formerly Galileo Industries GmbH) signed a 950 million euros contract for the In-Orbit Validation (IOV) phase that will be paid out equally by ESA and the EC to ESNI to construct four initial satellites and produce the ground network[56]. However, the four IOV satellites that will serve as a basis for the overall system design has been delayed as they have encountered numerous technical and management issues that may require a

[53] The 14 agency signatories are the national space agencies of Italy Britain, France, China, Canada, Australia Germany, India, Japan, South Korea, the United States, Ukraine, Russia, and the 17-country ESA

[54] de Selding P.: "NASA Seals Deal to Launch Webb Telescope on an Ariane 5" 18/6/2007

[55] ESNI is owned by the following five companies: EADS Astrium NV, Alcatel Space, Alenia Spazio, Thales, Galileo Systemas y Servicios

[56] The total cost of the development phase, approximately 1.5 billion euros is shared equally between the EU and ESA

wholesale design review. This make it less likely that these satellites will be launched as scheduled in 2008, and the deployment of the IOV units could be stretched out to late 2009 or early 2010. On a parallel track coordinated with the EC, ESA agreed 15 March 2007 to intervene more heavily in the operation of the industry consortium that is building the first four Galileo test satellite for the IOV phase (ESNI), as this assembly of European space-hardware companies has some trouble working together.

ESA was also active in the field of space-based Earth observation with the adoption in September 2006 of a new science strategy for the future direction of the Living Planet Programme which addresses the continuing need to further the understanding of the Earth System and the impact that human activity is having. While new missions are currently developed and scheduled for launch in early 2008 (i.e. GOCE - Gravity Field and Steady-State Ocean Circulation Explorer - and SMOS - Soil Moisture and Ocean Salinity) ESA's Envisat launched in 2002 with an expected lifespan of five years has been extended in April 2007 for another five to seven years. Furthermore, the CryoSat-2 satellite which will replace CryoSat, which was lost as a result of launch failure in October 2005 was adopted in 2006 and is scheduled for launch in 2009. ESA has also geared up its efforts in the development of the space component for GMES. It announced on 18 April 2007 that it has selected Thales Alenia Space as prime contractor for a C-band Synthetic Aperture Radar (SAR) Earth observation satellite called Sentinnel-1 to be launched in 2011 under a manufacturing contract valued at 229 million euros[57]. The contract was signed on 18 June 2007 at the Paris Air Show.

3.3 European Union

The major event for the EU in 2006/07 was the adoption of the first European Space Policy jointly drafted with ESA in consultations with their member states. Another stepping stone event was the adoption in December 2006 of the budget for new Framework Programme (2007-2013), or FP7 (Cf. Chapter 4). The space thematic priority has been allocated a budget of 1.43 billions euros over 7 years representing a significant increase compared to FP6 (+1,075 billion euros).

2006/07 was also marked with progress, albeit limited, on EU's two "flagship" programmes: Galileo and GMES.

The EC adopted on 7 June 2006 a communication "Taking stock of the Galileo programme" that examined the status and main elements of the Galileo programme and provided an outline of the phases of this programme and its updated timetable[58]. A Green Paper on Satellite Navigation Applications was also presented by the EC in December 2006. The aim of this document is to launch a discussion on what the public sector can do to create an appropriate policy and legal framework for supporting the development of satellite navigation applications, beyond the financial support for research and the creation of infrastructure. The answers gathered in the consultation process will be analysed by the EC and used as basis for recommendations to the European Council and the European Parliament.

2006 was a symbolic year for Galileo as the successful operation of the first experimental Galileo test satellite, Giove-A launched on 28 December 2005, permitted European governments to meet the radio frequency reservation deadlines before mid-2006 and to secure the frequency for the system. Giove-A, which was build by Surrey Satellite Technology Ltd. (SSTL) is functioning perfectly and should operate successfully through early 2008. However, the second test satellite, Giove-B which had been scheduled for launch in 2005, and now December 2007 is experiencing major technical problems as a result of an onboard computer glitch found during testing by its manufacturer, ESNI. Consequently, to mitigate risks related to the Giove-B launch, and further programme slips, in March 2007 ESA announced it intends to issue a new contract for a third Giove test satellite, Giove A2 to SSTL. This new spacecraft is set to be launched by the second-half 2008 if the Giove-B fails at launch to prove key technologies, particularly atomic clocks, and to meet in-orbit operation requirements set out by the International Telecommunications Union (ITU)[59].

Besides technical difficulties the Galileo programme, with its complex governance and funding structure wasn't able to avoid political

[57] Sentinel-1, a follow-on for the radar instruments aboard ERS-2 and Envisat. Sentinel-2, carrying a super-spectral land monitoring sensor that will complement data from the U.S. Landsat, is planned for launch in 2011 – 2012. Sentinel-3, also expected to launch in 2011 – 2012, will carry an ocean measuring altimeter and optical and infrared radiometers that will serve as follow-ons to the Medium Resolution Imaging Spectrometer Instrument (MERIS) on Envisat.

[58] European Commission Communication "Taking stock of the Galileo programme" COM(2006) 272 final 7/6/2006

[59] The ITU mandates that rights to orbital slots expire if the slot remains vacant for two years

struggle. European transports ministers failed to agree on 12 December 2006 where the government body overseeing the Galileo satellite navigation project, the Global Navigation Satellite System (GNSS) Supervisory Authority (GSA) will be headquartered. Eleven EU member States are vying to host the organization, and none has been so far willing to stand down to permit a compromise[60].

Moreover, while on 1 January 2007, the European GSA officially took over the tasks previously assigned to the Galileo Joint Undertaking (GJU), which was dismantled at the end of 2006[61]. The negotiations between the GSA with the eight-member consortium (AENA, Alcatel-Lucent, EADS, Finmeccanica, Hispasat, Inmarsat, Thales and TeleOp) were difficult in 2006/07 and no suitable agreement for both parties on Galileo operations has been reached[62]. The particular issues of concern focused on whom from the European governments or the private Galileo concession will be responsible for the various types of programme risks for the 20-year Galileo operations concession. Out of the nine blocks of risks identified. The main differences of opinion concerned the sharing of the risks associated with the system design and with commercial revenue and market development. However, besides the differences of opinions between the commercial consortium and the GSA on Galileo's risks, another main element for the blockage of the negotiations was due principally to the fact that the eight companies have been unable to agree on conditions for incorporating the consortium, determining a workable governing structure, or naming a chief executive officer (CEO).

Following these negotiations problems, in a letter addressed on 14 March 2007 to the German Minister Tiefensee as Germany hold the Presidency of the EU Council, Transport Commissioner Jacques Barrot expressed serious concerns regarding the success of Galileo, and indicated that the delay so far accumulated and the absence of any sign of progress on the negotiation of the concession contract must be considered a risk for the delivery of the project in the timeline and budget envisaged. In his letter, Barrot among others gave the consortia until 10 May 2007 to incorporate the Galileo Operating Company (GOC) and appoint a CEO of that company. He indicated also that if the private sector is not able to reach these deadlines, he expects "the Council to provide the Commission with a clear political mandate to review the situation"[63].

Consequently, following Barrot's letter, on 22 March 2007 the EU Transport Council gave the Galileo consortium partners a strict deadline by which the eight companies are expected to solve their internal problems linked to distribution of responsibilities, organisational structure, risk-sharing and pending financial aspects[64]. The Transport Council indicated that it would consider alternative scenarios, including a possible new call for tender at its next meeting scheduled in June 2007 if negotiations were not resumed by then. In the mean time, the Council also mandated the EC to look at alternative solutions. In response to the pressure applied by the EC and the Transport Council, the concession group incorporated the GOC in Toulouse, France on 26 March 2007 and selected a CEO.

On 16 May 2007 the Commission presented six scenarios on the future of Galileo saying that the most realistic and economic option is for the public sector to put the initial infrastructure in place[65]. At the subsequent Transport Council meeting on 6-8 June 2007, EU transport ministers recognized the failure of the current concession negotiation and the Commission was asked to go into more details concerning the options for the project's completion it laid out in May, and present those findings in September 2007. In the mean time the Member of the European Parliaments adopted on 20 June 2007 a joint resolution on the financing of Galileo considering that it should be financed in full from the Union's budget, and that the EU budget should be increased accordingly[66]. A majority of the EU-27 is currently backing this option[67]. However, the Transport Council of 1-

[60] European heads of state in 2003 agreed that new EU agencies should, where possible, be located in one of the new EU member states and not in the EU-15, nevertheless several EU-15 states presented a candidate to host the GSA

[61] The European GNSS Supervisory Authority (GSA) was established by Council Regulation (EC) 1321/2004 of 12 July 2004 (and amended by Council Regulation (EC) No 1942/2006)

[62] The role of the Supervisory Authority is to manage the public interests connected with the European GNSS programmes and to be the regulatory authority for these

[63] Letter sent by Vice President Jacques Barrot to the German Presidency of the EU on March 14, 2007

[64] Transport, Telecommunications and Energy Council "Council Conclusions on the status of the concession negotiations in respect of the Global Navigation Satellite System (GALILEO)". 22/03/2007

[65] European Commission Communication "Galileo at a cross-road: the implementation of the European GNSS programmes" COM(2007) 261 final 16/5/2007

[66] The resolution drafted by the Parliament Budget Committee and adopted in plenary (P6_TA-PROV(2007)0272) is not legally bidding but needs however to be taken into account by the other institutions as the Parliament holds budgetary co-decision powers

[67] Several countries would like to see individual states contribute the extra funding funds to ESA which could finance and manage the project

2 October 2007 shall decide on how the 2.4 billion euros needed to complete the Galileo infrastructure by 2012 will be financed, as well as how the competences will be shared between the public and private sectors during the exploitation of the operational satellite system.

In 2006/07, advancements were made in the GMES programme, particularly in the preparation of three first "Fast Track Services" dealing with Emergency Response (ERCS - Emergency Response Core Service, Land Monitoring (LMCS - Land Monitoring Core Service) and Marine Services (MCS - Marine Core Service). Pre-operational validation of these three "Fast Track" services is planned for 2008. They aim to provide on a sustained basis, reliable and timely information in support of public policy makers' needs.

Progresses were also made on the GMES architecture following the orientations of the third Space Council held in November 2005 whereby it was underlined that the implementation of a phased operation GMES calls for consolidation of the overall GMES architecture, including the interrelationship between the functional components and identification of the appropriate governance schemes. The functional GMES architecture is foreseen to comprise three main layers: an information infrastructure layer with two components representing the "data collection basis" of GMES (both space-based and in-situ infrastructure), two levels of GMES Services representing the main "outcome" of GMES (Core Services and Downstream Services) and finally an Information management and dissemination layer.

Regarding the GMES programme management in a decision dated on 8 March 2006, the EC announced its willingness to complement the existing GMES management structure (GMES Advisory Council and the GMES Programme Office) by the establishment of a specialized core team, the Bureau for GMES within its services. Since 1 June 2006, this GMES Bureau has been created in the Directorate General Enterprise and Industry (DG ENTR) for a period of 3 years to become the focal point of the Commission GMES related activities and strengthen the management of the programme. The Bureau is tasked to prepare, in close coordination with the relevant stakeholders, proposition around GMES, and especially the GMES governance and the long-term sustainability of the programme.

3.4 Eumetsat

2006/2007 was a significant period for the European Organisation for the Exploitation of Meteorological Satellites. First, the agency celebrated in July 2006 its 20th anniversary. Then, Eumetsat released on 1 October 2006 a document entitled "Eumetsat Strategy: 2030". This 32-page document presents the strategic framework for future activities which envision making of the Eumetsat the leading operational satellite agency for European Earth observation programmes that are consistent with its Convention. Consequently, Eumetsat while maintaining the priority of operational meteorological and climate services, is considering evolving to new areas and develop new services for the environment covering oceans, atmosphere, land and biosphere and natural disasters to the extend they are linked to meteorology and climate.

Eumetsat extended also it membership, with Estonia becoming the third Baltic State to join EUMETSAT as Cooperating State in December 2006, and in July 2006 Croatia became the last full Member of the European meteorological agency. Eumetsat has now 20 member states[68] (the same as ESA plus Turkey, Croatia and Slovakia) and 10 Cooperating States (Bulgaria, Estonia, Hungary, Iceland, Latvia, Lithuania, Poland, Romania, Slovenia and the Czech Republic[69]).

Another major step change was reached on 25 January 2006 with the EC and Eumetsat signing letters of intention setting out areas of cooperation between the two parties as a prelude to a future Framework Cooperation Agreement. Following those letters of intent, Eumetsat will offer technical support on how to establish operational services and the EC recognizes Eumetsat as an operational agency for future GMES initiatives. Furthermore, in 2006 the ESA Programme Board on Earth observation and the Eumetsat Council endorsed an Agreement supporting the role of Eumetsat as the operator of relevant GMES missions.

Consistent with recent Eumetsat's aspirations, its core mission of providing operational meteorological observations has been expanded to include LEO satellites following the successful launch of the first European polar-orbiting satellite (Metop-1) on 19 October 2006 after a series of delays. This

[68] Eumetsat will soon have 21 member states with the full membership of Slovenia

[69] Serbia Montenegro has recently expressed its willingness to join the organization

marks the first step outside of Eumetsat's initial perimeter of data provider from geostationary Earth-orbit satellite fleet. Metop-1 is the first of three satellites developed under a joint programme being carried out by ESA and Eumetsat which are designed to provide meteorological operational data from polar orbit until 2020. Metop-1 is also the inaugural satellite of the space segment of the Eumetsat Polar System (EPS), designed to collect atmospheric and environmental data to complement the hemispheric survey conducted from geostationary orbit by the Meteosat system. EPS will be operated in coordination with the U.S. Polar Operational Environmental Satellite (POES) system managed by the National Oceanic and Atmospheric Administration (NOAA). Completing Eumetsat's push into new activities, the European meteorological agency is broadening its geographical presence and activities. In addition to the cooperation with the U.S. in the International Joint Polar System (IJPS), the agency has been active in recent years in the Indian Ocean Region, where it has temporarily stationed a Meteosat spacecraft.

3.5 National governments

The major space countries in Europe that are France, Germany, Italy and the United Kingdom were the more active in 2006/07.

France

A series of high-level policy document were released in France in the past months illustrating the sustained support of space at a political level.

A report issued on 7 February 2007 by the French Parliamentary Office for the Evaluation of Scientific and Technological Choices, also known as the "Cabal Report" makes a series of proposals to reinvigorate Europe's civil and military space policy. The report argue that Europe is losing ground to the United States, China, India and Russia due to their growing space budgets and that Europe should act soon to avoid to fall too far behind the aforementioned countries. It covers almost all space topics and has an exhaustive list of 50 proposals so that Europe can remain competitive in space in the future.

In February 2007, the French Minister for Defence released also a document entitled "Let us Make more Space for our Defence. Strategic Guidelines for a Space Defence Policy in France and Europe". The 29-pages un-classified report is based on the work of the strategic directions of Defence Space Policy (GOSPS) chaired by the former French Ambassador to the United States François Bujon de L'Estang. The exercise started in October 2003 and was completed in the fall 2004 with the presentation of the GOSPS conclusions to the Minister of Defence and was finally partially released to the public on 15 February 2007. The un-classified document presents a comprehensive range of proposals aimed at strengthening French military space capabilities that will serve as a reference for forthcoming work, and is intended to be used to promote dialogue and strategic analysis between the civilian, military, industrial and the institutional partners in both France and Europe. This policy document advocates that France should increase its annual military space budget to 650 millions euros per year. That would represent a 50 % increase from the current budget. It proposes also a Europe-wide effort to increase military space capabilities through reciprocal dependence on nationally owned space-based military assets. The document demonstrates the growing significance of space, at both the military and political level for both France and Europe. It places emphasis on the role that space should play, as a catalyst in enhancing the effectiveness of Defence resources and as a unifier in the emergence of a European Defence.

With the finances now in order and a stable budget through at least 2010, CNES is looking for new investments in space such as Jason-3, but also in launch vehicles including the French-Russian partnership (Oural) to develop a commonly designed heavy-lift rocket for commercial and government payloads that would be ready for service around 2020. Nonetheless not everything is going according to plan. Notably the dual use optical Earth observation satellite Pleiades has a 18-month delay, with an expected launch of the first unit around 2010.

Germany

German Chancellor Angela Merkel has endorsed a multiyear increase in German space spending and reiterated in 2006 the government's support for ISS. On 2 May 2006, speaking at a ceremony marking the end of development of Europe's Columbus orbital module she said that "in the past years, and even decades, technology has not been appreciated as its fair value, especially in a nation like Germany. This needs to be changed"[70] and "space would be one of five

[70] Taverna M.: "Germany Ups Space Spending" Aviation Week & Space Technology 05/08/2006

priority areas targeted for the extra spending, along with nano- and information technologies"[71]. The German government is thus expected to boost the budget for research and development (R&D) and innovation by 6 billion euros over the next four years in a bid to increase the proportion of Gross National Product (GNP) spent on research from 2.4% to 3% by the end of the decade[72].

The DLR founded in 2007 a new Institute of Space Systems in Bremen on 26 January 2007 (the ninth DLR location in Germany). The new Institute will focus its work on systems analysis and technology, and their applications for space systems. Finally, as of 1 March 2007, the DLR has a new chairman in the person of Johann-Dietrich Wörner.

Italy

The Italian government approved in March 2006 to raise space spending by about 8% over the next three years[73]. This major budget increase shows Italy's determination to expand its activities in the space sector, and its upward budget trend is in contrasts with most other European agencies. Two-thirds of the spending is intended to fund activities in three areas: Earth observation (which will get 29% of the funds), science (21%) and space transportation (18%)[74]. The remainder is targeted at telecommunications, navigation and manned space flight. Most of the money will go to existing programmes, such as the Galileo, the GMES network and the Aurora exploration programme[75], but the new funding will also enable the agency to undertake a number of new projects. These include:

- Bissat, a fifth satellite for the CosmoSkyMed radar satellite system.
- Siage, a global X-/L-band radar system to be deployed with Argentina.
- Lyra, a more powerful version of the Vega launcher with a first launch set in 2009.
- A national lunar mission.
- A Ka-band dual broadband system that could be carried out on a bilateral basis with France or as part of ESA's AlphaSat mission.

After a 6-month vacancy following the departure of Sergio Vetrella, Giovanni Bignami, has been appointed in April 2007 for a four-year term as the new president of ASI

United Kingdom

2006 was a particularly active year for space policy in the United Kingdom. First, the British Parliament's Science and Technology Committee conducted what it called "a major and wide-ranging inquiry" into aspects of UK space policy in fall 2006[76]. This inquiry has a twofold approach.
First the Committee has been collecting written evidence form interested organizations and individuals on:

- The impact of current levels of investment on space-related activities on the UK's international competitiveness in this sector;
- The benefits and value for money obtained from participation in the European Space Agency and other international programmes;
- The maximisation of commercial benefits and wealth creation from UK space-based technologies through innovation and knowledge transfer;
- The delivery of public benefits from the space-related activities of different Government departments, and the co-ordination of these activities; and
- Support for space-related research and the UK skills base.

Secondly, the Committee has been conducting a series of hearing of experts on the aforementioned issues. The results of this wide parliamentary enquiring are expected in the second half of 2007.

The British government through the BNSC[77] started also a 12-week survey to determine whether its current space policy should be modified, especially with respect to global exploration effort. The 40-page document

[71] Ibid
[72] Ibid
[73] Nativi A. and Taverna M.: "Italy Plans Space Spending Hike Aviation" Week & Space Technology 03/27/2006
[74] Ibid
[75] Ibid

[76] "Parliament Initiates U.K. Space Priorities Study" Space News Briefs 10 August 2006
[77] The British National Space Centre (BNSC) was set up in 1985 to co-ordinate civil space activities across a number of Government Departments and Research Councils that have interests in space. It is a voluntary partnership of 11 Government departments and Research Councils: the Department of Trade and Industry (DTI); the Office of Science and Innovation (OSI); the Department for Education and Skills (DfES); the Department for Transport (DfT); the Ministry of Defence (MoD); the Foreign and Commonwealth Office (FCO); the Department for Environment, Food and Rural Affairs (Defra); the Council for the Central Laboratory of the Research Councils (CCLRC); the Natural Environment Research Council (NERC); the Particle Physics and Astronomy Research Council (PPARC); and the Met Office. It also acts as the UK point of contact with ESA, the EC, and space-faring countries

called "A Consultation on the UK Civil Space Strategy 2007-2010" should help to determine which civil space strategy the U.K. should pursue over the last four years of the decade. The survey, to be published in the fall 2007, will canvass government agencies, academic and research institutions, industry and the general public. The UK Civil Space Strategy proposes three primary objectives:

- Delivering world-class science by exploiting the UK's space activities and expertise;
- Delivering public benefits in partnership with Government bodies and institutions to exploit the full potential of space activities;
- Maximizing the potential for wealth creation from space activities by facilitating a progressive business environment.

BNSC and NASA on 19 April 2007 signed an agreement to jointly study how the two organizations might work together on future lunar and planetary exploration illustrating the new ambitions of the UK in space[78]. Finally, David Williams has been appointed for a four-year term as Director General of the BNSC in May 2006.

3.6 United States

Quietly, the White House Office of Science and Technology Policy (OSTP) rolled out a 10-page unclassified version of the new U.S. "National Space Policy" on its website on 6 October 2006[79]. The new policy supports not only a Moon, Mars and beyond exploration agenda, but also responds to a post 9/11 environment of emerging transnational threats and the increased need for intelligence-gathering internal and external to the United States. The U.S. National Space Policy[80] enunciates seven primary principles saying that the United States:

- "Is committed to the exploration and use of outer space by all nations by peaceful purposes, and for the benefits of all humanity"
- "Rejects any claims to sovereignty by any nation over outerspace or celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right of the United States to operate in and acquire data from space"
- "Will seek to cooperate with other nations in the peaceful use of outerspace to extend the benefits of space, enhance space exploration, and to protect and promote freedom around the world"
- "Considers space systems to have the rights of passage through and operations in space without interference"
- "Considers space capabilities - including the ground and space segment and supporting links" vital to its national interests". To safeguard the U.S. to "dissuade or deter others from either impeding those rights or developing, capabilities intended to do so; take those actions necessary to protect its space, capabilities; respond to interference; and deny, if necessary, adversaries the use of space, capabilities hostile to U.S. national interests"
- "Will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit US access to or use of space"
- "Is committed to encouraging and facilitating a growing and entrepreneurial U.S. commercial space sector"

Major areas of emphasis that were only touched on by previous presidential space directives include: the development of high quality cadre of space professionals, space acquisition reform, the space industrial base, space situational awareness, intelligence collection, space protection, and interagency collaboration. And new subjects include: homeland security, radiofrequency spectrum access and protection, as well as orbital assignments and the space sensitive technology list.

Following the Chinese's ASAT test on 11 January 2007 initial high-level talks on potential sino-amercian cooperation in civilian space activities that started in late 2006, including joint exploration ventures, have been suspended by the Bush Administration. According to NASA spokesman Jason Sharp, the test of a kinetic anti-satellite weapon undermined an agreement reached between President Bush and Chinese President Hu Jintao during an April 2006 summit[81]. Nonetheless while the test has been widely being criticized in the U.S., standing by the aforementioned new space policy the United States oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to, or use of space. China's ASAT test will therefore not

[78] The BNSC has commissioned studies of a lunar lander, a lunar penetrator and high bandwidth telecommunications technologies that could be used from the lunar surface, but no decision has been taken so far to pursue them into hardware development

[79] President George W. Bush signed off on the new space policy on 31 August 2006. This document supersedes the September 1996 version of the directive

[80] U.S. National Space Policy accessible at www.ostp.gov/html/US%20National%20Space%20Policy.pdf

[81] Gertz B.: "U.S. halts China space ventures" The Washington Times 2/2/2007

cause the U.S. to open negotiations on a new treaty that would place limits on what countries can do in space, but will more likely foster more R&D research in the domain.

The U.S. government is by far the largest investor in space programmes, with an estimated 53.13 billions U.S. dollars spent on civil and military space activities in 2006 which represents about 81 % of total space budgets worldwide with two agencies, the DoD and NASA receiving the largest share of U.S. space funds. When taken together those two organizations concentrate over 60 % of all institutional budgets spent on space in the world (39 billion U.S. dollars in 2006).

National Aeronautics and Space Administration (NASA)

Although NASA asked for almost 16.8 billion U.S. dollars (about 12.92 billion euros) for the 2007 fiscal year and planned accordingly, it didn't see a budget increase under the new Democratic congress[82]. For NASA, it means having only around 16.62 billion U.S. dollars (about 12.78 billion euros). The biggest change for NASA concerns the amount of money it plans to spend on science missions. By holding science spending essentially flat NASA is able to provide its Exploration System Mission Directorate (ESMD) with the funding needed to get rolling its exploration infrastructure. Thus, a number of space science programmes would be delayed or deferred because of budget constraints. Consequently NASA finds itself facing tough choices with little room to manoeuvre with a budget short of about half-billion and must therefore adapt to new budget realities. In particular the flat funding could wreck NASA's plans for fielding Orion and Ares by 2014.

NASA announced on 18 August 2006 that it has selected Space Exploration Technologies (SpaceX) and Rocketplane Kistler to share 500 million U.S. dollars (about 380 million euros) in funding under the Commercial Orbital Transportation Services (COTS) demonstration programme to help complete the development of new launchers and spacecraft and demonstrate by 2010 that they can safely deliver cargo to ISS[83]. Under the terms of the COTS Space Act Agreement RpK and SpaceX must show NASA they are making technical, programmatic and financial progress in order to continue receiving financial assistance. Neither company, however, is guaranteed a NASA re-supply service contract even if they successfully complete their demonstration, as NASA intends to hold another competition at the end of the decade for the actual service contract. NASA also announced on 1 February 2007 that it it had agreed to cooperate with PlanetSpace Inc and Transformational Space Corp (t/Space) to facilitate the development of capabilities to deliver goods and people to orbital destinations. Those non-reimbursable Space Act Agreements involve no agency funding, but establish milestones and objective criteria by which the companies can gauge their own progress. Those Space Act agreements aim to provide those companies up-to-date technical requirements and specifications for crew and cargo flights to the ISS[84]. While in April 2007, NASA announced it has signed a 719 million U.S. dollars (about 553 million euros) modification to the current ISS on contract with Russia's Federal Space Agency, Roskosmos for crew and cargo logistics services through 2011[85] NASA plans to rely on its COTS programme to provide space station logistics starting in 2010. In this context, NASA announced on 18 June 2007 that it signed three more non-reimbursable Space Act Agreements with private firms (Constellation Services International (CSI), SpaceDev and Spacehab) that aim to field new space transportation system that could carry cargo and/or astronauts to the international space station.

On 31 August 2006 NASA made also the long-waited announcement that Lockheed Martin[86] won over a team of Northrop Grumman and Boeing a 3.9 billion U.S. dollars contract (about 3 billion euros) through 7 September 2013 to help NASA design and build the Crew Exploration Vehicle (CEV), now named Orion[87]. This contract covers design, development, construction, testing and evaluation of the first two spacecrafts. The contract could be worth as much as 8.15 billion U.S. dollars (about 6.26 billion euros) through 7 September 2019

[82] In the 110th Congress a yearlong spending resolution, also known as the Byrd/Obey plan (from Senator Robert Byrd (D-W.Va.) and Representative David Obey (D-Wis.) the new appropriations committee chairmen), will force all agencies besides the DoD and Department of Homeland Security (DHS)

[82] to stay within their 2006 spending levels in 2007

[83] Four other companies were COTS finalists. Andrews Space, SpaceDev, Spacehab and Transformational Space Corp (t/Space)

[84] NASA will monitor via quarterly meetings the progress that both firms make developing their systems

[85] NASA News Release "NASA Extends Contract With Russia's Federal Space Agency" 9/4/07

[86] Lockheed Martin's Orion industrial team include: United Space Alliance, Orbital Sciences Corp, Honeywell Defense and Space Electronics Systems and Hamilton Sundstrand

[87] It is a six-person ballistic re-entry capsule meant to replace the space shuttle as the agency's primary manned spacecraft that will to become the centerpiece of the U.S. human spaceflight programme

depending on how many spacecraft are ordered by NASA covered in a set of still-to-be negotiated options worth as much as 3.5 billion U.S. dollars (about 2.7 billion euros) plus an additional 750 million U.S. dollars (about 576 million euros) in sustaining engineering work[88]. NASA wants this vehicle in service no later than 2014 to ferry astronauts and cargo to ISS and later transport up to four astronauts to the Moon[89]. The number of vehicles NASA will ultimately buy depends on a variety of factors, including how many flights NASA can get out of each vehicle and how many missions it needs to conduct.

NASA Administrator Mike Griffin announced on 31 October 2006 that space shuttle astronauts would be sent to refurbish Hubble as soon as May 2008. The decision followed a lengthy risk analysis that concluded that Hubble's life can be extended to 2013 and later without posing undue danger to the lives of the crew that will perform the repairs and upgrades[90]. NASA signed also an agreement on 18 June 2007 to launch the James Webb Space Telescope (JWST) aboard an Ariane 5 rocket. The launch of the successor of the Hubble Space Telescope is tentatively scheduled for launch in 2013. ESA is providing the launch as part of its planned contribution to the mission. It has already made a down payment of about 2.5 million euros to Arianespace for an Ariane 5 ECA, nonetheless it doesn't need to convert the agreement into a formal launch contract until three years before the launch[91]. The two agencies will also split instrument development for the telescope with in particular NASA supplying the Near-Infrared Camera and ESA the new Near-Infrared Spectrograph.

On 6 December 2006 NASA rolled out its strategy and rationale for robotic and human exploration of the Moon centered around a lunar polar outpost to achieve a sustained, human presence on the Moon[92]. The base would be built in incremental steps, starting with four-person crews making several seven-day visits. The first mission would begin by 2020. The Moon base would eventually support 180-day lunar stays, a stretch of time seen as the best avenue to establish a permanent presence there, as well as prepare for future human exploration of Mars. NASA's lunar plan also encourages participation by other nations, as well as non-governmental organizations and commercial groups. Griffin has tasked also NASA's ESMD to begin in 2007 a formal assessment of potential approaches for sending humans to Mars

National Oceanic and Atmospheric Administration (NOAA)

NOAA received 1.705 billion U.S. dollars (about 1.3 billion euros) for space programmes in 2006 nearly 43 % of the agency's overall request. The largest item line in the 2006 budget was the National Environmental Satellite, Data and Information Service (NESDIS) with an enacted 952 million U.S. dollars (about 732 million euros) allocated. The next generation polar-orbiting weather satellites, the civil-military National Polar-orbiting Operational Environmental Satellite System (NPOESS) to be launched staring 2013, was the second biggest item in NOAA's 2006 budget with 317 million U.S. dollars (about 243 million euros).

Departement of Defense (DoD)

The 1958 National Aeronautics and Space Act specified that military space activities be conducted by the DoD. Tracking the DoD space budget is extremely difficult since space is not identified as a separate line item in the DoD budget and DoD's annual budget justifications do not include a figure for "space activities". DoD requested 22.5 billion U.S. dollars in FY2006[93] (about 17.3 billion euros). It is thus the leading governmental agency investing in space worldwide but also the main driver for the U.S. space industry.

Funding for space programmes continued its upward trend in the U.S. Air Force's (USAF) 2007 budget proposal with a 9.8 billion U.S. dollars request (about 7.5 billion euros) for unclassified space activities (+500 million U.S. dollars from last year or about 384 million euros)[94]. The spending plan also features a more conservative approach to programme development and budgeting, away from the

[88] Berger B.: "Lockheed Takes Center Stage in NASA Human Spaceflight Program" Space News 4/9/2006
[89] A preliminary date for the first manned flight in Earth orbit has been fixed for 9/11/2014
[90] NASA scrapped the planned fifth and final Hubble servicing mission in early 2004 on the grounds that complying by the Columbia Accident Investigation Board (CAIB) report would require developing a unique set of shuttle inspection tools that would not be needed for mission to the ISS.
[91] de Selding P.: "NASA Seals Deal to Launch Webb Telescope on an Ariane 5" 18/6/2007
[92] The preliminary location is on the rim of the Shackleton Crater on the South Pole

[93] Congressional Research Service (CRS): "The National Aeronautics and Space Administration's FY2006 Budget Request: Description, Analysis and Issues for Congress". January 24, 2006
[94] Singer J.: "Air Force Budget, New Development Approach Reflect Congressional Scrutiny of Cost Growth" Space News 13/2/2006

50-50 standard for estimating cost of space programmes[95]. This was a major issue for the Congress as virtually all of the Air Force's major space development efforts in the last decade have experienced technical problems leading to cost growth and delays.

The intelligence sector allocated an estimated 9.5 billion U.S. dollars (about 7.3 billion euros) thru the NRO and the NGA. The U.S. government invested also about 430 million U.S. dollars in 2006 (about 330 million euros) for developing a layered defence against ballistic missiles through the Missile Defense Agency (MDA) with the biggest unclassified space programmes being the Space Tracking and Surveillance System, a series of experimental satellites that would track missiles during the midcourse phase of flight, at about 228 million U.S. dollars (or about 175 million euros)[96].

3.7 Russia

Recent years have been marked by an impressive recovery of the Russian space programme as high oil and other natural resources prices have made it possible to balance and grow the Russian institutional budget. In this context, in October 2005, the Russian government adopted a new Federal Space Programme (2006-2015) that comprise a space spending plan to attempt to halt the decline of the country's industrial base and ending years of under-funding (Cf. Chapter 5). The new research and procurement strategy calls for the civil space programme to receive about 305 billion rubles (about 8.9 billion euros) for space activities in 2006-15[97], as well as 182 billion rubles of private investments (about 5.3 billion euros). This budget increase is leading to new ambitions and partnerships in space. Nonetheless, despite the massive investment in space activities in recent months Russia's national space budget remains small in international comparison[98].

Among the major items in the 10-year-plan are the development, replenishment and maintenance of orbital space constellations in the interests of the country's socio-economic developments, science and national security (communications, TV broadcasting, Earth observation, hydrometeorology, environment monitoring, emergency situations control, fundamental space research, microgravity space research). The development, deployment and subsequent operation of the upcoming ISS Russian Segment to carry out fundamental and applied research, the implementation of the long-term applied research programme and experiments planned for ISS are also perceived as important, as well as providing the operational continuity of the Russian Segment of the International Search and Rescue Satellite COSPAS-SARSAT.

The development of the replacement of the Soyuz space capsule used to support ISS and its associated infrastructure, as well as the maintenance and development of the Baikonur cosmodrome facilities and the development of internationally competitive rocket technology are also major items in the new Federal Space Programme. In the new space-spending plan, 27.32 billion of rubles (about 797.06 million euros) would be assigned to the development of the various Russian spaceports in a two-step approach[99]. The first phase, (2006-2010) will focus on the development of new launch pads to launch military payload on Soyouz-2 from Plesetsk, as well as the test of the new heavy launch vehicle Angara for 9.53 billion of rubles (about 278 millions euros)[100]. The second phase (2011-2015) will consist of the development of the infrastructure needed by Angara in Plesetsk and the transfer of all Russian military launches on Russian soils. The second phase is allocated a budget of 17.79 billion of rubles (about 519 millions euros)[101].

With increasing funding, Russia is also reenergizing its lunar and planetary programmes[102]. No Soviet lunar mission has been launched after 1976 and no planetary missions were flown after the Mars 96 launch failure. However, Russia which pioneered and then abandoned robotic exploration of the Moon after the loss of the Space Race and the collapse of the U.S.S.R. is starting the development of its first lunar mission in more than 30 years[103]. Russia is planning to launch

[95] The new approach will use a benchmark of 80%, meaning that the likelihood of cost overrun is only 20%
[96] Singer J.: "US National Shield Dominates MDA Budget" Space News February 13, 2006
[97] CNES Moscow Office "Revue de presse 173" 26/9/2006
[98] For Russia, as well as for emerging powers like China and India assessing the domestic commitment to space activities only using on budgets figures is misleading due principally to major purchasing power differences with Western space powers
[99] CNES Moscow Office "Revue de presse 151-153" 10/5/2006
[100] Ibid
[101] Ibid
[102] Lunar missions are not a major item in the new Federal Space Programme but are nevertheless major element of the current Russian overall space strategy
[103] Major Soviet achievements included the first lunar flyby in 1959; the first lunar far-side photos in 1960; the first semi-soft lander to return images from the surface in 1966; a series of successful lunar orbiters starting in 1966; three robotic sample returns in 1970, 1972 and 1976; and two Lunokhod rovers in 1970 and 1973

a sample return mission to the Martian moon Phobos in October 2009, and then, launch an ambitious lunar penetrator mission in the 2009-2012 timeframe that could be followed by a lunar rover in 2015-16.

In parallel with the sharp increase of Russia's Federal Space Agency budget allocation, the Russian government aims to revitalize its national space programme with a clear effort to expand and modernize capabilities. Russia has consequently undertaken the upgrade of its navigation system, Glonass. Three Glonass M class satellites were launched on 25 December 2006[104]. And, by the end of 2007, the Russian space agency plans to launch two Proton rockets each carrying three Glonass spacecraft to have when taking into account satellites expected to be retired by then to have a total of 18 fully operational satellites so that its domestic system can provide continuous coverage over Russia. By late 2009 Russia foresees to have a full constellation of 24 operational satellites.

The renewed space interest at the highest-political level in Russia has also led to the reinforcement of several cooperation and partnerships.

Russia and the EU (and ESA) signed a cooperation agreement on space technologies and activities on 10 March 2006. The areas of specific interest are space applications (satellite navigation, Earth observation and satellite communications) access to space (launches and future space transportation systems) space exploration and the ISS and space technology development[105]. The main axis of Euro-Russian cooperation remains however the cooperation on launch vehicles. Russia is participating with ESA in a two-year programme to explore crew-transport vehicle designs for missions to ISS, the Moon and elsewhere. Furthermore, at a meeting in Moscow on 14 February 2006, the French and Russian government officials recommitted themselves to the five-year joint programme (Oural) whose ultimate goal is the development of a commonly designed heavy-lift rocket for commercial and government payloads that would be ready for service around 2020. Then, on 26 February 2007 the construction site of the Soyuz launch base in French Guiana was officially opened.

Following the signature of an agreement with India in March 2006, India will collaborate on updating Russia's Global Navigation Satellite System (Glonass) as part of a broad space cooperation plan. For Russia, the Indian in-kind contribution would help the refurbishment of the Glonass constellation. On the Indian side, the objectives for this cooperation are twofold. Firstly, to launch a Russian-built spacecraft and build the platform for another satellite and launch it. Secondly, to participate in the next-generation navigation satellite system development. The deals based on a no-exchange of fund basis were signed by ISRO Chairman Gopalan Madhavan Nair and Russian Federal Space Agency (Roskosmos) Director General Anatoly Perminov on 17 March 2006 in New Delhi[106]. This Russo-Indian cooperation has been also extended in space sciences and an Indian instrument for solar physics and solar-terrestrial sciences will be flying on board the Russian Coronas-Photon satellite[107].

Russia is also looking at an increased partnership with China in lunar exploration to evolve beyond the traditional sales of Russian equipment. A dedicated cooperation agreement whereby a Chinese small satellite to be launched along the Russian sample return mission "Phobos Explorer" to the Martian moon Phobos due to launch in October 2009 has been signed during a three-day visit to Russia by the Chinese President Hu Juntao in March 2007. The agreement signed between the China National Space Administration and the Russian Federal Space Agency follows pledges by Moscow in recent months to work closely with Beijing on exploration of both Mars and the Moon, and consequently more substantive Russian-Chinese cooperation in exploration is to be expected in the future. China and Russia are also cooperating in space astronomy. China will participate to the "Radioastron" programme scheduled to be launched in 2007-08 and it will also launch the Russian ultraviolet observatory in 2010[108].

Russia's revitalization of its space programme has led also to an increasing number of space cooperation agreements with non space faring countries as a tool of foreign diplomacy. On 5 September 2006 a 10-year agreement between Russia and South Africa has been signed that covers in particular the development of launch vehicles and in other aspects of peaceful use of space activities[109]. Russia will also help Brazil on its VLS-1 launch

[104] Russia announced that all precision restrictions on Glonass use would be lifted in 2007 to enable more accurate and unlimited civilian and commercial use of the navigation system
[105] Ibid

[106] Jayaraman KS: "India To Launch Russian Glonass Satellite" Space News 27/3/2006
[107] Russia will also cooperate with India on the development of cryogenic upper stages for Indian launchers
[108] CNES Moscow Office "Revue de presse 165" 31/7/2006
[109] CNES Moscow Office "Revue de presse 171-172" 19/9/2006

vehicle (Veículo Lançador de Satélite)[110]. Furthermore, the astronaut Marcus Pontes became the first Brazilian in space and went onboard the Soyuz TMA-8/12S mission to ISS. Russia has also been reported to consider the possibility to cooperate with Venezuela and in particular in the training of a Venezuelan astronauts for a possible trip to space at the earliest in fall 2008[111] Iran would like also to send its first astronaut in space with the help of Russia[112], as well as Thailand[113], but for both of these cooperation no dates have been proposed. Russia has also started discussions with Vietnam[114], Chile and the United Arab Emirates[115] on general cooperation in space activities, and the 2004 agreement between South Korea and Russia has been ratified on 7 July 2006[116].

3.8 Japan

Japan's overall space policy is currently in transition, a new bill was submitted on 20 June 2007 to the Lower House of the Diet by the ruling Liberal Democratic Party (LDP) for the establishment of a "Basic Law for Space Activities". The new law pushes three main elements. Firstly, it proposes to set up a new Minister for Space and Space Development Headquarters (a forum of user ministries with strong authority) and a Minister for Space that would reside in the Cabinet Office for coordinating space policies governing civil, military and commercial activities of different ministries. Secondly, the "Basic Law of Space Activities" aims to reconsider the assumption of the "exclusively peaceful purpose" clause in the Diet resolution of 1969 to allow the use of space assets by military authority (Cf. Chapter 6)[117]. The change would permit Japan to use space for defensive purposes only (e.g. crisis management and disaster monitoring in Asian region or peacekeeping missions in distant territories) and adapt therefore to the post-Cold War geopolitical context and environment. Finally, the third element of the new proposal concerns ways and means to increase the competitiveness of the Japanese industry. In particular, the Basic Law calls to strengthen industrial capability and autonomous business foundation from public budget by relaying on the Public-Private-Partnership (PPP) mechanism to foster the effort of "industrialization" of Japan.

Japan transitioned from its second national technology plan (2002-2006) to the third national technology plan (2007-2011) in April 2007. In the new plan space, is mentioned as "stem technologies for the nation" (rocket technology and Earth observation programmes) for the first time ever[118]. Consequently, Japan Aerospace Exploration Agency's (JAXA) budget in fiscal year 2006[119] was of 180 billion yens (1.142 billion euro) up from 177 billion in 2005 (1.12 billion euro) and is foreseen to continue to augment in the framework of the aforementioned third national technology plan. Japan investment in space focuses almost exclusively on civilian space activities and only the Information Gathering Satellites (IGS) programme receives some "non-civilian" funding (Cf. Chapter 6).

Following the creation of the Asia-Pacific Space Cooperation Organization (APSCO) a regional space organization under Chinese leadership, JAXA is trying to re-launch the Asia-Pacific Regional Space Agency Forum or APR-SAF hat started in 1993[120]. JAXA is aiming at supporting Asian countries in various applications programmes and in particular in Earth observation and education programmes. APR-SAF meets annually and the last meeting was held in Jakarta, Indonesia on 6 December 2006. A new project that complements the four pre-existing working group (Communication Satellite Applications, Space Education and Awareness, Earth Observation, International Space Station) have also been initiated in early 2006. The Disaster Management Support System in the Asia-Pacific Region or "Sentinel Asia" is a "voluntary and best-efforts-basis initiatives" led by the APRSAF to share disaster information in the Asia-Pacific region on the Digital Asia (Web-GIS) platform and to make the best use of Earth observation satellites data for disaster management in the Asia-Pacific region[121].

Current effort of the JAXA focus on reaching out public constituencies in the country even in rural areas to increase their awareness about space and consequently the support of space activities, but also because social return

[110] CNES Moscow Office "Revue de presse 143" 27/2/2006
[111] CNES Moscow Office "Revue de presse 145-146" 21/3/2006
[112] CNES Moscow Office "Revue de presse 149-150"18/4/2006
[113] CNES Moscow Office "Revue de presse 143" 27/2/2006
[114] CNES Moscow Office "Revue de presse 142" 20/2/2006
[115] CNES Moscow Office "Revue de presse 162" 11/7/2006
[116] Ibid
[117] Currently, Japan's use of space is limited to non-military purposes under a strict interpretation of the 1967 Outer Space Treaty as required by the Japanese constitution and a subsequent parliamentary resolution incorporating the treaty into its domestic law
[118] Discussion with JAXA representatives in Europe in December 2006
[119] The Japanese fiscal year start in April
[120] http://dmss.tksc.jaxa.jp/sentinel/ accessed in January 2007
[121] Ibid

is an important mandate of the agency[122]. Nevertheless, following the release of a new plan in 2005 the so-called JAXA Vision, JAXA has set a goal of constructing a manned lunar base in 2030. Astronauts would be sent to the Moon by around 2020 so that they will start construction of the base to be completed by 2030. In this context, JAXA is interested to participate in the future Advanced Crew Transportation System (ACTS) with Europe and Russia but no dedicated funds have been earmarked, nevertheless current JAXA President has been using its personal funds as initial seed money to start internal studies[123].

Programme	Budget in billion yen	Budget in million euros
Reliability Improvement Programme	10.4	66.03
Space Flight and Operations	22	139.7
ISS	29	184.11
Space Applications	34.8	221
Space Technology and Aeronautics	14.7	93.32
Space Science	26	165.05
Others	43.2	274.31

Table 3.1 JAXA budget for its major programmes in 2006

3.9 China

On 12 October 2006, China released its new White Paper entitled "China's Space Activities in 2006" that drives its use of space for the next five years[124]. In China, policies are established mainly through White Papers released by the State Council[125]. White papers are the most important official policy documents and are released by the Information Office of China State Council on behalf of the government[126]. At the difference of the "U.S. National Space Policy" issued just a week before, the new White Paper has received little media attention outside of China. Furthermore, besides the difference of treatment of international cooperation by the U.S. and China in their respective policy documents[127], the Chinese White Paper has avoided any discussion of developing military space capabilities and has sought to portray its space programme as peacefully driven[128] and stresses the benevolence of its space programme[129].

The White Paper consists of five sections dealing with aims and principles of development; progress made in the past five years; development targets and major tasks for the next five years; development policies and measures; and international exchange and cooperation. The overall aims of China's space activities are listed to be "to explore outer space, and enhance understanding of the Earth and the cosmos; to utilize outer space for peaceful purposes, promote human civilization and social progress, and benefit the whole of mankind; to meet the demands of economic construction, scientific and technological development, national security and social progress; and to raise the scientific quality of the Chinese people, protect China's national interests and rights, and build up the comprehensive national strength"[130]. Top priorities involve also developing and operating a high-resolution Earth observation system, a polar and geostationary weather satellite network and a system of small disaster protection spacecraft, along with associated satellite, launcher, ground production and operating facilities. Launcher development will focus on a new non-toxic, low-cost, high-performance rocket family capable of lifting 25-tons to low-Earth orbit and 14-tons to geostationary transfer orbit. Extravehicular activity and rendezvous/docking maneuvers will be the main thrust of manned missions. Sciences will focus among others on the development and launch of "breeding" satellite to expand the application of space technology in the field of

[122] Discussion with JAXA representatives in Europe in December 2006
[123] Ibid
[124] The first White Paper on "China's Space Activities" was released in 2000. This document introduced China's situation in space technology, space applications and space science. It also provided guiding principles and core policies for China's space activities, as well as sets of priorities for international cooperation.
[125] It is largely synonymous with the Central People's Government and is the chief administrative authority of the People's Republic of China. It is chaired by the Premier and includes the heads of each governmental department and agency.
[126] The Information Office of the State Council is an administrative office under the State Council, the chief administrative body of the People's Republic of China
[127] As indicated in the White Paper, China value highly international cooperation and in the past five years it has signed 16 international space cooperation agreements and memorandums with 13 countries, space agencies and international organizations
[128] "Defence" and "security" are mentioned only three times throughout the entire document, and there is no mention of the China National Space Administration (CNSA) partnership with the People's Liberation Army (PLA), which is responsible for the operation of China's launch sites and its spacecraft, as well as the Human spaceflight programme
[129] While China's military establishment may participate in producing policies and initiatives, they do not independently publish doctrinal documents as in the U.S. for instance
[130] Chinese White Paper accessible at www.fas.org/spp/guide/china/wp2006.pdf

agricultural sciences research, but also to strengthen the ability to monitor the space environment and space debris, and set up a space environment monitoring and warning system[131].

On 12 February 2007 the Commission of Science Technology and Industry for National Defense (COSTIND) issued its "Eleventh Five Years Space Development Plan", which is a blueprint of the Chinese government on future space scientific development[132]. In particular, the COSTIND puts focus on improving the innovation of space science and its continuous development capability and is scheduled to engage in scientific research and exploration in three fields: space astronomy and solar physics, space physics and solar system exploration, microgravity science and space life science[133]. According to the plan the overall strategic objectives in the next 15 years include: pioneering exploration and study of key scientific issues, space and astronomical survey and research, solar-terrestrial space environment survey and solar system exploration, capacity-building for microgravity science and space life science research[134].

China space programme budget remains relatively opaque. China's White Paper and other official documents on space activities do not provide budgetary figures, though they state the great prominence of the space programme and its vital contribution to achieve the modernization of the country. A number of unofficial statements on various aspects of China's manned space programme have been made but they vary in dimension and scope and thus provide only vague clues about budgetary numbers. Furthermore, most analysts consistently doubt any figures claiming there are issues of currency conversion, labor wage differentials and that the Chinese space research and development sector is integrated to a degree with that of the military. Estimates of China's space activities vary also considerably. Though unsupported by documentation, many analysts report that China's annual spending on space activities could range between 1.3 billion U.S. dollars to 3 billion U.S. dollars (1 billion euros to 2.3 billion euros), which is comparable to what Japan spends, and far more than Russia. But, as indicated in Washington in April 2006 by Luo Ge, one of two Vice Administrators in the CNSA, the figures of China's spending in space is difficult to calculate but said that it is about 500 million U.S. dollars (about 384 million euros) a year and for that China gets about 200 000 full-time space workers[135].

The Chinese government is moving ahead to build its own global satellite navigation system named Compass/Beidou[136]. This system is expected to provide services to customers all over China and neighboring countries by 2008 before being expanded into a global network of navigation and positioning[137]. In this context, on 3 February 2007 China launched successfully its fourth navigation satellite since 2000 as part of the aforementioned effort to build a domestic positioning system[138]. This Compass satellite was unable to deploy its solar panels correctly after launch and it took 60 days to fix this glitch[139], but the Compass satellite has been reported to work successfully since. On April 2007, China launched its fifth navigation satellite onboard a Long March 3-A rocket from the Xichang launching center.

2006 was also marked by the breakdown of China's newly launched Sinosat 2 direct broadcast satellite (the largest, most complex spacecraft ever developed by the Chinese). This event is one of the biggest spacecraft failure of the recent history of the Chinese space programme and was therefore a major setback to China's development of a new generation of larger, more powerful satellites. Sinosat 2 was to be the vanguard for major new Chinese space developments more in line with existing U.S. and Western European spacecraft. Designed for 15 years of operations, and as a key element in broadcasting the 2008 Olympics in Beijing to the Chinese masses, Sinosat 2 began to fail after only about a week in orbit in early November as both its solar arrays and its large antennas failed to deploy.

Continuing the recent trends observed recently, China in 2006 and 2007 has been more prone to participate to international fora and engage into international cooperation. In this context, while China intends to launch its first lunar mission Chang'e I in 2007, it attended also various international exploration workshops and meetings in 2006/07. China signed a dedicated agreement with Russia in

[131] Ibid
[132] www.cnsa.gov.cn/n615709/n620682/n639462/94761.html
[133] Ibid
[134] Ibid
[135] Morring, Jr. F.: "In Orbit Chinese Space Lags U.S., Russia By 15 Years, Manager Says" Aviation Week & Space Technology 04/10/2006
[136] Compass known as Beidou in Chinese would feature 35 satellites with 5 in geosynchronous orbits and the rest in medium Earth orbits
[137] Xinhua News "China launches "Compass" navigation satellite" 14/4/2007
[138] The previous three were launched in 2000 and 2003
[139] Xinhua News "China fixes new navigation satellite" 11/4//2007

March 2007 to contribute a small satellite to be launched along the Russian sample return mission "Phobos Explorer" to the Martian moon Phobos in October 2009. A remote controlled lunar rover is also planned to be launched in 2012[140] that will be followed by an unmanned mission landing on the moon and eventually around 2017 by a manned lunar voyage. The third Shenzhou mission that had been planned for late 2007 and that will carry three astronauts[141], one of whom is to do an extravehicular activity (EVA) has been delayed by about six months into early 2008 to complete testing of a indigenously developed spacesuit.

China reinforced also its partnership with countries form the "South". In January 2006 China's export-credit agency accorded a 200 million U.S. dollars (about 153 million euros) loan to the Nigeria government to complete the financing package of Nigeria's Nigcomsat 1 telecommunications satellite that was subsequently built and launched by Chinese companies. China decided also to donate data-receiving stations for its weather satellites to seven nations around the Pacific Rim and Indian Ocean (Bangladesh, Indonesia, Iran, Mongolia, Pakistan, Peru and Thailand[142]) that are all member of APSCO, a Chinese-led initiative.

However, following the January 2007 kinetic ASAT test destroying the Feng Yun 1C weather satellite sino-amercian civilian space cooperation talks that started in 2006 following a meeting in Washington in April 2006, between U.S. President George W. Bush and Chinese President Hu Jintao has been ruled out by Washington.

3.10 India

India has been particularly active in space affairs in 2006/07 despite the failure on 10 July 2006 of its Geosynchronous Satellite Launch Vehicle (GSLV) that destroyed the domestically built Insat 4-C television broadcasting satellite. Indian leadership continued to support financially and politically its space programme. India's main space agency the Indian Space Research Organisation (ISRO) received a 3 billion ruppes funding increase for the 2006-07 fiscal-year. The Total ISRO budget for this period is 30 billion rupees (about 535 million euros). Included in the annual plan are 250 million rupees (4.6 million euros) to begin development work on a new generation of communications satellites in the 4-ton class. This larger class of satellites are being developed both to fulfil India's growing domestic needs and possibly for future export on the international market. ISRO is also developing a new vehicle that will be able to lift these new 4-ton satellites to geostationary transfer orbit and 10-tons into low Earth orbit (GSLV Mk3). Another major driver of the spending hike is the Indian Regional Navigation Satellite System (IRNSS) a 7-8-constellation satellite designed to enhance signals of the U.S. GPS satellite throughout India. The Indian government has approved spending 14.2 billion rupees (253.5 million euros) to develop this independent regional satellite navigation system that would be launched starting in 2008[143].

On 28 February 2007 India unveiled a 38,5 billion rupee (or about 690 million euros) space activities budget for the fiscal year beginning April 1 2007. The novelty of this budget is the fact that significant funds (500 millions rupee or about 9 million euros) for a human spaceflight programme has been allocated[144]. The budget includes plans to develop a new rocket engine using Kerosene/Liquid Oxygen propellants and money for a new observing satellite in GEO. India has well-developed space capabilities in the field of Earth observation and telecommunications and long ago demonstrated the ability to build sophisticated launch vehicles and satellites for national development needs. But ISRO is eager to start a human spaceflight programme, and to launch autonomously its first manned flight by 2014-15 and land an Indian astronaut on the Moon by 2020[145]. A manned spaceflight programme marks a very big step for India. ISRO estimated the project leading to a first manned flight will cost from 2.5 to 3 billion U.S. dollars a year[146]. With a growing economy (Cf. Chapter 1) and a high-tech workforce India appears to have the means and the resources it needs to fulfil its aspiration of developing a manned spaceflight programme.

[140] According to press reports this rover could be potentially nuclear powered

[141] Two Chinese astronauts flew during the second Shenzhou manned mission in 2005 and one was onboard the first manned flight in 2003

[142] Morring, Jr. F.: "In Orbit China Donating Weather-Satellite Ground Stations" Aviation Week & Space Technology 04/03/2006

[143] Jayaraman KS : "India To Develop Regional Navigation System" Space News 22/5/2006

[144] Jayaraman K.S. "Indian Space Budget Funds Astronaut Capsule" Space News 5/3/2007

[145] The decades-old rivalry with China for regional supremacy seems also to be a major driver in such initiative

[146] Jayaraman K.S.: "ISRO Seeks Government Approval For Manned Spaceflight Program" Space News 13/11/2006

	2005-06	2006-07	2007-08
Space Technology	16158,2	17264,9	23507
Space Applications	3297,6	3630,6	4111,6
INSAT Operation	4321,5	4582,4	4897,8
Space Sciences	1518,3	2662,7	3108,5
Direction, Administration and Other programmes	1380,4	1832,3	2963,1
Total	**26676**	**29972,9**	**38588**

Table 3.2 ISRO space budgets for the 2005-08 period (in million of rupees)
(Source ISRO Annual Plan 2007-08)

The proposal of developing an Indian human spaceflight programme was presented to Indian Prime Minister Mamohan Singh on 17 October 2006, and on the latter's advice, the proposal was presented by ISRO chairman in a brainstorming session to a cross section of the scientific community who met in Bangalore on 7 November 2006[147]. Initial funding began on 1 April 2007. The decision of the development of a man-rated GSLV has been taken and actions initiated[148]. ISRO already validated its re-entry technology in January 2007 with the successful recovery of its space capsule in the Bay of Bengal. The Space-capsule Recovery Experiment (SRE-1) was launched on a Polar Satellite Launch Vehicle (PSLV) on 9 January 2007 and stayed in orbit for 12 days. SRE-1 carried a metallurgical and a biomaterial experiment, and aimed to provide experience in spacecraft recovery, thermal protection, guidance, navigation, as well as control and recovery. ISRO is also working on its first unmanned mission, Chandrayaan-1, to orbit the Moon in early 2008. Finally, ISRO is also beginning to define its first Mars orbiter for launch as early as 2013.

However, despite these activities in the field of space exploration, ISRO is still actively working on various space technology applications. Following the difficulties of cooperation in the Galileo project, India has been considering participation in the joint restoration of the Russian Glonass system[149]. During the seventh Indo-Russian summit held in January 2007, space issues were on the top of the agenda of discussion between President Putin and Prime Minister Manmohan Singh. And, in particular, a bilateral document was signed on the inclusion of India in the Glonass system[150]. Then on 17 March 2007 in New Delhi was signed a formal cooperation agreement between ISRO and Roskosmos in which India agrees to launch a Russian Glonass navigation satellite and build the platform for another one and launch it. In exchange, the Glonass system will be available to India for both civilian and military applications[151]. The Russo-Indian cooperation has been also extended to space sciences with an Indian instrument set to fly onboard the Russian Coronas-Photon satellite.

During the November 2006 visit to New Dehli by Chinese President Hu Jinto India and China despite their regional rivalry indicated their desire to cooperate in the use of space technologies for peaceful purposes. Potential areas of cooperation include remote sensing, communications, meteorology, distance learning, disaster management and launch services. Nonetheless, China's ASAT test in January 2007 has slowed down any further endeavour.

Despite Galileo's difficulties, ISRO is developing its cooperation with Europe, and besides European participation in Chandrayaan-1 it has agreed to include an atmospheric sounder called Rosa from the Italian Space Agency (ASI) on board its Oceansat-2 satellite. The Indo-French joint satellite mission, Megha-Tropiques, to study the atmosphere water circulation in the tropical belt has also made further progress. And, following this cooperation, plans for a ministaellite altimeter to be launched in 2009-2010 are moving forward.

Following the visit on 16 May 2006 of an ISRO delegation to Brazil to meet their counterpart from the Brazilian Space Agency (AEB) ISRO signed an agreement with its Brazilian counterpart on 4 June 2007. ISRO will equip a Brazilian Earth station with instruments that will enable it to receive and process data from India's remote sensing. India is therefore

[147] Jayaraman K.S.: "ISRO Seeks Government Approval For Manned Spaceflight Program" Space News 13/11/2006
[148] Discussion with the ISRO representative in Europe in December 2006
[149] India signed an agreement to participate to Galileo but has ratified it yet
[150] An agreement between ISRO and the Federal Space Agency on cooperation in the joint satellite project "Youthsat" was also signed on January 2005, 2007
[151] Jayaraman KS: "India To Launch Russian Glonass Satellite" Space News 27/3/2006

expanding its reach in South America and fostering "South-South" cooperation.

Finally, India is now entering the "open-commercial market" as it the first time in April 2007 it launched a foreign payload after winning an international competition (an Italian scientific satellite) on board its indigenously developed PSLV (Cf. Chapter 5). ISRO announced also on 18 April 2007 that following the contract signed with Eutelsat in February2006[152], Antrix Corporation which is the commercial arm of ISRO, will be building a communications satellite for Avanti Screen Media, a British company, potentially scheduled for launch 2009[153]. Like for the Eutelsat W2M satellite Antrix will be responsible for building the platform while the transponders for the satellite would be sourced from Europe.

3.11 Emerging space powers

Besides the aforementioned traditional space powers a variety of new actors have increased their developments in space in the last months.

In 2006/07, South Korea was particularly active in the space sector, and based on the strength of its information and telecommunications technologies, it is aiming to become a global leader in space technology by 2015[154]. Kim Woo-sik Korean Minister of Science and Technology recently vowed to push science-related projects to develop the nation's space capabilities in earnest. The first Korean satellite (Korea Institute of Technology Satellite-1 or KITSAT-1) was only launched in 1992, but since then Korea has started numerous initiatives with so far a remarkable success. In 2006 South Korea became the newest member of the club of countries with their own high-resolution optical reconnaissance satellite with the successful launch on 28 July 2006 of Kompsat-2 satellite aboard a Rockot vehicle from Russia's Plesetsk Cosmodrome[155]. South Korea has also purchased a high-resolution radar sensor from Italy for its Kompsat-5 (Arirang-5), satellite to be launched around 2009, with an expected ground resolution of between 1 and 3 meters. Seoul's ambition to become a space power was further confirmed with the launch of the Koreasat-5 civil/military telecommunications satellite aboard a Sea Launch vehicle in late August 2006.Officials announced also on 1 December 2006, that South Korea plans to launch a civil-military satellite (Arirang-3A) carrying high-resolution optical and infrared sensors in 2012.

The South Korean government is also overseeing launch related projects. One such project is the construction of the Oinarodo Space Center. The construction project started in 2002 and is scheduled for completion in late 2007. The space center will serve to launch the currently under development Korea Space Launch Vehicle 1 or KSLV-1 which is developed with technical cooperation from Russia and scheduled for its first launch in 2008. It is also envisioned that by 2015 Korea will have developed an indigenous space launch vehicle made entirely from local technology[156]. Furthermore, on 25 December 2006, the final two runners in the race to become Korea's first astronaut were chosen by the Ministry of Science and Technology and the aeronautics and space agency of South Korea, the Korea Aerospace Research Institute (KARI). The final candidate set to travel to ISS aboard a Russian Soyuz in April 2008 will be selected later this year.

2006 saw also Brazil entering the exclusive club of countries having astronauts with the first Brazilian astronaut Marcus Pontes sent in space in March 2006 aboard the Soyuz TMA-8/12S mission for a 9-day trip to ISS. Furthermore, Brazil is as aforementioned increasingly cooperating with India in a similar fashion it cooperated with China in the 1990s to foster "South-South" cooperation.

In 2007, another emerging space actor is set to have its first national in space. Dr Sheikh Muszaphar Shukor Al Masrie bin Sheikh Mustapha will be the first Malaysian astronaut or "Angkasawan" in October 2007, and will fly with the Russians to the ISS.

In Israel, major developments related to the way Israel manages and operates in space for its military activities occurred in 2006/07. In particular, the Israeli Air Force was given the lead role in all military activities in space. Israel also successfully launched its newest reconnaissance satellite, Ofeq-7, on 11 June 2007 aboard its indigenous Shavit rocket. This

[152] Antrix Corporation in cooperation with EADS Astrium will manufacture the W2M satellite for Eutelsat. The transponders for the satellite build by EADS Astrium while the satellite platform will be built by Antrix Corporation

[153] The Hindu News "ISRO builds communication satellites for European clients" 19/4/2007

[154] He-suk C.: "Science Ministry vows to turn Korea into a global space leader by 2015" Korea Herald 15/01/2007

[155] Kompsat-2, known in South Korea as Arirang-2, carries an optical imager with a 1-meter ground-resolution in panchromatic mode. It is also equipped with a multispectral instrument with a 4-meter resolution

[156] He-suk C.: "Science Ministry vows to turn Korea into a global space leader by 2015" Korea Herald 15/01/2007

launch was much needed to overcome the September 2004 loss of Ofeq-6 due to a Shavit failure and marks the beginning of an expansion of Israeli military space capabilities.

On 31 July 2006 the South African cabinet has approved the establishment of South Africa's space agency, which will be tasked with coordinating the use of space technology and local science research.

3.12 International sectoral comparisons

In order to asses the reality of the plans of the respective space powers one must look at the achievements of the various space faring countries in emblematic and selected space activities such as the ability to launch missions, as well as the number and type of missions launched.

Launching sector

It is widely recognized that the possession of launch vehicles and space bases are a key element in a country's independence in space activities. However, the number of launches conducted, as well as the level of activities of its bases indicates also the dynamism of a country in the space sector.

In 2006, 6 countries, plus the multinational consortium Sea Launch conducted 66 launches. However, when looking at Figure 3.1 it appears clearly that the number and capacity of launch vehicles varies widely among space actors. In 2006, when comparing the levels of activity country by country, Russia was the world's space leader according to the launch rate criterion followed by the United States.

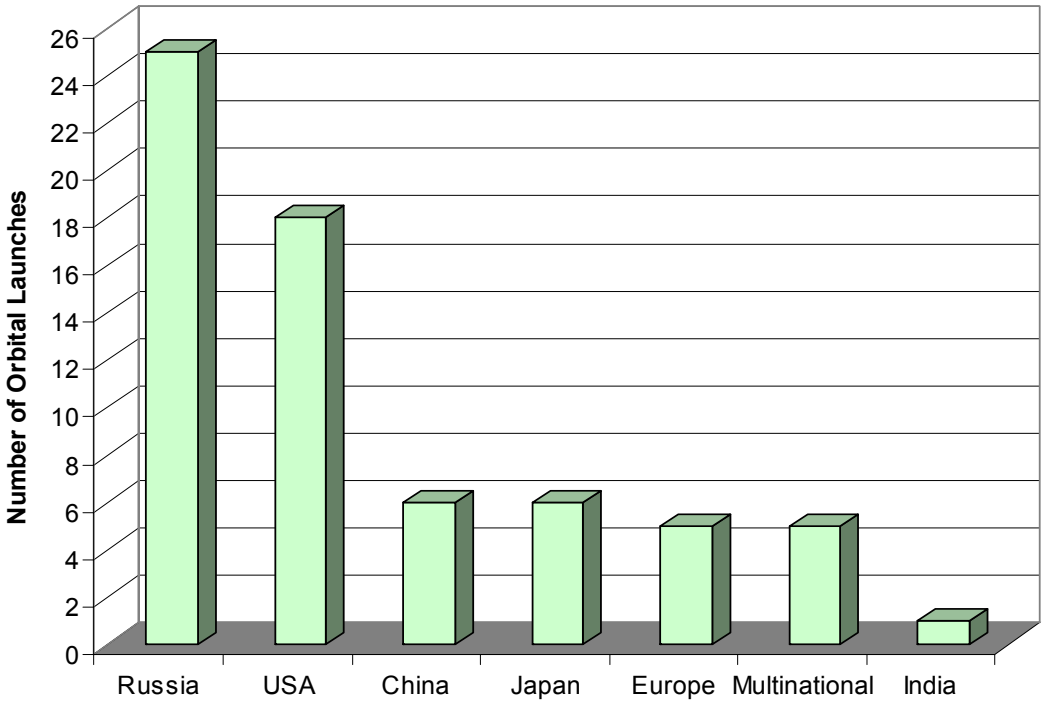

Figure 3.1 Total Worldwide orbital launches per country in 2006

Those 66 launches were distributed over 25 different launch systems with Russia using ten different launch vehicles and the United States seven, while China used three different launchers and Europe, Sea Launch and India used only one launch vehicle (Figure 3.2). The versatility of the launch vehicle fleet reflects therefore the national capabilities of a country and the importance it gives to independent access to space.

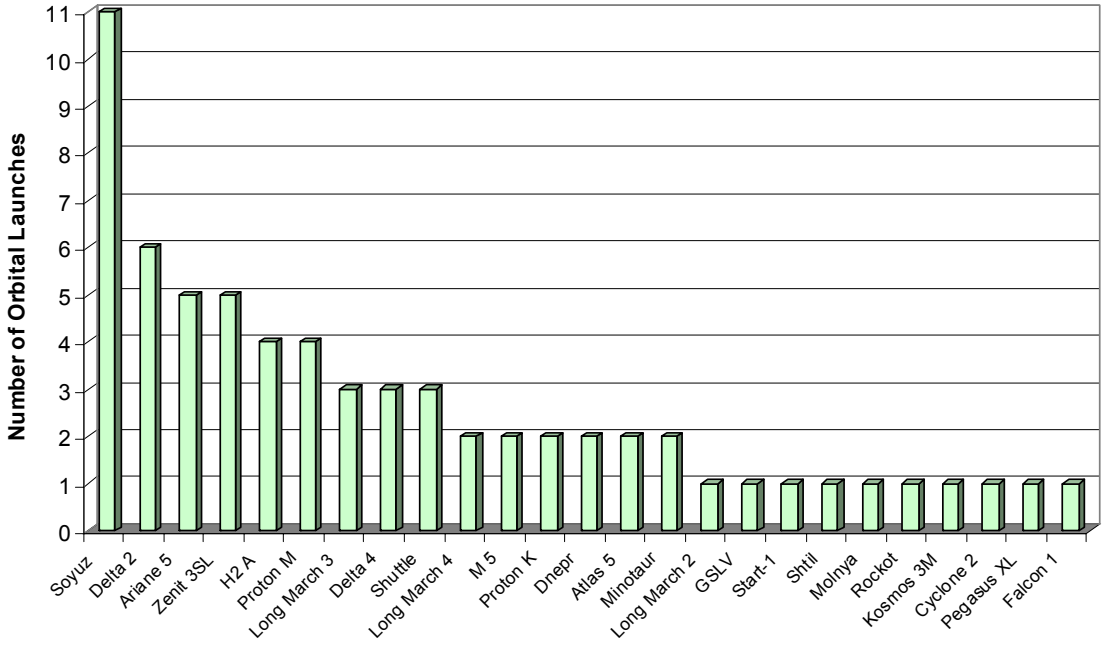

Figure 3.2 Worldwide launches by launch system in 2006

While the number of launches performed by each country indicates the number of vehicles produced by a country, the number and degree to which space bases are used reflects also directly the hierarchy of states in their capacity as major space actors and indicate to which extent a country is maintaining and improving its infrastructure.

In 2006, 17 launches sites performed at least a launch including two mobile platforms one form the Pacific Ocean, and one from a Russian submarine in the Barents Sea. Mobile platforms represented therefore 9% of the volume of launch site activity while the rest were performed form fixed launch sites. Baikonur in Kazakhstan (but operated by Russia) was the busiest space base in 2006 with 17 launches followed by Cape Canaveral in the U.S. with 10 launches (Figure 3.3).

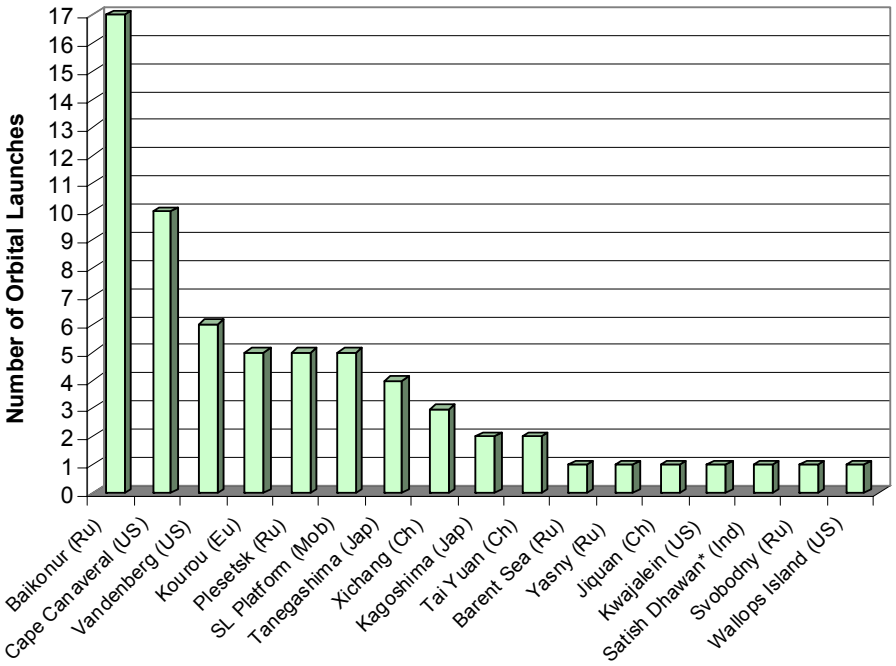

Figure 3.3 Launches by launch site in 2006

Russia used five different launch sites, including a mobile platform, while the U.S. used four bases. China used in 2006 three distinct launch sites to launch its rockets, three from the Xichang launch site, two from Tai Yuan and one from Jiquan (Figure 3.3). Japan used both of its launch sites in 2006 while India and Europe used only one base. Finally, Sea Launch relied probably in 2006 for the last time solely on its mobile platform "Odyssey" to launch rockets, as it plans to operate launches from Baikonur in fall 2007 (Cf. Chapter 5).

Furthermore some bases are being reactivated after being dormant for quite some time, and new ones are being inaugurated (i.e. Yasny launch base also known as Dombarovskiy missile base). In early 2007, China has also been reported to have chosen the site for its new satellite center. The Wenchang Satellite Launching Center will be the fourth in China and will be likely the launch site for the next generation of rockets to be put in use at the beginning of the next decade[157]. However, other countries that didn't launch rockets in 2006 are also improving or building their launching complex. For instance, South Korea is building its first launching pad the Oinarodo Space Center to be operational by 2008, while Brazil is refurbishing the Alcantara launch site.

[157] AP Press release "China Picks Site for Satellite Center" 08/2/2007 accessible at www.space.com/spacenews/asia/APChinanlaunchsiteweb_020807.html

Missions launched

While the possession of launch vehicles and space bases are important elements for the independence of a country to access space, and indicate the dynamism of a country in the space sector it is however only a partial indicator of the dynamism and the ambition of a space power. The variety of missions launched in space must therefore also be looked at as it indicates the activity and capabilities of a country to implement its space policy.

In 2006, 21 states, as well as an international organisation, launched a mission in space including ISS crew and cargo payloads[158]. Two countries cooperated on bilateral missions that were launched in 2006 (Israel/USA and Taiwan/USA). When looking at the performance of individual country, it appears that the United States was the world's leader according to the number of missions launched in space criterion (41% of all missions) followed by Russia (14%), Japan (12%) and China (6%) (Figure 3.4). The first European country was France which launched 5 missions in 2006, including two for the company Eutelsat. Italy was the second most active actor in Europe in 2006 when looking at the number of mission launched in space, with 3 missions launched. Germany, Norway, Luxembourg and Spain, as well as Eumetsat all launched a mission in space in 2006 (Figure 3.4).

[158] The number of humans in space, as well as their nationality are not taken into account in this analysis

The unequal activity in space is particularly striking when looking at the number of missions launched by country. Twelve countries (without counting Eumetsat) launched only one mission each in 2006, while 9 countries launched almost 90% of all missions[159]. Therefore like the launch sector, the number of missions launched per year is highly concentrated among a small number of countries/entities.

Furthermore, when looking at the scope of the mission only a handful number of countries had several types of missions launched in 2006 (Figure 3.5). The U.S has the most diverse set of missions being launched (12 different mission types), followed by Russia (9 different mission types) and Japan (8 different mission types) (Figure 3.5).

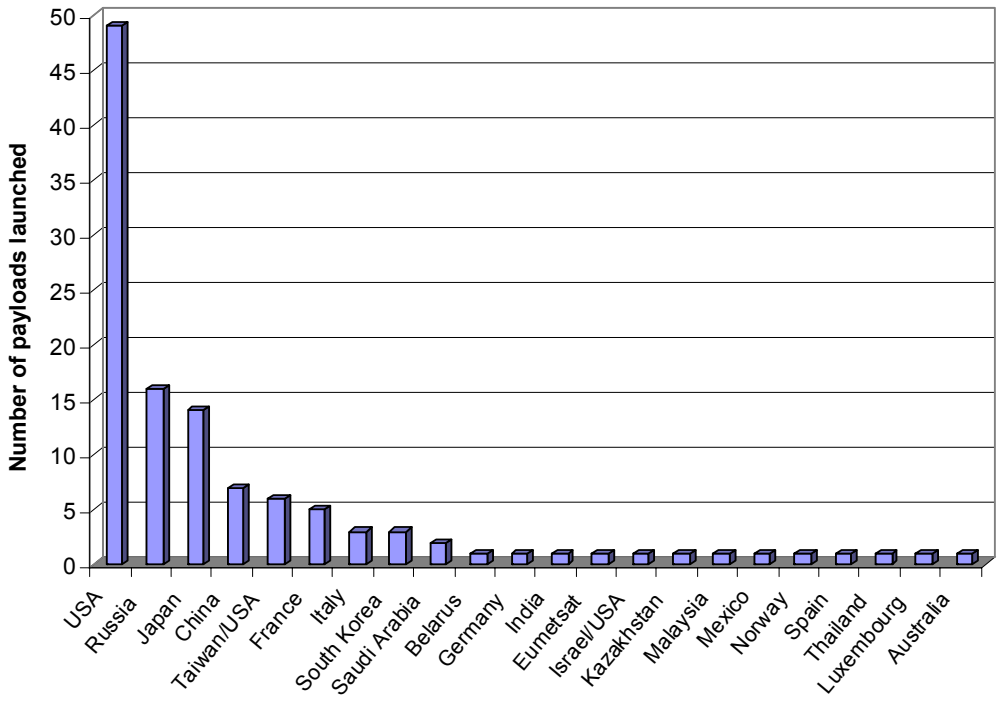

Figure 3.4 Number of missions launched into orbit in 2006 per country/institutions

[159] Nonetheless, while the nationality of missions launched in space is a major criterion to assess the capability of a country it may however over-represent small countries that are not developing indigenously their own space systems

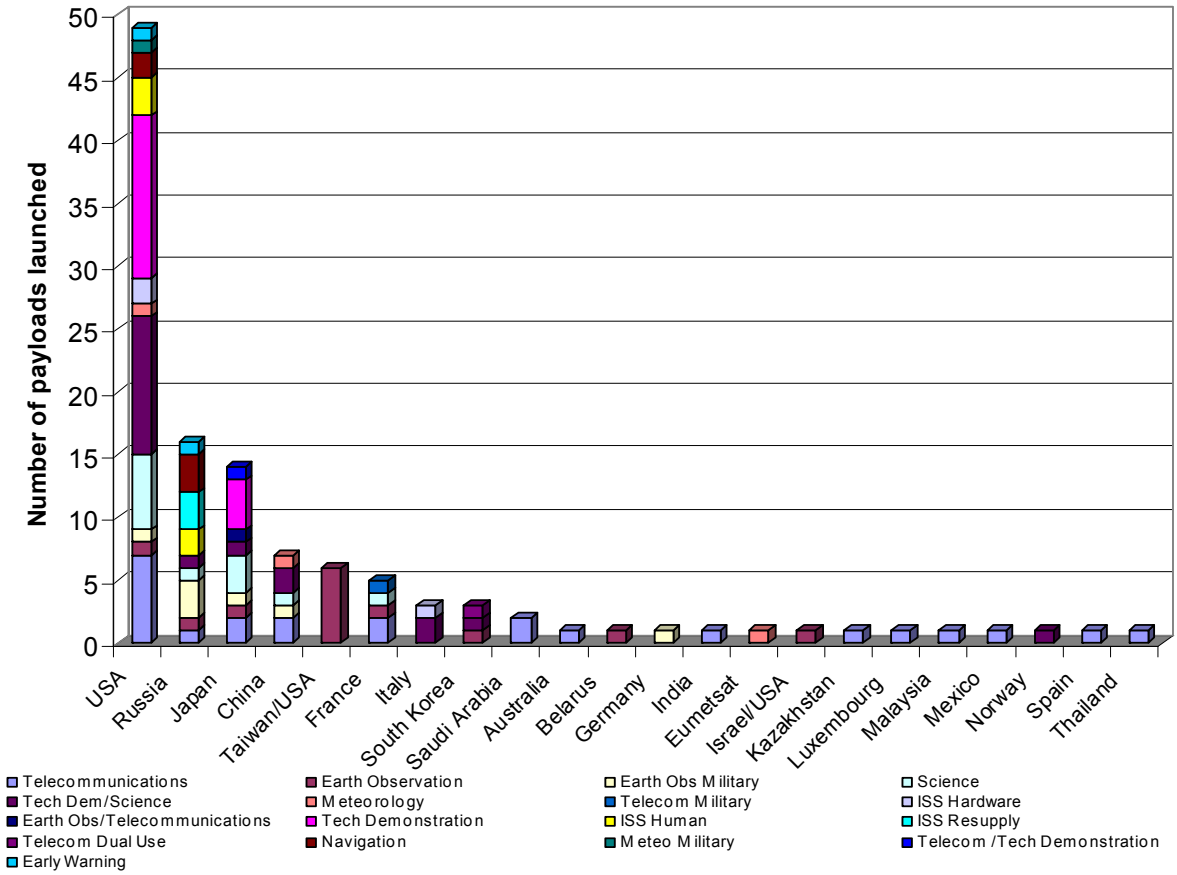

Figure 3.5 Types of missions launched into orbit in 2006 per country/institutions

Overall assessment

Finally, when looking at the combination of the activity of space powers in the launch sector and the types of missions launched it appears that the overall hierarchy of major space faring countries has not evolve tremendously in recent years.

The analysis of the level of activities of the launching sector and the missions launched sites reveal therefore certain persistent historical factors, such as the domination of Russia and the United States (Figure 3.6), with the U.S. being the space hegemon particularly in the number of missions launched[160], while Russia remained the world leader in the launch sector when using the launch rate criterion (Figure 3.6). Europe had a solid year in 2006 particularly in the launch sector with 5 launches and 13 missions launched. Asia has been in 2006 a dynamic region with the overall lead of Japan, but also with the confirmation of the strong position of China, while India had limited achievements due to a failure of its launcher that grounded its fleet.

[160] The United States cooperated on 7 bilateral missions with Israel and Taiwan that are not included with the U.S. total

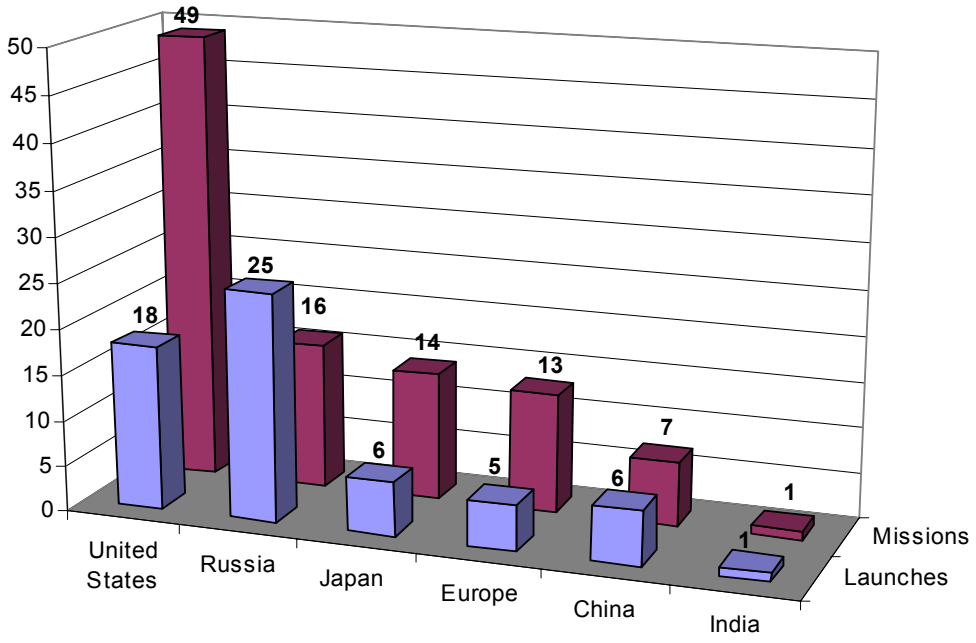

Figure 3.6 Assessment of major space powers' activities in 2006

4. European institutional market

Institutional space budgets have historically been the main source of funding for space activities and have therefore been the driver of the space sector and this is particularly true for Europe. The main purpose of the data on European institutional space expenditure is to provide an easily identifiable estimate of the scale of governmental resources spent on space and by proxy the volume absorbed by the European space sector.

4.1 European institutional market

European space activities are unique, as they combine national programmes as well as multinational programmes in the framework of ESA, Eumetsat and the EU. When, considering consolidated European public space expenditure, Europe is the second largest player in space (when referring to known space-related institutional budgets). Europe represents about 10% of all public investment in space.

Although Europe through several countries invest in defence programmes, the main institutional investment is overwhelmingly focusing on civil space activities. About 87 % of institutional space budgets are dedicated to civil applications. Only a small share of its overall space expenditure is allocated to national or multinational defence programmes.

4.2 Civilian space expenditure

ESPI estimated that in 2006 the overall civil institutional expenditure to be about 5.23 billions euros (Figure 4.1). ESA concentrates about 55% of the civilian institutional resources, national agencies and programmes represent about 38% of the civilian European institutional resources, while Eumetsat and the EU space budget follow distantly with an agglomerated 7% of the total civilian European institutional resources spent in 2006 (Figure 4.1).

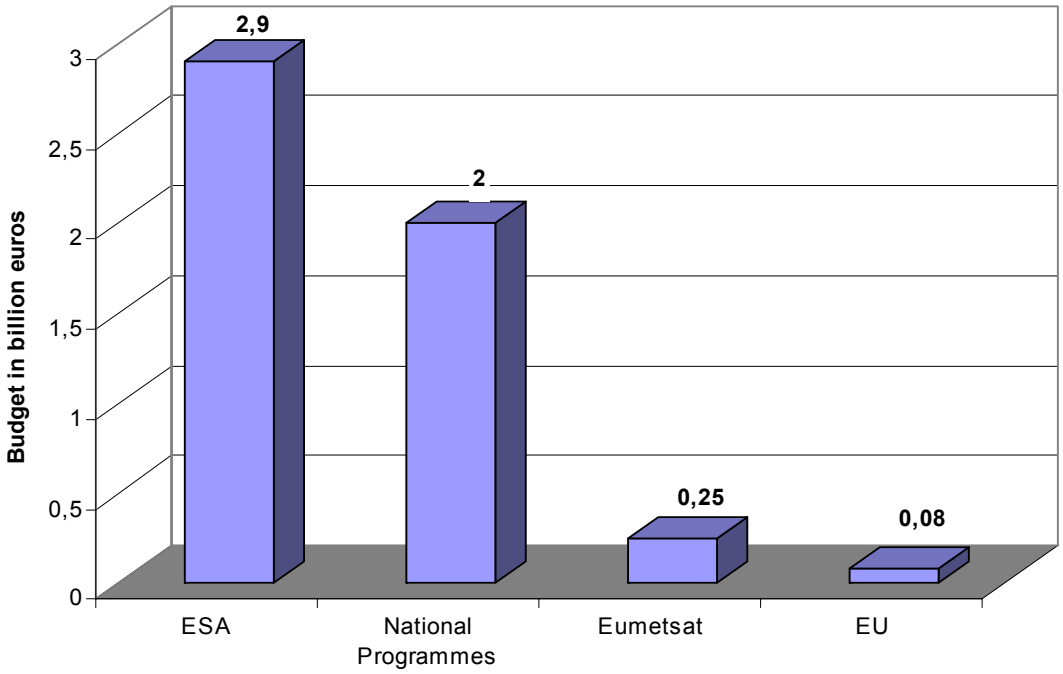

Figure 4.1 Estimated European civil public expenditure in 2006

4.3 European Space Agency

ESA accounted for the largest share of European space expenditure in 2006 representing more than half of total European civil spending in space with about 2.9 billions euros (Figure 4.1).

An enduring trend that emerged in recent years in Europe is the decrease of civilian space expenditure by individual countries allocated to national programmes in favour to ESA activities. This is particularly marked for small space countries. There is nevertheless a stabilization of the budget of ESA approximately at the same level as 2005.

When looking at the sectoral budget of ESA, support for launcher vehicles is the largest single category for spending, followed by Earth observation, Human spaceflight and space sciences (Figure 4.2). ESA budget reflects also a strong emphasis on technology independence with almost a combined 25 % dedicated to Navigation, telecommunications and technology activities (Figure 4.2).

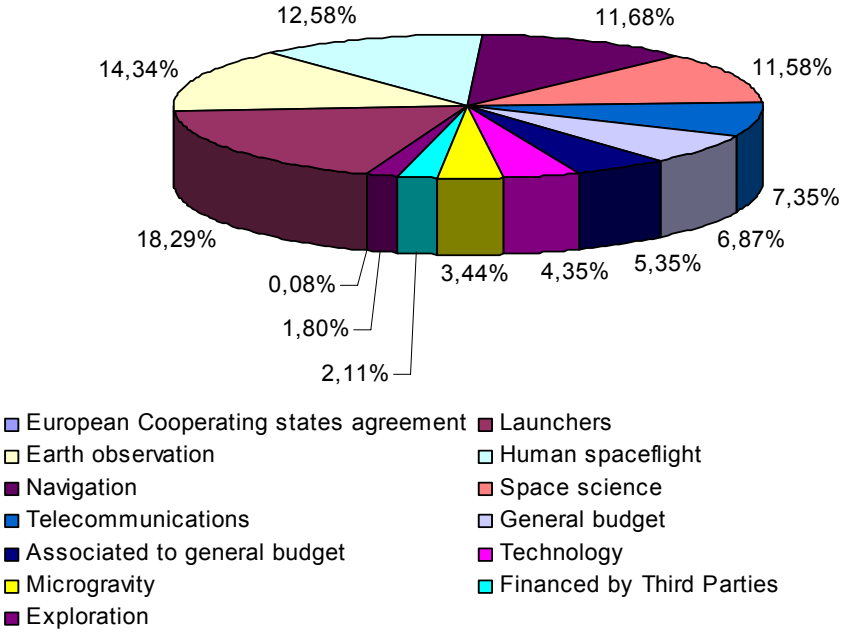

Figure 4.2 ESA programmatic budget allocation for 2006 (source Space News)[161]

[161] de Selding P.: "2006 ESA Budget Emphasizes Independence, Satcom Technology" Space News January 23, 2006

4.4 National agencies

In addition to contributions to ESA, a majority of its member states and other EU-27 countries have a dedicated space agency, space office, or funds allocated to domestic space programme. However, there is an important heterogeneity of public support devoted to space activities in Europe. The size of specific national programmes differs widely, and a great number of countries channel their investment in space affairs.

The institutional funding of space activities allocated to national programmes, ESA and Eumetsat varies considerably among European countries depending on their national priorities (Figure 4.3).

Most European countries funnel the majority of their investment to ESA, and only four member states (France, Germany, Italy and the United Kingdom) have a wide ranging spectrum of national activities and invest substantially in domestic programmes (Figure 4.4).

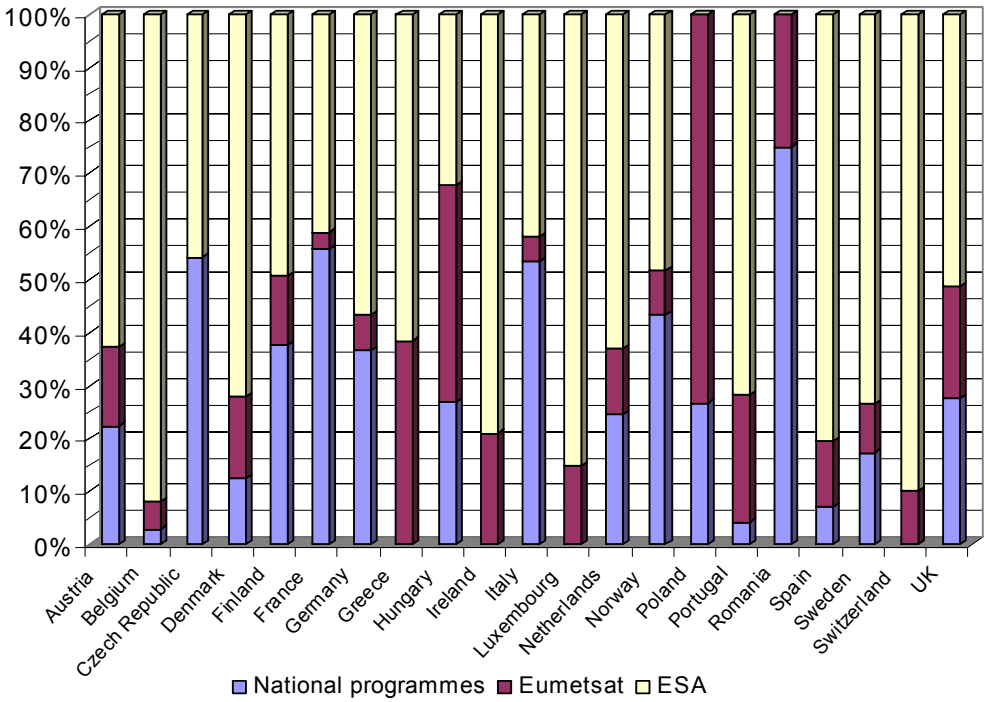

Figure 4.3 Estimated shares of national institutional investments in space in 2005 (Source ESA SRA ESTMP)

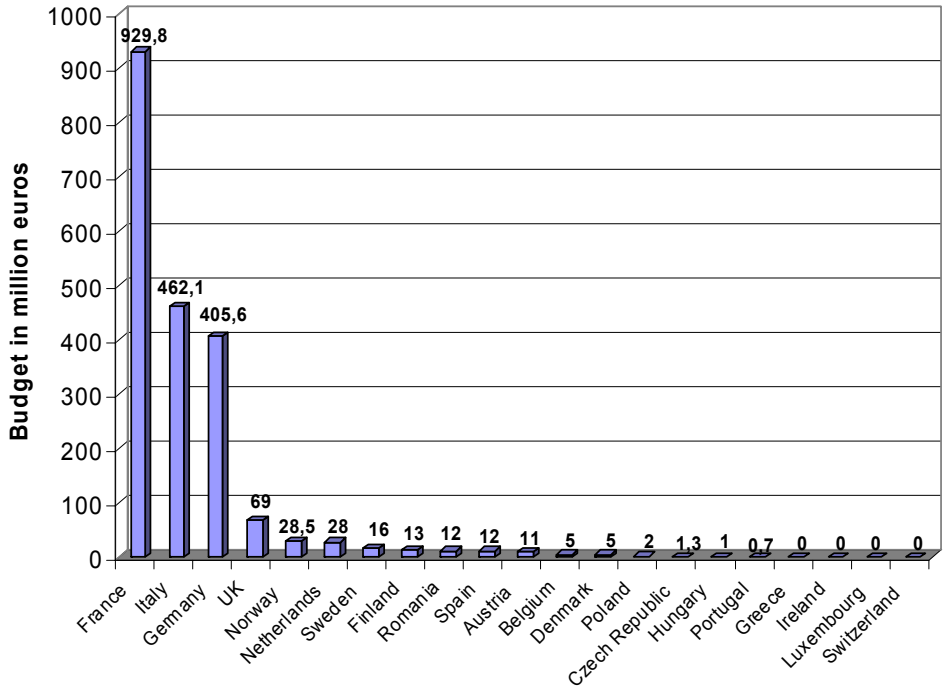

Figure 4.4 Estimation of the national space budgets in space in 2005 (Source ESA SRA ESTMP)

The Centre National d'Etudes spatiales (CNES) from France, the Deutsche Zentrum für Luft- und Raumfahrt (DLR) from Germany, the Agenzia Spaziale Italiana (ASI) from Italy and the British National Space Centre (BNSC) from UK concentrate an overwhelming majority of overall European national civil expenditure.

France

France has the largest national civilian budget in Europe with about 1760 millions euros in 2006 devoted to the CNES, with 685 million euros devoted to ESA and 1071 million euros allocated to its national programme. Space utilization was the biggest budget items for CNES in 2006 followed by launchers development (Table 4.1).

Programme	**Budget in million euros**
Launchers	381
Space Utilization	575
Collective ressources	*146*
General public	*32*
Sustainable development	*95*
Space sciences	*159*
Security and defence	*143*
Others	115
Total	**1071**

Table 4.1 Programmatic budget allocation for CNES in 2006 (Source CNES Annual Report 2006)

Germany

In 2005/06, Germany allocated an estimated 890 million euros to civilian space activities, and represents therefore the second biggest institutional space spender in Europe (Figure 4.5). Of that total 71% were spent on Germany's contribution to ESA and Eumetsat, 17% on the German national space programme led by the DLR, and 12% on R&D in DLR's space business (Figure 4.5). Figure 4.4 Estimation of the national space budgets in space in 2005 (Source ESA SRA ESTMP)

Italy

Italy is the third European space power by its budget and it has in recent months indicated its ambition to increase substantially its space effort. The Italian government approved in March 2006 to raise space spending by about 8% over the next three years (Table 4.2) Two-thirds of the spending is intended to fund activities in three areas: Earth observation (which will get 29% of the funds), science (21%) and space transportation (18%)[162].

[162] Nativi A. and Taverna M.: "Italy Plans Space Spending Hike Aviation" Week & Space Technology 03/27/2006

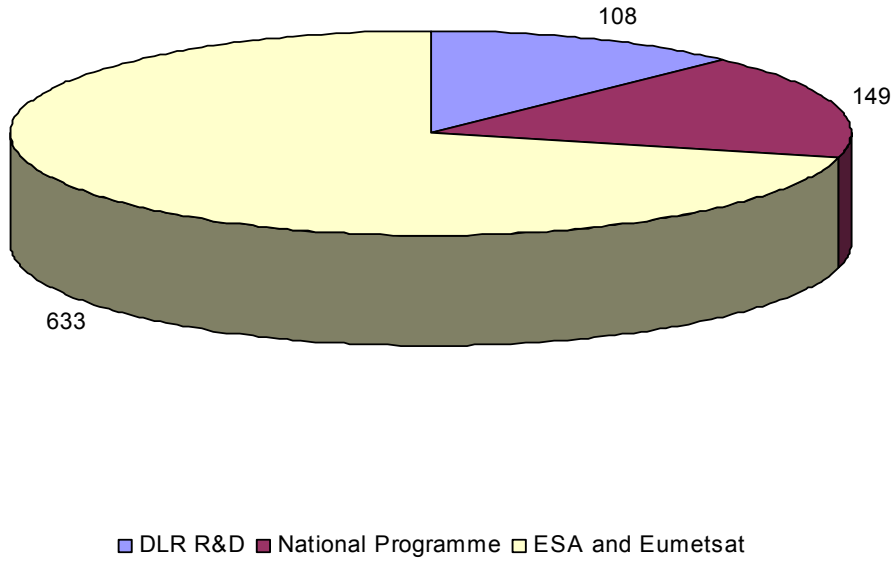

Figure 4.5 German public funding for space in 2005 in millions euros (Source DLR Research and Corporate Results 2005/06)

Programme	**2006**	**2007**	**2008**
Human spaceflight	88,24	57,8	45,82
General Budget	11,22	14,5	15,15
External training	2,81	2,55	1,8
Medicine and biotechnology	24,29	37,03	31,66
Navigation	20,73	72,71	77,85
Earth observation	225,66	230,55	313,37
Space sciences	109,13	166,87	211,41
Telecommunications	19,37	40,52	56,11
Space transportation	111,2	206,72	208,72
New Initiatives	2	15	20
New technologies and technology transfer	1	5	7
Total	**615,65**	**849,25**	**988,89**

Table 4.2 Provisional ASI budget for 2006-08 in million euros

United Kingdom

The United Kingdom is the last member of the quartet of big European space spenders. Through the British National Space Centre (BNSC) which coordinates civil space activities of its funding partners spent in the fiscal year 2005/2006, £207 million on space programmes or about 305 million euros. About 65% of this budget was the UK's contribution to ESA projects (Table 4.3).

Programme	National	ESA	Total
Earth Observation	54,54	66,44	**120,98**
Sciences/ Microgravity	32,46	68,00	**100,46**
Telecommunications/ Navigation	2,35	31,46	**33,81**
Technology	2,94	3,31	**6,25**
Transportation	0,00	7,35	**7,35**
Other	7,64	28,69	**36,34**
Total	**99,93**	**205,26**	**305,19**

Table 4.3 BNSC spending by subject area in 2005/06 in million euros (Source BNSC[163])

4.5 Eumetsat

Eumetsat, the European Meteorological Satellite Organisation located in Darmstadt (Germany) that is in charge of providing satellite data and products to its member states for operational meteorology and climate monitoring had in 2006 contribution of its Member and Cooperating States' of about 251.9 million euros. Eumetsat has 20 member states[164] (the same as ESA plus Turkey, Croatia and Slovakia) and 10 Cooperating States[165]. The contribution are based on a pro-rata to the Gross National Income (GNI) of the respective State, therefore Germany, the United Kingdom, France and Italy are the main contributors to Eumetsat and represent almost 70% of the total of the contribution of the member states.

The Eumetsat budget for 2006 covered total expenditures of 251.90 million euros largely financed by its member states's contribution, as well as limited additional income from licensed users for particular services. Of these funds, 11.5 % were allocated to the General Budget, to cover operating costs and to fund activities required in preparing for possible future programmes. Eumetsat had therefore dedicated 222.93 million euros of its budget to programme-related activities in 2006 with Eumetsat Polar System (EPS) representing the biggest earmark for 2006 followed by the Meteosat Second Generation (MSG) programme (Table 4.4).

Programme	2006
Eumetsat Polar System (EPS)	125,71
Jason-2	3,67
Meteosat Third Generation (MTG)	8,27
General budget/core activties	28,97
Meteosat Second Generation (MSG)	85,28
Total	**251,90**

Table 4.4 Eumetsat programmatic expenditure in 2006 in million euros (Source Eumetsat Annual Report 2005)

4.6 European Union

The EU expenditure through the Commission on space-related activities is rather modest and fragmented when looking at its advertised political ambitions. Its budget dedicated to space activities is mostly concentrated on R&D activities in the context of the Framework Programmes (FPs) rather than on operational programmes[166]. In an important development in FP6 (2002–2006), for the first time is included space activities under the thematic priority "Aeronautics and Space". It had a budget of 1.075 million euros, with 355 million euros directly devoted to technological activities for space systems focused on Earth-oriented applications[167]. The amount of EC funds directly or indirectly dedicated to space varying from one year to another as a function of the number for calls for proposal issued, the quality of projects presented and their cost it is estimated that the EC spent about 80 millions euros on space activities through various mechanisms in 2006.

The current Framework Programme (FP7) covering the period 2007 thru 2013, has seen its space emphasis grow thanks to a dedicated 'Space" theme, illustrating the EU's willingness to enhance Europe's industrial competitiveness in space activities. Space has a budget of 1.43 billion euros over 7 years out of about 50 billion euros dedicated to the whole of FP7. The allocation for space activities in FP7 represents thus a significant advance compared with FP6. However, since about 85% of this has been earmarked for GMES, that leaves "only" about 200 million euros over 7 years for launches, exploration,

[163] http://www.bnsc.gov.uk/content.aspx?nid=5551
[164] Eumetsat will soon have 21 member states with the full membership of Slovenia
[165] Serbia Montenegro has recently expressed its willingness to join the organization

[166] Even if with its two flagship programmes (Galileo and GMES) this is evolving
[167] Peter N. "The EU's emergent space diplomacy". Journal of Space Policy. Volume 23 (2) 97-107 May 2007

technological developments and science projects, etc.[168,169] For 2007 a total of 88.7 million euros is to be committed through the FP focusing almost exclusively on GMES related services (Fast Tracks Services and access to Earth observation data). Over the duration of FP7 an average of 205 millions euros is planned to be allocated to space through the space thematic alone. Moreover, on top of the FP a part of the Trans-European Network funds are also dedicated to space activities, and particularly to the Galileo programme, with 900 millions euros over 7 years for space infrastructure[170] and another 70 millions euros for Competitiveness and Innovation. On the period 2007-13 it is therefore estimated that the EC will spend on average about 340 millions per year on space activities.

4.7 Security-related space expenditures

While European space activities focus principally on civil space affairs, several European countries are increasingly identifying space assets as a top priority to support their security related activities. However, European investments on space security are limited in size and scope. Furthermore, while Europe collectively maintains several security-related capabilities its efforts in this domain are left to member states with limited bi-national or multi-national cooperation (Cf. Chapter 6). Only seven countries are involved substantially in those activities (Belgium, France, Germany, Greece, Italy, Spain and the United Kingdom). It is estimated that the defence-related space investments in Europe in 2006 were about 650 millions euros which is significantly less that the U.S. space investments (Cf. Chapter 6).

France is Europe's major investor in defence-related space activities and is spending about 72 % of the European total space security-related expenditure with an estimated public effort of 469 millions euros devoted to military space activities in 2006. However, while France has seen its budget stagnating in recent years, more modest historical contributors like the United Kingdom, Italy, Germany and Spain have seen their investment in security related space activities increase as they have been developing or procuring new national capabilities such as COSMO-Skymed or SAR-Lupe respectively (Cf. Chapter 6). Other countries like Belgium or Greece rely on cooperative programmes to reap the benefits of military space assets (i.e. access to Helios data).

4.8 The institutional market and its impact on the industrial base

The institutional market has historically constituted the main source of funding and revenues for the world space industry and governments are the major clients for the space industry. However, in recent years due to a slowdown of government expenditures the commercial market has been playing an increasing role in sustaining the activity of the space industry particularly in Europe. However, the commercial market, with its cyclic activities and its competitive nature is not a guaranteed source of revenues for the space industry compared to the institutional market which is relatively stable budget from one year to another. When looking at the turnover of the European space industry generated by the institutional and commercial markets since 1996, the cyclical nature of the commercial is particularly striking and contrasts with the somewhat flat trend of the institutional market (Figure 4.6).

[168] Ibid
[169] However, other resources can be funnelled through other thematic priorities, e.g. security, to space-related activities
[170] This budget allocation might increase dramatically in the upcoming months following the problems of the Galileo programme (Cf. Chapter 3)

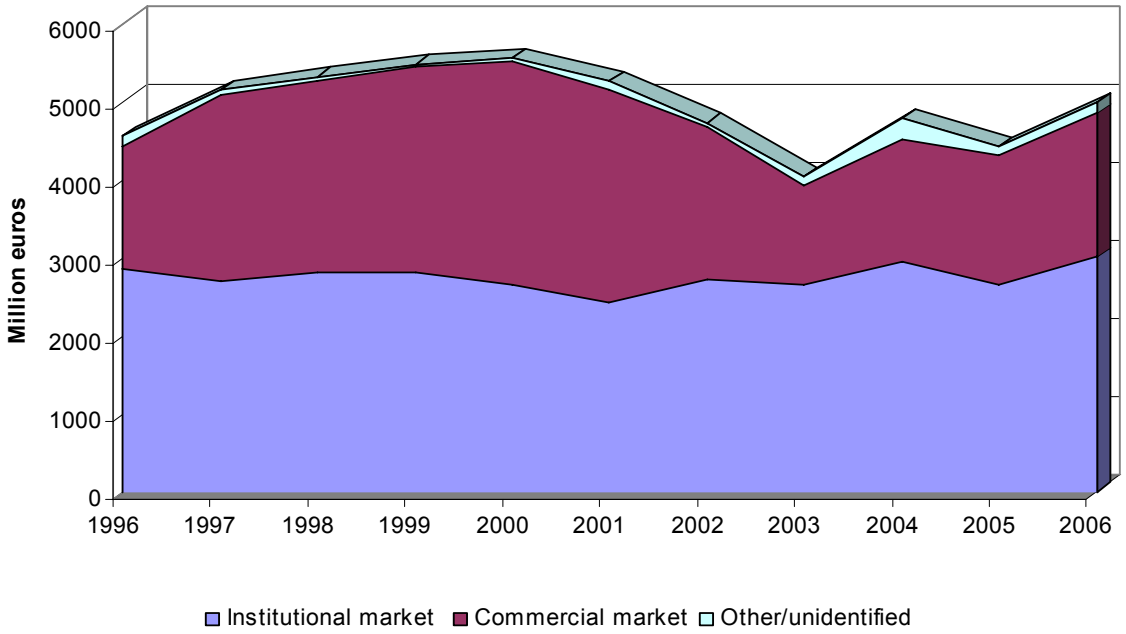

Figure 4.6 Evolution of the European industrial turnover by customer since 1996 (Adapted from Eurospace)

The revenues of the European space industry are particularly dependent of the health of the telecommunication sector that drives the manufacturing sector, as well as the launch services sector. However this business sector is not immune from sudden collapse as illustrated with the 2001-03 crises in the telecommunications services. The institutional market, both civil and military, is therefore vital for the space industry due to the volume of its procurement, as well as for its stability of expenditures and the fact it is often exempt from open-competition.

Governments can therefore provide a minimum baseline of funded activities to sustain their domestic space industry. However, institutional markets in Europe do not provide a sufficient compensation to commercial market variations as it has remained flat over the years. Furthermore, the European institutional market is rather peculiar when comparing with major space actors.

The institutional market is not large enough to counterbalance the dependency of the European space industry on the commercial space market, particularly for launch services, telecommunications and Earth observation services. This is due to limited institutional space budgets and this is overwhelming striking when looking at space military expenditure. Albeit Europe spends more than 5 billion euros yearly on space activities (almost 6 billion euros in 2006), Europe when compared to among others the United States and Russia, cannot guarantee domestic companies a significant captive market that support its industries. However, because the space market is not in general a market-driven industry, but more a technology push sector, institutional support to develop the technologies needed is crucial. A key challenge for European industries, as compared to their U.S. competitors, is therefore Europe's much smaller institutional market. Between 50 and 60% of the European turnover comes from institutional customers depending of the years, while in the United States it hovers between 70 and 85%. For the European industrial base the global commercial market is therefore essential to be able to maintain a minimum of activities and growth as the large closed institutional market enable the U.S. industry and its "primes" to have a competitive edge when entering the global competition market, as most of the non-recurrent costs for technology development have been covered by previous institutional demand.

Finally, the European industry's competitiveness in commercial market is also dependent of exchange rates. A strong euro adversely affects the competitiveness of the European suppliers of satellite systems/payloads and launch services as most of the transactions are done in U.S. dollars. The European space industry is therefore disadvantaged compared to others, and primarily vis-à-vis the U.S. space industry. Europe has been able to conquer a respectable share of the global commercial market to date, particularly for launch services and satellite manufacturing (Cf. Chapter 5). However, the fierce competition already underway between the U.S. and Europe in the commercial market can be evolving dramatically with the entry in the years to come of new players such as China and India, the recent reorganization of the Russian space industry, as well as the Japanese proposal for a new "Basic Law on Space Activities" to increase among others the robustness and the competitiveness of its domestic industry. Thus, while the global demand for new services and space hardware is not expected to grow dramatically a potential reduction of Europe's overall market share cannot be ruled out. This may pose a survival issue for the European space industry if European institutional market keeps stagnating at present level, a time when space powers worldwide increase their investment and support of space activities.

5. Space industry evolution

The space industry has witnessed in the last decade an increasing competition. The most visible and direct effect of this phenomenon is the multiplication of consolidation, mergers and the formation of strategic alliances, and consequently the shrinking number of prime contractors. In the United States, of the 20 major space companies in the 1980s only 3 "prime" were left in the mid-1990s (Boeing, Lockheed Martin and Northrop Grumman). A similar development took place in Europe in the 1990s. And, at present only 2 major space conglomerates (EADS Astrium and Thales Alenia Space) are operating at the integrator or "prime" level. A second wave of consolidation and rationalization of the space industry has been observed in recent months in major space faring countries in order to improve the global competitiveness of their domestic industrial base.

5.1 Industrial evolution in Europe

Following the acceptance of the merger of Alcatel with U.S.-based Lucent Technologies by the White House in October 2006, and after months of on-and-off-again discussions, Thales filled the same month an offer for merger with Alcatel Space which would see Thales acquire Alcatel's 67% stake in satellite manufacturer Alcatel Alenia Space and 33% share in the space services company Telespazio, along with a pair of secure telecom activities. Then, following the review by EC's Competition Directorate of the pending takeover of Alcatel's share in those two space ventures due to a possible market dominance that could result from the deal[171], on 4 April 2007 the EC announced that under the EU Merger Regulation the proposed acquisition was accepted. This concluded therefore the second and final phase of the agreement between Thales and Alcatel-Lucent announced on 5 April 2006 and represents the final regulatory approval and enables the creation of the New Space Alliance between Finmeccanica and Thales.

In 2006, EADS Space changed its name to EADS Astrium, but without any operational management changes. However in the recent months the European defence conglomerate has seen a series of modification of its shareholding. Following DaimlerChrysler reduction in EADS stakes from 30 % to 22.5 % in April 2006 in a deal worth 2 billion euros, a group of 15 banks paid DaimlerChrysler 1.5 billion euros in February 2007 to take over temporarily a 7.5% stake in EADS[172,173]. This transaction meets the combined objective of reducing DaimlerChrysler's holding in EADS to 15 % while keeping the German influence in EADS. DaimlerChrysler will retain voting rights for the full 22.5 % stake in order to maintain the Franco-German balance of power in the aerospace group[174]. This agreement can be dissolved from July 2010 when DaimlerChrysler can buy back the shares or transfer them to the German and French governments and Lagardère. Furthermore, Russia's second-largest bank VneshTorgBank (VTB) acquired 5.02% of EADS in 2006, and the Gulf state of Qatar announced in Spring 2007 its interest in taking a stake of up to 10% in EADS.

In the field of space-based tele-communications on 30 March 2006 the Luxemburg-based SES Global announced that it has completed the acquisition of 100% of New Skies Satellites. The integration of New Skies' assets aimed to strengthen SES' industry position, and extend SES' presence in emerging markets like India, the Middle East, Africa and Latin America. With the acquisition of New Skies, the satellite fleet of SES Global and its affiliates now comprises 43 spacecraft at 32 orbital locations[175]. SES in a deal with General Electric (GE) Capital sold also its minority stakes in AsiaSat and Star One to GE, plus an underused satellite over the Pacific Ocean and removed GE as an SES shareholder.

Finally, on 21 June 2007 Germany's OHB Technology AG announced that it had purchased German space-component manufacturer Kayser-Threde GmbH for 5.95 million euros[176]. This is the second strategic

[171] The EC was concerned that Thales could gain an unfair advantage by combining Thales Traveling Wave Tubes (TWTs) with related Alcatel components and subsystems

[172] Simensen I.: "Banks to Net bonus in EADS deal" Financial Times 10/2/2007

[173] The consortium is composed of seven private institutions that are buying 60 % of the stake and are Allianz, Commerzbank, Credit Suisse, Deutsche Bank, Goldman Sachs, Morgan Stanley and Sal Oppenheim. The eight public banks and regional states that bought the remaining 40 % of DaimlerChrysler's share are led by KfW, the state development bank.

[174] Simensen I.: "Banks to Net bonus in EADS deal" Financial Times 10/2/2007

[175] SES Global Press release 30/03/2006

[176] OHB Press Release "OHB Technology AG acquires

acquisition of OHB in recent years following the purchase of majority stake in MT Aerospace in mid-2005.

5.2 Industrial evolution in the United States

Lockheed Martin announced on 7 September 2006 that it was selling its International Launch Services (ILS)[177] stake to Space Transport Inc. a privately held corporation based in the British Virgin Islands. Following the exit of Lockheed Martin, ILS is now owned at 51 % by Space Transport Inc. The remaining 49 % is owned by Khrunichev. The main consequence of Lockheed Martin's decision is that ILS no longer offer the same back up services with the Atlas V rocket as it did in the past whereby customers were able to be transferred between Proton and Atlas lauchers if the first vehicle was grounded or otherwise unavailable. Following this transaction Lockheed Martin transferred the marketing operation and future commercial Atlas V vehicles to Lockheed Martin Commercial Launch Services (LMCLS).

The U.S. Federal Trade Commission (FTC)[178] cleared on 3 October 2006 the United Launch Alliance (ULA) deal to go forward with the Boeing and Lockheed Martin merger of their launch manufacturing and services businesses. And, following the FTC approval, the joint venture officially began operations on 1 December 2006. Under the ULA, Boeing and Lockheed Martin will jointly address the non-commercial U.S. government launch market by selling Lockheed Martin Atlas V and Boeing Delta II and IV rockets to the U.S. government and particularly the DoD in the framework of the Evolved Expendable Launch Vehicle (EELV) programme. On 14 December 2006 the first launch carried out under ULA auspices occurred when a Delta 2 rocket carried a classified NRO payload into LEO.

In the field of space-based Earth observation, the Orbimage acquisition of Space Imaging, was completed in January 2006, making of GeoEye the largest commercial remote sensing company in the world (Cf. Chapter 3).

In the emerging domain of satellite radio services, on 19 February 2007, XM Satellite Radio and Sirius announced an agreement, under which the companies will be combined in a tax-free, all-stock merger of equals (Cf. Chapter 2). Nevertheless, XM Satellite Radio and Sirius Satellite Radio will have to overcome intense regulatory scrutiny to complete their proposed merger. Furthermore, even if the companies are able to meet their ambitious goal of closing the deal by the end of 2007, integrating their satellite-based systems could take years longer due to different satellite architectures.

In the domain of space-based telecommunications on 3 July 2006 Intelsat announced the completion of its merger with PanAmSat Holding Corporation creating the world's largest commercial FSS provider. Intelsat acquired all of the outstanding common shares of PanAmSat for approximately 3.2 billion U.S. dollars[179] (or about 2.4 billion euros). Then UK-based private-equity investor BC Partners announced it will purchase a 76 % ownership stake in Intelsat Holdings Ltd., in a deal agreed on 19 June 2007 by Intelsat's current quartet of private-equity owners (Apax Partners, Apollo Management, Madison Dearborn Partners and Permira). Intelsat's current owners will receive 4.6 billion U.S. dollars (or about 3.5 billion euros) in cash from BC Partners. The transaction is expected to take between six and nine months to close pending regulatory approvals.

5.3 Industrial evolution in Russia

For many decades, Russia's space industry vied for first place with the United States in both military and civil space applications. However, funding issues since the implosion of the U.S.S.R. in the 1990s has greatly reduced its effectiveness, degrading the space industrial base and infrastructure and ergo hampering its global competitiveness. The Russian space industry has in the last decade relied on lower cost of production, low marginal cost, already proven technologies and joint venture with foreign companies to gain commercial market shares, and thus revenues, particularly in the business of launch services. However, higher cost of production (principally labour and raw materials) and a fragmented industrial base,

Kayser-Threde GmbH, Munich" 21/6/2007

[177] ILS was a joint-venture formed in 1995 between Lockheed Martin, and Khrunichev State Research and Production Space Center, and RSC Energia for the purpose of co-marketing their respective rocket launch services, the Russian Proton and the Lockheed Martin Atlas V

[178] The Federal Trade Commission is an independent agency of the United States government and its principal mission is the promotion of consumer protection and the elimination and prevention of anticompetitive business practices

[179] Intelsat Press Release 3/7/2006

as well as increasingly technological obsolescence, particularly in satellite manufacturing have pushed the Russian government to act to sustain its domestic space industry. The conjunction of Russia's marked economic recovery since 1999, mainly due to high world prices for energy, and the renewed involvement of Russia in major topics of world affairs together have led the Russian government under President Putin's leadership to develop an ambitious space policy and revitalize its industrial base.

In this context, in October 2005, the Russian government adopted a new Federal Space Programme (2006-2015) that attempts to halt the decline of the country's industrial base and ending years of under-funding. The new research and procurement strategy calls for increased funding in the civil space programme and for the consolidation of the Russian space industry into 10 large holdings by 2010 and eventually into three or four in 2015[180]. This new strategy entails also a wave of capital investment designed to increase Russia's share of the global marketplace for space-related goods and services and narrow the technology gap with other space powers. The new research and procurement strategy calls for the civil space programme to receive about 305 billion rubles (about 8.9 billion euros) for space activities in 2006-15, as well as 182 billion rubles of private investments (about 5.3 billion euros) (Cf. Chapter 3).

One of such holding has already been created. President Putin ordered on 9 June 2006 the merger of a number of Russian space enterprises into a new state-owned company named the Information Satellite Systems (ISS) that will become the flagship of Russia's satellite manufacturing industry. ISS will be centred around the Academician Mikhail Reshetnev Scientific Production Association of Applied Mechanics (NPO PM), Zheleznogorosk, Krasnoyarsky Krai. ISS's priorities projects would be the development of the next generation of multi-media telecommunications satellites based on the light weight satellite platform Express-1000 and the heavier platform Express-2000 platform[181]. Pending governmental approval, the Krunichev State Research and Production Space Center of Moscow will be the centerpiece of another holding that would include two rocket-engine makers and one manufacturer of satellites and launchers. Krunichev Center's would integrate Voronezh Mechanical Plant, the Isayev Design Bureau of Chemical Machine-Building of Koroloev, Production Association Polyot and Moscow for Entreprise for Equipment Dlina. Roskosmos has also set up one such holding centred around the Scientific Research Institute of Space Device Engineering in Moscow, while another holding will be built around the Scientific Production Association of the Machine-Building[182]. Nonetheless, while Russia is reinforcing its domestic industrial base in 2006, Russia's second-largest bank VneshTorgBank (VTB) - an institution hold by the Kremlin - spent about 1 billion euros to acquire 5.02% of EADS to foster cooperation with the Russian aerospace industry.

5.4 Industrial evolution in Japan

The new bill submitted to the Diet for the establishment of the "Basic Law of Space Activities" proposes to establish a new institutional framework to structure the space policy-making process more coherently in three areas, one being the competitiveness of the Japanese space industry. In particular, the Basic Law in its third point calls to strengthen industrial capability and autonomous business foundation from public budget to foster the effort of "industrialization" of Japan[183].

Since 1990, and the agreement with the United States to open government procurement for non-R&D satellites to international bidders the Japanese space industry is plagued by inefficiencies. In particular, because of the nature of government-funded R&D projects, the Japanese space industry was not concerned by improving its international competitiveness as it considered that it was sufficient to receive institutional R&D contracts for its survival[184]. The Japanese satellite industry focused its efforts on R&D and technological development satellites and public funding rather than the commercial market[185]. However, the Basic Law is urging the government, as well as industry to strengthen its industrial capability by relaying on the Public-Private-Partnership (PPP) mechanism to increase Japanese industrial competitiveness and reduce its dependence on public funding.

Public funding is nonetheless still important for technology development programmes in Japan. In this context, the Japanese Diet passed legislation (the so-called Fundamental

[180] CNES Moscow Office "Revue de presse 166-170" 4/9/2006
[181] Saradzyan S "Krunichev-Led Conglomerate Moves Closer to Approval" Space News 6/11/2006
[182] Ibid
[183] Suzuki K. "Transforming Japan's space policy-making" Space Policy (23) 73-80. May 2007
[184] Ibid
[185] Ibid

Law on the Promotion of Geospatial Information Activities) on 23 May 2007 that commits the government to fund the development and launch of the initial satellite in a planned GPS augmentation system, plus a period of on-orbit testing[186]. This satellite is foreseen to be part of the future Quazi Zenith Satellite System (QZSS) three-satellite constellation.

5.5 Industrial evolution in China

Two documents formulated by the Chinese government in 2006 "The Outline of the 11th Five-Year Programme for National Economic and Social Development" and "The National Guideline for Medium-and Long-term Plans for Science and Technology Development (2006-2020)" put space industry in an important position. These documents led subsequently to the development of a new plan for China's space industry, and thus to a new White Paper entitled "China's Space Activities in 2006" (Cf. Chapter 3). The main drivers for this new document were the principles of independence and Chinese-led initiative to meet the needs of the national modernization drive, and have therefore a clear industrial slant.

In White Paper the aims of China's space activities are listed to, among others, "meet the demands of economic construction, scientific and technological development, national security and social progress; and to raise the scientific quality of the Chinese people, protect China's national interests and rights, and build up the comprehensive national strength"[187]. Top priorities involve also developing and operating a series of high level space missions (e.g. high-resolution Earth observation system, new launcher development etc.)[188]. These initiatives aim to increase Chinese industrial competitiveness by developing new space assets.

Following the overall political impulse to increase Chinese space industrial competitiveness, 2006 and 2007 were already marked by several commercial successes. On 14 May 2007, China's first satellite export success was put successfully into orbit from the Xichang Satellite Launch Center using a Chinese Long March 3B. Nigcomsat-1 is a 5-tonne multi-band telecommunications satellite but for Nigeria with 14 Ku-band, eight Ka-band, four C-band and two L-band transponders based on China's DFH-4 satellite platform developed by China Aerospace Corporation. The satellite and the launch were purchased as a package and insured for about 300 million U.S. dollars[189], or 230 million euros. The Venezuelan government has also ordered a similar spacecraft for launch in 2008.

5.6 Industrial evolution in India

India has now entered the "global open-commercial market" as it has for the first time on 23 April 2007 launched on board its indigenously developed PSLV a foreign payload (the Italian astronomical satellite Agile) after winning an international competition. ISRO announced also on 18 April 2007 that following the contract signed with Eutelsat in February 2006[190], Antrix Corporation, which is the commercial arm of ISRO, will be building a communications satellite for Avanti Screen Media, a British company, potentially scheduled for launch in 2009[191]. Like for the Eutelsat W2M satellite Antrix will be responsible for building the platform while the transponders for the satellite would be sourced from Europe.

5.7 Trans-Atlantic industrial comparison

Despite the worldwide trend of rationalization and modernization of the space industrial base in major space faring countries the two major industrial space actors remains nonetheless Europe and the United States. An overview of the health of the industrial sector of those actors is therefore necessary to assess the dynamism and capabilities of the respective industrial base of each side of the Atlantic.

[186] Kallender-Umezu P.: "Japanses Government Commits to Funding 1st of the Three QZSS Satellites" Space News 28/5/07

[187] Chinese White Paper accessible at www.fas.org/spp/guide/china/wp2006.pdf

[188] Ibid

[189] de Selding P.: "China Launches Chinese-Built Spacecraft for Nigeria" Space News 14/5/2007

[190] Antrix Corporation in cooperation with EADS Astrium will manufacture the W2M satellite to Eutelsat. The transponders for the satellite built by EADS Astrium while the satellite platform will be built by Antrix Corporation

[191] The Hindu News "ISRO builds communication satellites for European clients" 19/4/2007

State of the European space industry

According to the results of the European space industry association, ASD-Eurospace[192] the European space manufacturing sector globally suffers from low margins, declining revenues, and employment reduction since the year 2000. However, after 5 years of continuous decrease, the consolidated turnover in Europe was 4.98 billion euros in 2006 up from 4.42 billion euros in 2005[193]. This revenues growth was supported mainly by increased sales of military system and operational launcher systems. The latest results of Eurospace demonstrate nonetheless that the space sector represents only a small fraction of the total Aerospace and defence sector in Europe as the turnover of ASD activities in Aerospace and Defence were in 2006 of about 121 billion euros up from 7.17% in 2005[194].

The European space industry turnover in 2006 was dominated by institutional customers with 62 % of its turnover or 3 billion euros generated by the institutional market while turnover of the commercial market was just about 1.8 billion euros in 2006[195].

ESA was the main institutional customer of the European space industry with about 50 % of its overall turnover (Figure 5.1). And, following the increasing interest devoted to military space programmes in Europe (Cf. Chapter 6), the share of revenues generated by the European space industry coming from national military space programmes is increasing to reach almost 30% in 2006, up from less than 20% in 2002 (Figure 5.1).

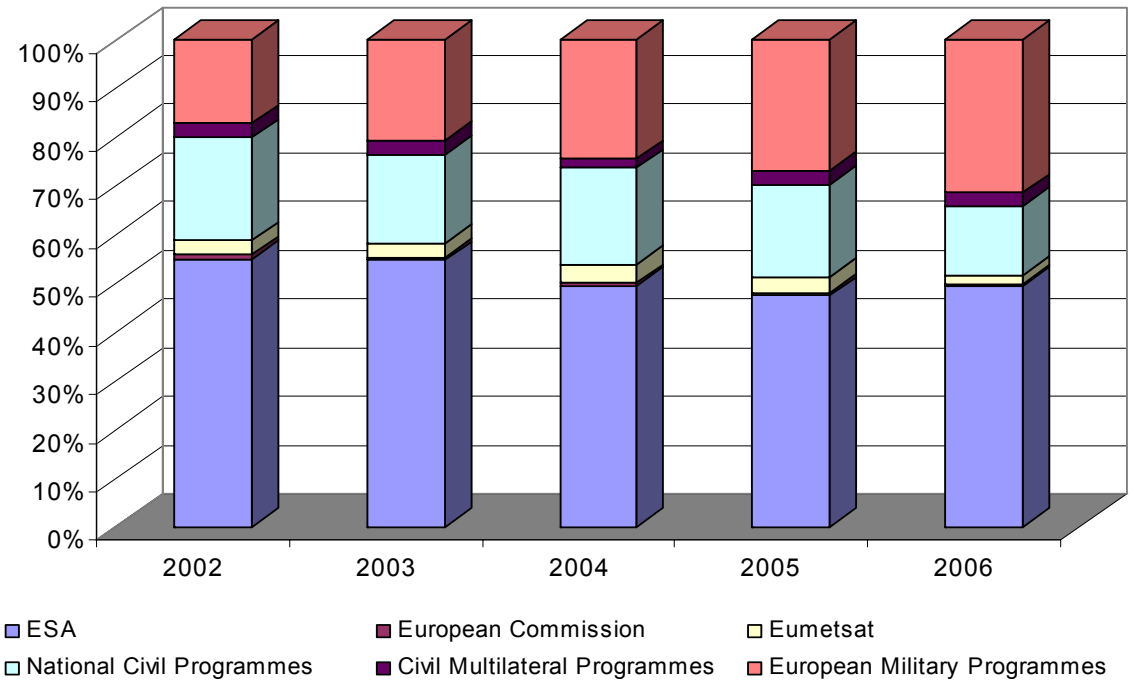

Figure 5.1 Estimated share of European space industry consolidated turnover by institutional customer since 2002 (Adapted from Eurospace)

[192] Eurospace is the space group of the ASD, AeroSpace and Defence Industries Association of Europe. Its members are the main European space systems manufacturers and launch services providers

[193] Eurospace facts and figures is a survey of European space industrial manufacturing activities undertaken by Eurospace since 1996. The survey focuses principally on Eurospace membership but not only. It identifies space industry revenues distributed by end customer (space agencies, satellite operators, Arianespace etc.) and by main activity line (satellite applications, launcher activities, scientific activities etc.)

[194] For comparison the aeronautics sector had a turnover of about 88 billion euros in 2006

[195] ASD-Eurospace "Facts and Figures, 2007 Edition. The European space manufacturing industry in 2006" May 2007

The turnover of the European space industry was in 2006 split almost evenly between the turnover generated by the satellite sector and the launch sector. (Figure 5.2). Arianespace was the main customer for the European space industry and generated more than half of the commercial turnover, due in part to the successful and dynamic year for the launching sector. The GEO operators were the second biggest European customer with about 40% of turnover generated by the European space industry.

The main space industry consolidated turnover was in 2006 generated in France, followed remotely by Italy and Germany and the United Kingdom (Figure 5.3).

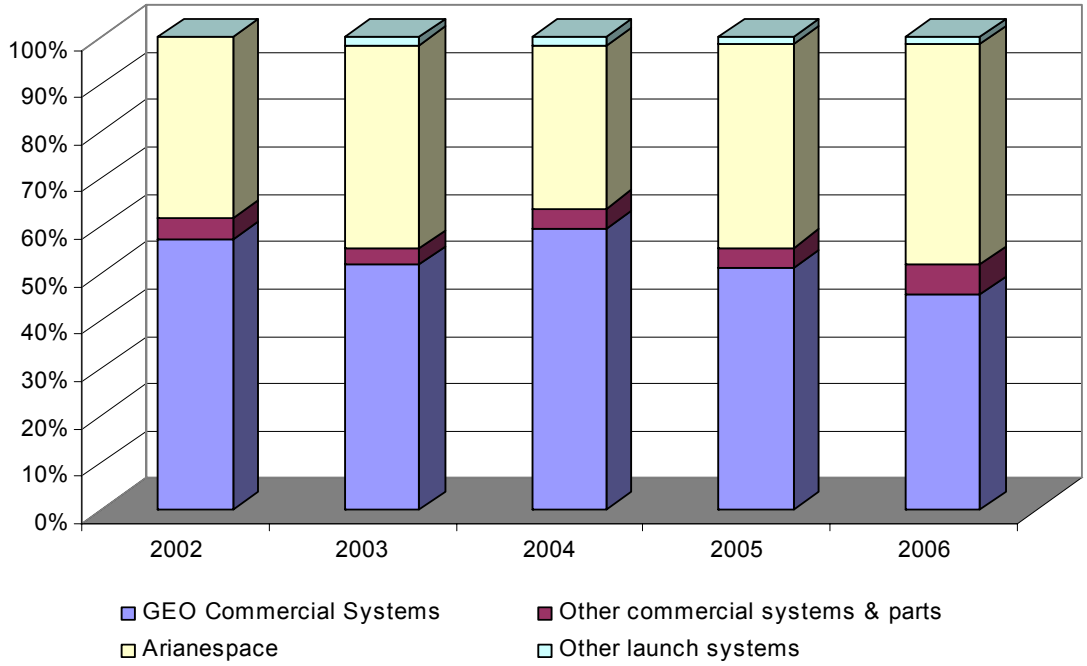

Figure 5.2 Estimated European space industry consolidated turnover by commercial customer since 2002 (Adapted from Eurospace)

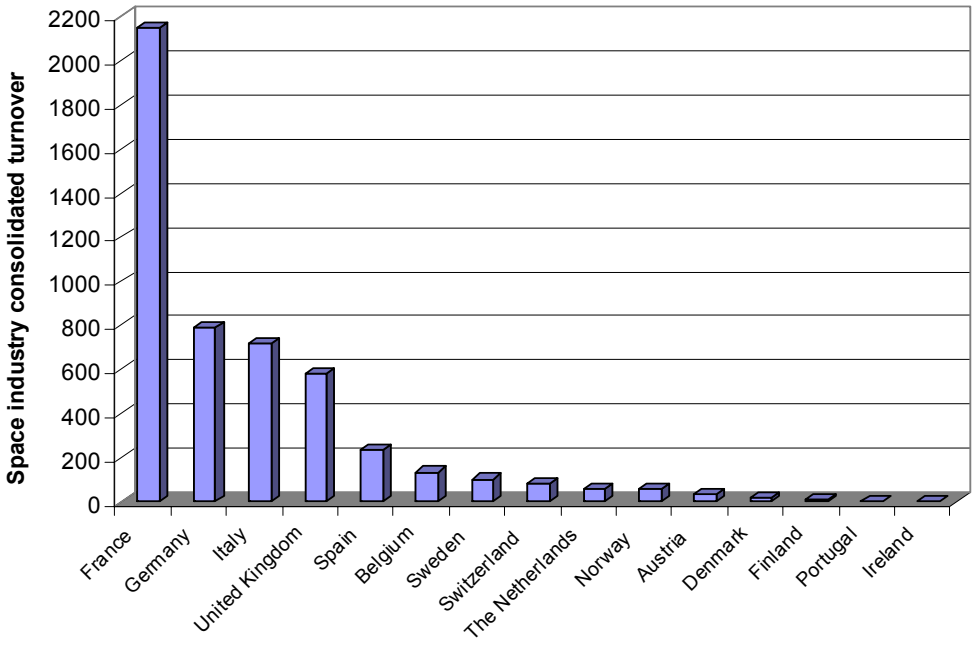

Figure 5.3 Estimated European space industry consolidated turnover in 2006 per country (Adapted from Eurospace)

When looking at the European consolidated turnover by customer and countries it appears that only the French industrial base generated more revenues from the commercial customer than from the civilian one (Figure 5.4). Nonetheless, France is the country whereby its companies made the most revenues from institutional customers. Institutional civilian customers are also important for the space industry located in Italy, Spain, Germany and Sweden. For the United Kingdom military institutional programmes are of particular importance. Satellite applications were the application generating the biggest turnover for the European space industry in 2006, followed distantly by the launcher segment and scientific activities (Figure 5.5). The companies which integrate complete space system like spacecraft or launchers, the so-called system integrators, generated a majority of the European industrial turnover. Equipment suppliers had a 19% share of the overall European turnover, followed by subsystem suppliers and ground services suppliers (Figure 5.6).

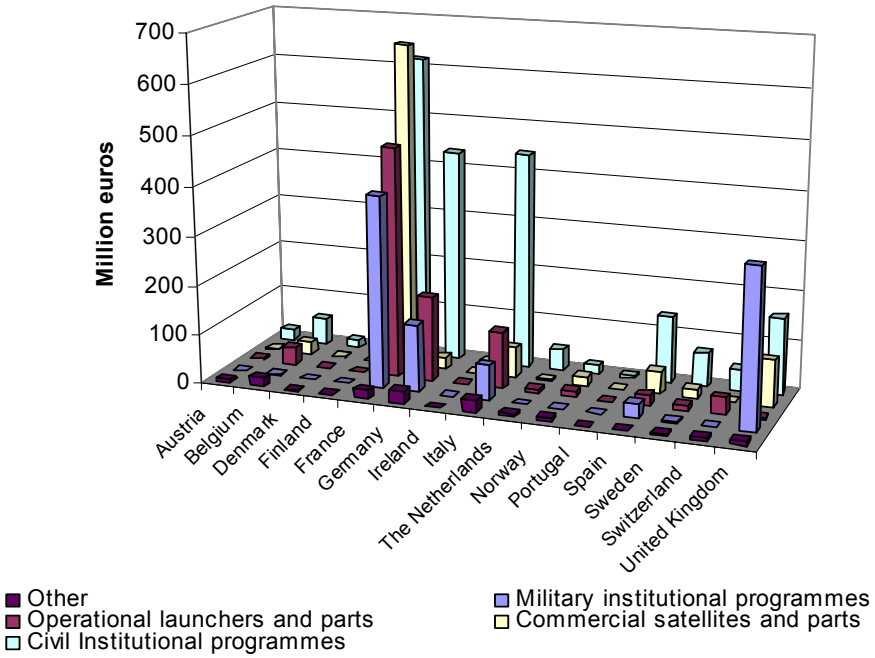

Figure 5.4 European consolidated turnover by customer per country in 2006 (Adapted from Eurospace)

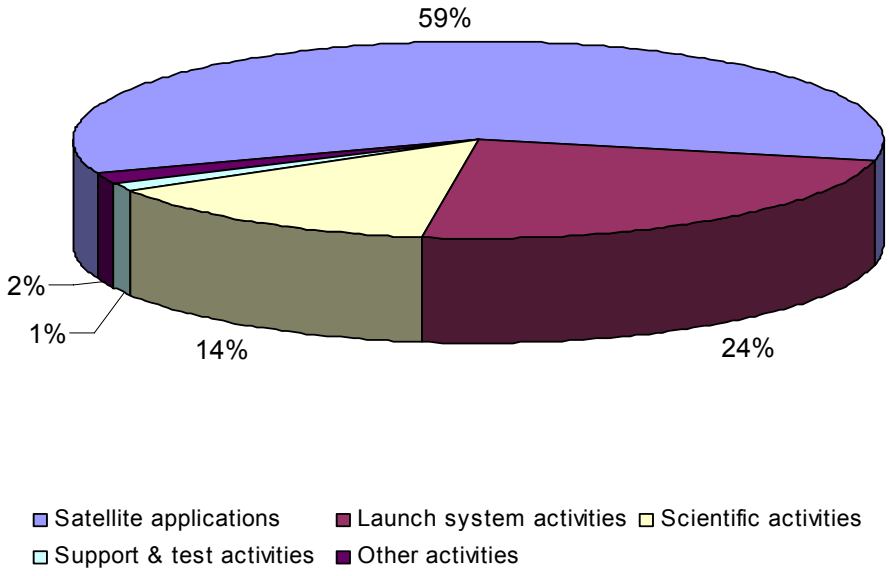

Figure 5.5 Estimated European consolidated industrial turnover by application in 2006 (Adapted from Eurospace)

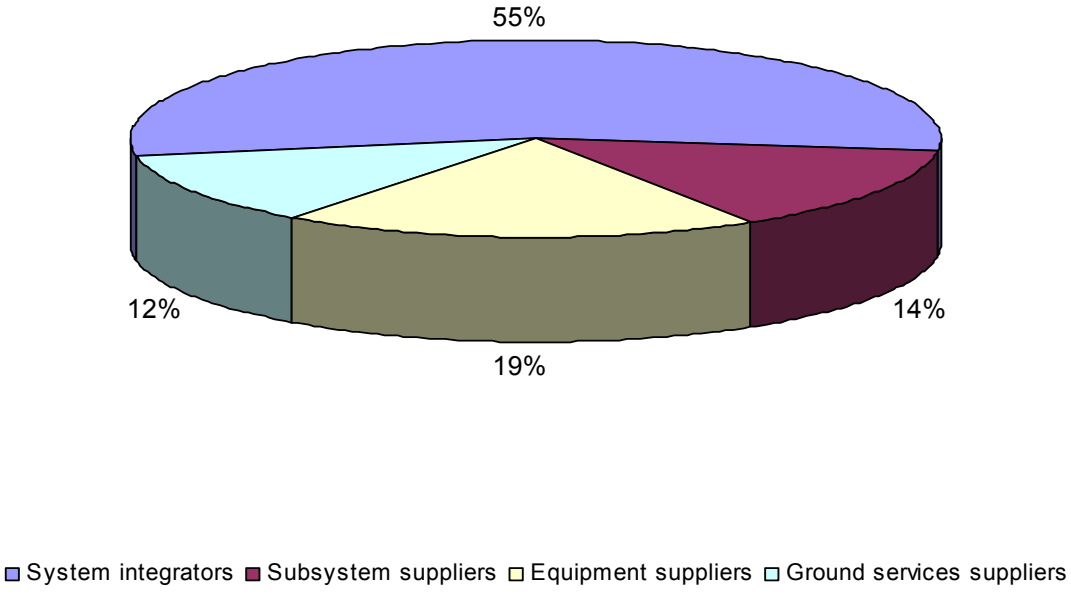

Figure 5.6 Estimated European turnover by company type in 2006 (Adapted from Eurospace)

The European space manufacturing industry was estimated to have an overall workforce of 28 863 in 2006[196] out of an estimated workforce in Aerospace and Defence of about 638 000. And, following the aforementioned trend of consolidation and rationalisation of the space industry, five large industrial groups (Alcatel, EADS, Finmeccanica, Safran, and Thales) concentrate the overwhelming majority of the total space industry employment.

According to Eurospace the system integrators concentrated about 55% of the workforce (15 783 jobs), followed by equipment suppliers (5 567 jobs) and the subsystems suppliers (4 067 jobs). Finally, the ground service suppliers concentrated 10 % of the European industrial workforce in 2006 (Figure 5.7).

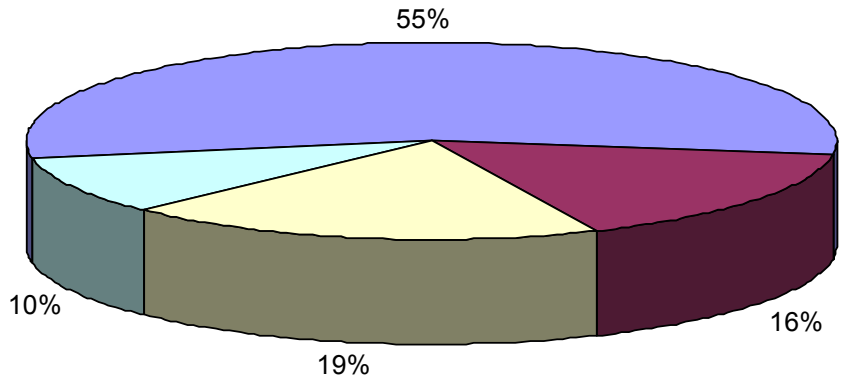

Figure 5.7 Estimated European employment by company type in 2006 (Adapted from Eurospace)

[196] Ibid

Six European countries concentrate almost 80% of the total European space industry employment, with France having 38% of the overall total (Figure 5.8). Germany, Italy and the United Kingdom had altogether 41% of the total space industry direct employment in 2006. And, smaller space countries like Belgium and Spain contribute an agglomerated 11 % of the total employment more as the remaining 9 countries (Figure 5.8).

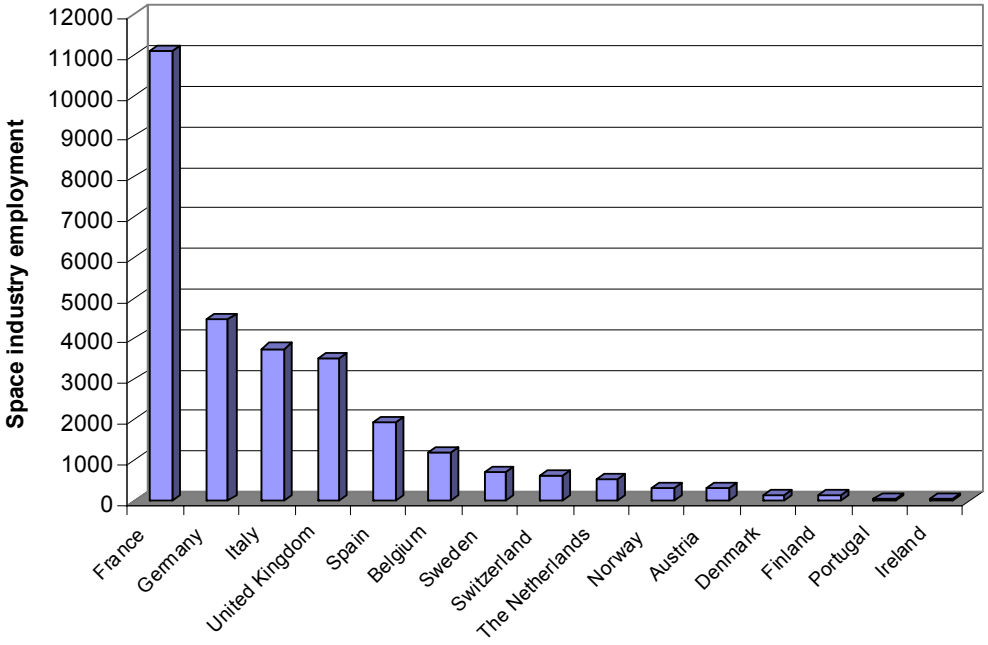

Figure 5.8 Space industry direct employment in 2006 (Adapted from Eurospace)

The main European space industrial centres are located mainly in France (Toulouse, Paris, Cannes), Germany (Munich, Bremen, Köln), Italy (Rome, Turin and Naples) and to a lesser extend the United Kingdom (Guildford, Stevenage), Spain (Madrid and Barcelona) and Belgium (Brussels and Liege).

State of the U.S. space industry

According to the latest results of the U.S. Aerospace Industry Association (AIA)[197], the total sales of the U.S. aerospace industry were approximately 184 billion U.S. dollars in 2006 (or about 141 billion euros) up more than 8 % from 2005 results particularly due to a strong increase in the civil aircraft sector (+21%)[198]. The main source of aerospace industry sales in the United States is the aircrafts with about 100 billion U.S. (dollars or about 77 billion euros) with 52% devoted to military aircrafts and 48 % to civil aircrafts[199]. The total U.S. industry space-related sales for 2006 increased by 3% compared to previous year and reached 38.5 billion U.S. dollars (or about 29.6 billion euros) level or about 21% of the overall aerospace industry sales (Figure 5.9).

[197] The AIA, is the premier trade association representing the United States' major aerospace and defence manufacturers. It comprises more than 100 major aerospace and defence companies as members of the association, and more than 175 associate member companies

[198] Aerospace Industry Association facts and figures 2006 data tables

[199] Ibid

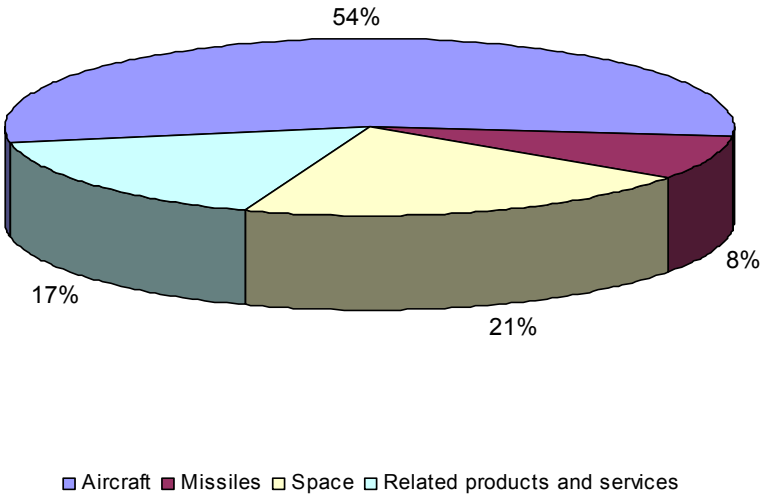

Figure 5.9 Aerospace industry sales by product group in 2006 (Adapted from AIA)

The major sources of sales for the U.S. aerospace industry is in direct aerospace products and services with about 153 billion U.S. dollars (or about 117.7 billion euros) in 2006 compared to 30 billion U.S. dollars (or about 17.64 billion euros) for related products and services (Figure 5.10).

The main U.S. space industry customers were in 2006 institutional customers (DoD, NASA and other non-DoD federal agencies). The major customer for U.S. aerospace products and services was the DoD with about 77 billion U.S. dollars (or about 59.6 billion euros) of purchase in 2006 (Figure 5.11).Figure 5.11 Aerospace industry sales by customer in 2006 for aerospace products and services (Adapted from AIA)

While exports of aerospace products soared to nearly 82 billion U.S. dollars (about 63 billion euros) in 2006, imports remained relatively stable under 30 billion U.S. dollars (about 23 billion euros). However, when looking in details at the space sector the picture appears somewhat bleaker. Most of the sales of the U.S. space industry are limited to the United States, and only a small fraction of its space sales originated in exports. In 2006, the U.S. space industry exports were valued at 441 millions U.S. dollars (about 339 million euros) with 420 millions U.S. dollars (about 323 million euros) for civil space systems and 21 millions U.S. dollars for military systems (about 16.1 million euros), while the U.S. imports of aerospace products for "space, missiles, rockets and parts" were of about 805 million U.S. dollars (about 619.2 million euros), producing ergo a trade deficit estimated at about 364 million U.S. dollars (about 280 million euros) [200].

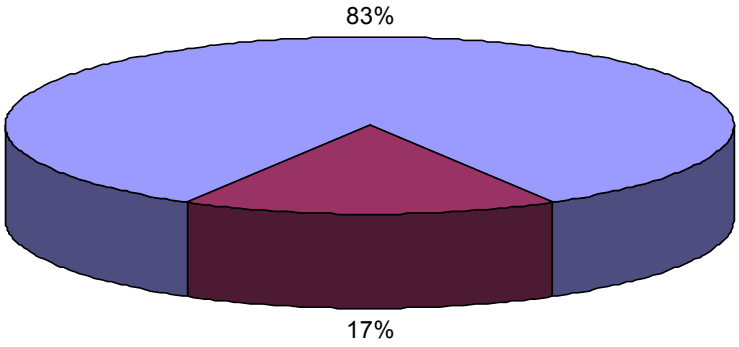

Figure 5.10 Aerospace industry sales in 2006 (Adapted from AIA)

[200] Ibid

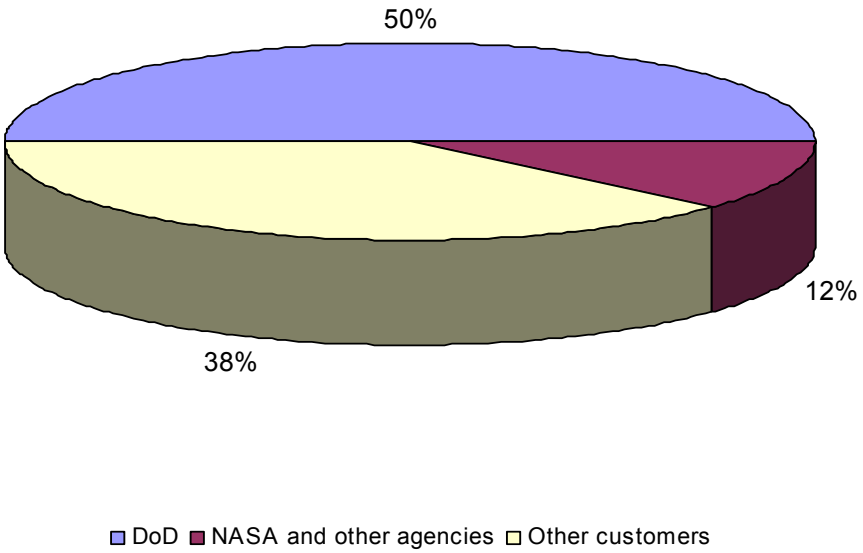

Figure 5.11 Aerospace industry sales by customer in 2006 for aerospace products and services (Adapted from AIA)

The aerospace industry employment increased for the third consecutive year, with the total workforce averaging some 635 000 for the year with about 400 000 employed in the aircraft, engines and parts sector. About 76 800 workers, including 42 500 production workers were employed in the category "Guided missiles, space vehicles and parts"[201].

The main space employment clusters are in the States of California, Washington, New Mexico, Texas, Colorado, Ohio, Mississippi, Alabama, Florida, Maryland, Virginia, Massachusetts and the District of Columbia.

5.8 Sectoral overview

Besides the overall comparison of the trans-Atlantic space industrial base, an in-depth sectoral analysis is required to assess the competitiveness and the latest developments of the main segments and markets of the space sector. Because of the strong link existing between the launching vehicle sector and satellite industries, neither can flourish without the other, and each must take the other's overall business health into consideration. The launching sector requires a steady stream of payloads, and both satellite manufacturers and operators need consistent access to launch vehicles. In this context, to asses the overall state of the space industry, a closer look will be given at these three segments: the launching sector, the satellite manufacturing sector and the satellite operators.

[201] Ibid

Launching sector

The following definitions apply to the launch sector analysis[202]. A commercial orbital launch is defined as a primary payload for which the contract was internationally competed (the launch opportunity was available in principle to any capable launch service provider) and/or the launch is privately financed without government support. A primary payload is defined as the payload with greatest mass for the concerned launch. Finally, launches are attributed to the country in which the main vehicle manufacturer is based, except on the case of Sea Launch which is designed as multinational[203]. However, when considering for instance ILS, when a launch was done using an Atlas V the launch was designed as U.S. and when a Proton has been used the launch is considered as Russian. Finally, no distinction has been made between the Ukrainian and Russian launch systems as major shareholders in most Ukrainian launch providers, as well as launch manufacturer are Russian.

[202] Several differences can be observed when comparing the following results with other studies due to methodological discrepancies

[203] Boeing is the majority shareholder (40 %) of Sea Launch. Other partners include S. P. Korolev Rocket and Space Corporation Energia of Russia (25 %), Aker ASA of Norway (20 %), and SDO Yuzhnoye/NPO Yuzhmash of Ukraine (15 %)

2006 results

2006 was a particularly dynamic year for the launch sector. Launch providers from the United States, Russia, Europe, China, Japan, India and the multinational consortium Sea Launch, conducted a total of 66 launches in 2006[204]. Overall, 21 commercial orbital launches occurred worldwide in 2006 representing about 32% of the total 66 launches of the year.

When comparing the level of activity in this sector country by country, Russia was in 2006 the world's leader according to the launch rate criterion with a 37% share of all launches made. It was followed by the United States (27%), Japan and China (9%). Europe performed 8% of all launches in 2006, the same level as Sea Launch (Figure 5.12).

China conducted also 6 launches in 2006, up from 5 in 2005, but less than in 2004 and its record 8. China used three types of rockets (Long March 2, 3 and 4). Europe conducted 5 launches in 2006 with its Ariane 5, all commercial ones, like Sea Launch and its Zenit 3SL. Finally, India performed only one launch in 2006, but it failed to reach orbit.

Whereas non-commercial launches are particularly important for the United States, and the Asian countries, commercial launches are the core of Europe's and Sea Launch's activities (Table 5.1). Four launch "operators", Europe, Russia, the United States and Sea Launch accounted for the 21 commercial launches. Russia commercial orbital launches represented only 40% of its launches total, but it was nonetheless the leader of the commercial launch market with almost 48 % of the total commercial launches. The U.S. as mentioned above relied

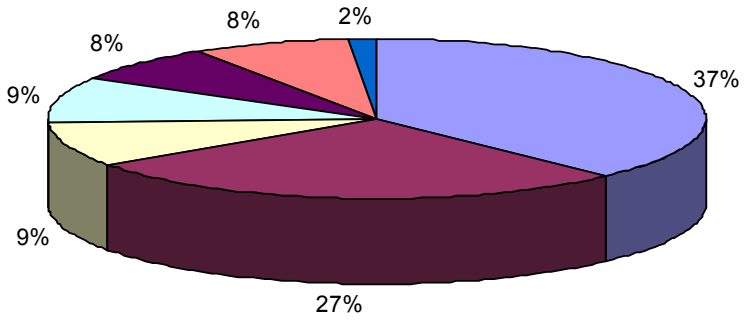

Figure 5.12 Worldwide launches by country/entity in 2006

Twenty five Russian vehicles were launched in 2006 using ten different launchers (Table 5.1). Ten of those launches were commercial ones and 15 were non-commercial, with 5 dedicated to re-supplying the ISS, 4 other to civil governmental launches and 6 to military launches. U.S. vehicles carried out a total of 18 launches in 2006 on seven different launchers, 17 of these launches have been non-commercial and only one commercial (Table 5.1). Japan conducted 6 launches using its two launchers M-5 and H2A, and those 6 launches were non-commercial (Table 5.1).

principally on the non-commercial market, and in 2006, Lockheed Martin's Atlas V conducted the single commercial U.S. launch. This launch was under the operation of ILS prior to the transfer of operation to LMCLS. Europe conducted 5 commercial launches in 2006 accounting for 100 % of its launches and about 24 % of the global commercial market share, as much as Sea Launch.

[204] Of the 66 worldwide orbital launches, there were four launch failures including one commercial (Proton) and three non-commercial (Falcon1, Dnepr and GSLV)

Launcher	Number of commercial launches	Number of non-commercial launches
China	0	6
Europe	5	0
India	0	1
Japan	0	6
Russia	10	15
United States	1	17
Multinational	5	0
Total	21	45

Table 5.1 Worldwide orbital events per country in 2006

In 2006, three launch services providers (Arianespace, ILS and Sea Launch) were predominant on the launch market for internationally completed launches accessible to Arianespace[205].

Arianespace had a 32 % of market share of internationally completed launches accessible to Arianespace and was the overall leader with 10 missions launched (Figure 5.13). It was followed by ILS and Sea Launch both at 19% of market share (5 missions). Puskovie Uslugi and Starsem conducted each two launches and United Start, Cosmos International, Kosmotras, Starsem all conducted one launch (Figure 5.13).

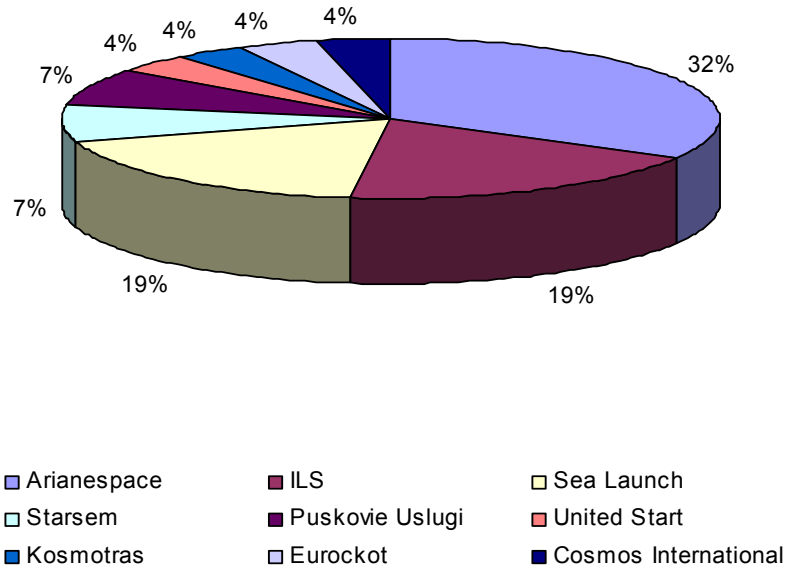

Figure 5.13 Launch services providers for internationally competed launch in 2006

[205] The market accessible to Arianespace as defined by ESA regroups the payloads for which the launch was competed and the European payloads for which the launch was not competed

When looking at the actual number of launches provided, Arianespace conducted 5 launch campaigns, the same level as its rivals ILS and Sea Launch. However, due to its dual-launch capability it launched twice more missions as its competitors.

Based on estimates form the United States Federal Administration Aviation (FAA) in 2006, the revenues of the 21 commercial launches is evaluated at about 1.4 billion U.S. dollars (or 1.12 billion euros). Europe generated the most revenues for commercial launch services (Figure 5.14).

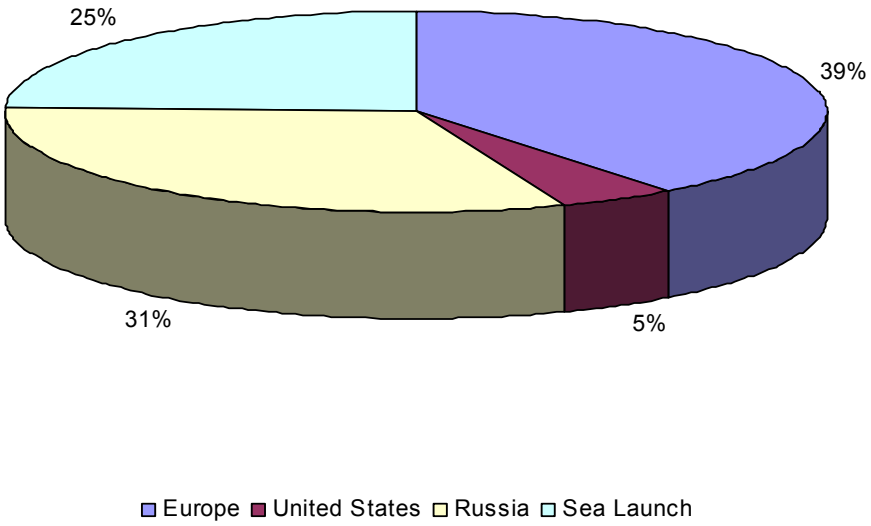

Figure 5.14 Commercial launch revenues in 2006 (based on FAA estimation)

2006 saw also the confirmation of the general trends of price increase in the launching sector, partially due to higher cost of raw materials and production (particularly in Russia and Ukraine). This is in turns leading to increasing revenues from commercial launches.

The low level of revenues of Russian launch services providers compared to their high level of activity is resulting from the fact that they are particularly active in the LEO market which has a lower price tag than launches to deliver satellites to GTO, the most lucrative market. On the contrary, Arianespace's good results with a similar number of launches that for instance Sea Launch can be explained by the fact that it is launching two payloads at the same time, and has therefore a higher revenues per launch.

Launch contracts awarded in 2006

While in 2006, the world's three principal commercial launch-services providers (Arianespace, ILS and Sea Launch) each conducted five launches, they have all different strategies for 2007 and had different results in the number of launch orders signed in 2006.

Arianespace[206] performed five launches in 2006 putting eleven payloads in orbit: ten satellites and a technology experiment into geostationary transfer orbit. Moreover, as a part of a cooperation programme with Russia Arianespace and Starsem launched the MetOp-A using a Soyuz 2-1a, and Corot on a Soyuz 2-1b. It was also the year the Ariane 5 ECA launcher entered commercial service. In 2006, Arianespace won twelve orders. Of those contracts won, eleven were for telecommunications satellites and one for an Earth observation satellite. These twelve satellites represent the equivalent of seven Ariane 5 launches; two will be in single launch configuration, one for the Helios 2B satellite and the other for the TerreStar 1 telecommunications satellite, while five will be dual launches.

Arianespace has also increased in 2006 its launch rate to meet the demands of its customers. For 2007 Arianespace expects to

[206] Arianespace has 23 shareholders from ten European countries including the main shareholders French space agency CNES (32.53%), EADS (28,59%), and all European companies participating in the construction of Ariane launchers

conduct 6 commercial Ariane 5 ECA launches carrying twelve satellites. Seven Ariane 5 flights are scheduled for 2008 and eight for 2009, by which time Soyuz and Vega will also be operating from the CSG[207].

As Lockheed Martin is no longer ILS's principal shareholder, ILS is now focusing exclusively on Proton launch vehicles, and in 2006, it has been reported to have signed four contracts.

In 2006, Sea Launch launched a record of 5 times (due to logistical constraints linked to the length of the voyage of the Pacific Ocean floating platform Sea Launch is limited to 6 launches in a given year). It reported to have signed four contracts in 2006 for the heavy-lift Sea Launch from its mobile platform and five for Land launch vehicles from Baikonur's cosmodrome.

However, after an historical year for Sea Launch its first launch of 2007 ended in a failure when the Zenit 3SL launch vehicle carrying a SES New Skies satellites was destroyed as it was lifting off the platform Odyssey on 30 January 2007[208]. Sea Launch was scheduled to conduct a total of 6 commercial launches in 2007, but now this plan seems dubious because this rocket failure damaged Sea Launch's ocean platform and grounded the vehicle for almost six months. Consequently, following the Zenit 3SL rocket failure several customers have sought alternative suppliers to assure they are in orbit to meet regulatory or customer requirements. Sea Launch is considering launching from Baikonur as early as early Fall 2007[209]. However, Sea Launch operations from its floating platform will take a little longer to return to flight because of the repair and recertification of the platform following the 30 January 2007 launch failure.

While the prospects of the launch sector are better than in the last few years several trends might have far reaching consequences for the launch sector in the near future.

Firstly, following the Sea Launch failure and the frenzy to find launch alternative, on 18 June 2007 SES purchased ten satellite launch slots from the launch-service suppliers, Arianespace and ILS, to give availability guarantees for satellites to be placed into orbit between 2008 and 2013. Each of the ten satellites (five for each company) are part of a bulk launcher procurement contract that features one primary launcher and a back up guaranteed by the other company. In addition, each company agrees to make the launch slots available for each satellite, to avoid a case in which satellite delays and a subsequent launcher delay grounds one of them. SES will also be able to switch from one launch-services provider to the other as late as three or four months before the launch without penalty. This marks the first bulk purchase of launch services to have a guaranteed access to launch capabilities and have a reduced price of access to space.

Secondly, following the recent trend whereby each commercial launch services providers have a full manifest for the years ahead, there is the prospect of the entry of China and India into the international launch market, as well as return of U.S. launch services providers in the commercial market. The consequences of the entry of China and India could be similar to entry of the Russian launch vehicles in the commercial launch market in the 1990s leading to an overcapacity in the market. But, while Chinese and Indian launchers are improving their reliability (particularly the Chinese launchers) the key element will be the decision of the U.S. government to let satellites carrying U.S. components being launched on a regular basis on Chinese and Indian launch vehicles. However, U.S. launch services providers are also increasingly looking at the commercial market to expand their revenues stream. LMCLS signed its first contract in February 2007 to launch Inmarsat 4 F3 mobile communications satellites onboard an Atlas V by early 2008. This marks the return of Lockheed Martin in the commercial market. And, while Boeing withdrew the Delta 4 from the commercial market in mid-2003, citing weak launch demand, it has been reported considering returning the Delta 4 launch vehicle to the commercial market to help make up for a shortfall in government launches later this decade under the request of the U.S. Air Force. Moreover, the U.S. launch services providers Orbital Sciences Corp. which has built its success on providing small satellites and small launch vehicles to both commercial and government customers is considering an expansion of its rocket business to be able to carry much larger satellites into orbit than its current aircraft-launched Pegasus and the ground-launched

[207] Arianespace will act as launch service operator of the Vega launcher for five consecutive launches following the qualification flight within the framework of the Vega Research and Technology Accompaniment (VERTA) programme decided at the ESA Council Meeting at Ministerial level in 2005. These launches will carry principally payloads built by ESA

[208] A Russian-Ukrainian government commission concluded that the failure was caused when a foreign object found its way into the first-stage engine and caused it to shut down

[209] The 29 June 2007 launch from Baikonur of a Zenit marked the return to flight in operation of the Zenit launch vehicle that caused the January 2007 Sea Launch failure and inaugurated the launch pad and ground facilities that will be used for Sea Launch's new Land Launch offering

Taurus and Minotaur[210]. Finally, with partial success of the second Falcon 1 launch in March 2007, SpaceX announced that it will start commercial launches to low Earth orbit in fall 2007. While Falcon 1 is not a competitor for the lucrative GEO market, SpaceX is however developing other launchers: Flacon 5 and Falcon 9 that would in the later case be a potential serious competitor in the commercial market if the development stays on tracks. SpaceX has been also granted by the Air Force on 26 April 2007 a five-year licence to launch from Cape Canaveral Air Station for both its future Falcon 5 and Falcon 9 heavy launch vehicles[211]. SpaceX has been operating up-to-now from a private launch complex in the Pacific Ocean's Kwajalein Atoll, but moving to Cape Canaveral is expected to be more attractive to future customers.

Satellite manufacturing sector

Space-based telecommunication is the most mature market of all space applications and constitutes therefore the core business for the satellite manufacturers (Cf. Chapter 2). Consequently, the health of the satellite telecommunications market determines to a great extent the sustainability of the international space industry. Looking at the satellite manufacturing market share of the GEO communications satellites ordered for a particular year is therefore a good proxy to assess the vitality of a national space industry as it reflects its competitiveness in the most lucrative segment of the satellite manufacturing market.

2006 results

In 2006, a total of 101 satellites were launched with 23% of those being commercial. The United States were the leader of commercial satellite manufactured and launched in 2006, with 60 % of the market. This domination is particularly due to the good performance of Lockheed Martin and Space Systems/Loral (Figure 5.15). Europe had about 26 % market share of all commercial satellites manufactured with 3 satellites built each by Alcatel-Alenia Space and EADS Astrium. In the segment of non-commercial satellites launched in 2006, Orbital Sciences Corp was particularly active (Figure 5.15).

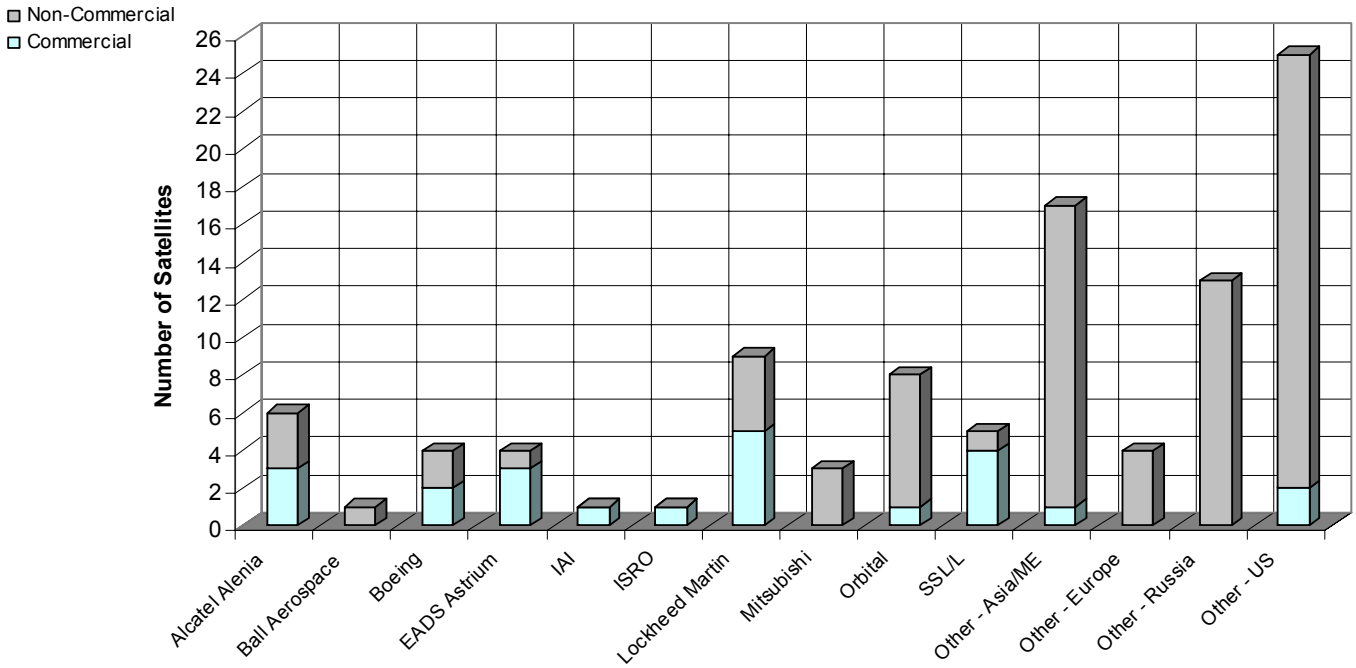

Figure 5.15 Manufacturer of satellites launched in 2006 by commercial status (source Futron)

Satellite contracts awarded in 2006

In 2006, with the emergence of new satellites operators and new commercial ambitions 43 new GEO telecommunication satellites were ordered, 28 were commercial satellites and 15 non-commercial (Table 5.2). The U.S. manufacturers won 16 contracts for GEO telecommunication satellites, 12 were commercial and 4 non-commercial. Europe followed with an overall total of 15 satellite contracts won with 12 commercial satellites and an additional 3 non-commercial satellites (Table 5.2). Russia won 6 contracts split evenly between commercial and non-commercial satellites, followed by China with 4 satellites and India with two (Table 5.2). China and India were the only two countries were the non-commercial total exceeded the commercial telecommunication orders and Japan has been reported having not being awarded GEO telecommunications satellites in 2006.

Primes	Commercial	Non-commercial
USA	12	4
Europe	12	3
Russia	3	3
China	1	3
India	0	2
Total	**28**	**15**

Table 5.2 Total GEO communications satellite orders in 2006

Twenty-eight GEO commercial telecommunications satellites were ordered in 2006. Space System Loral and EADS Astrium both signed 7 commercial GEO telecommunication satellites in 2006, having an agglomerated 50 % of market share, followed by Alcatel-Alenia Space with 5 satellites orders won in 2006. Europe was therefore particularly active with 12 new GEO telecommunication satellites orders in 2006 the same amount that the United States. The overall telecommunications satellite manufacturing market is thus still being dominated by European and U.S. companies.

However, 2006 was marked by the confirmation of the entry of new satellites manufacturers from the "South" (China and India) in this highly lucrative market. Despite problems with the newly introduced hardware it seems that China wants to reinforce its effort in telecommunications satellites development[212]. China's signed a contract with the Venezuelan government authorities for a large telecommunications satellite (Venesat-1) based on the new DFH-4 satellite platform. As in the case of its first export sale to Nigeria (Nigcomsat-1) this deal includes a launch aboard a Chinese Launch March rocket. Meanwhile, India's Antrix Corp, an organization part of ISRO, has teamed with Astrium Satellites to offer a small commercial telecommunications satellite product that competes with Orbital Sciences Corp's platform. The Astrium-Antrix joint venture posted two wins in 2006 (Hylas and W2M), and Antrix Corportaion signed another one in April 2007. Finally, Russia with Krunichev signed 3 satellites orders. Albeit the agglomerated total of these three players is rather limited, the volume of activity of their respective domestic satellite manufacturer base is expected to increase in the years to come following the evolution of their industrial policies.

Alcatel Alenia Space and Space System Loral were able to win 3 orders outside their domestic markets (for European manufacturers Europe is considered as a single market) demonstrating the competitiveness of their products and services. Astrium followed with two satellites orders won outside Europe (Figure 5.16).

[212] The first model of its new platform DFH-4 (Sinosat-2) was launched on 29 October 2006 but experienced severe in-orbit problems soon after

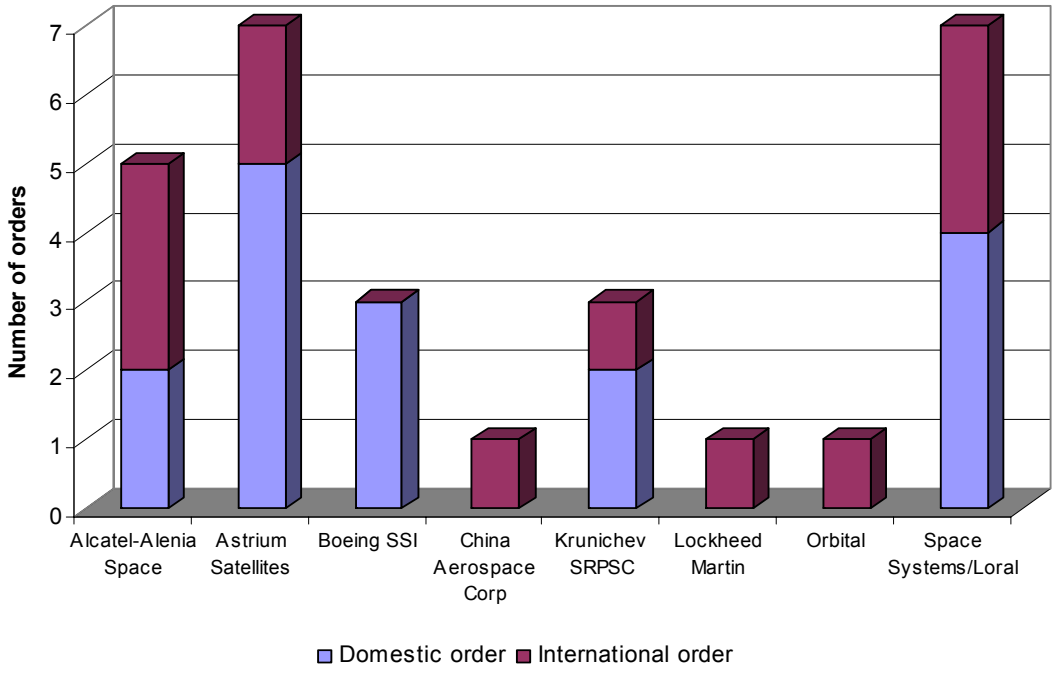

Figure 5.16 Commercial GEO satellite orders won in 2006 by manufacturers

Fifteen GEO non-commercial telecommunications satellites were ordered in 2006 (Table 5.2). The U.S. manufacturers had four orders, three to Boeing Satellite Systems International and one to Lockheed Martin, followed by Europe (all for Alcatel Alenia Space), China and Russia all with 3 orders each. Finally, India's Antrix Coporation had two satellites ordered in 2006.In 2006, no single satellite manufacturer was able to win a non-commercial GEO telecommunications satellites outside its captive domestic market (Figure 5.17).

When looking at the individual performance of companies, Alcatel Alenia Space was the world leader in 2006 by the number of contracts won (Figure 5.18), followed by another European company, EADS Astrium, as well as the U.S.-based Space Systems/Loral, and Boeing SSI. This quartet concentrated therefore 65% of contracts won in 2006 (Figure 5.18).

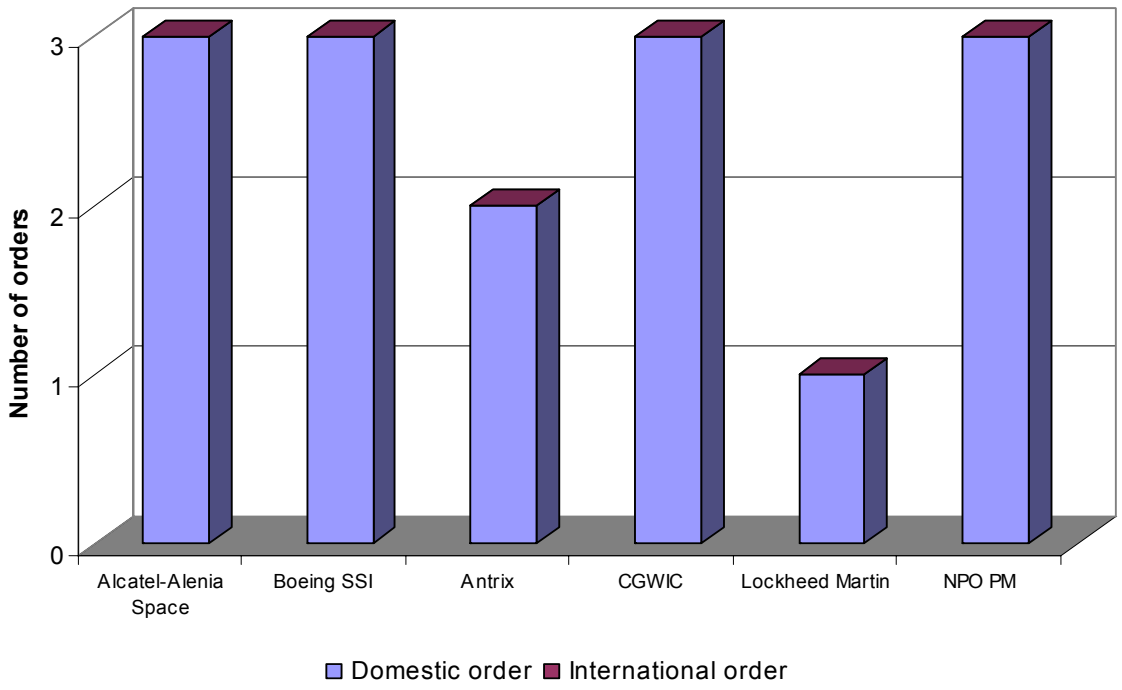

Figure 5.17 Non-commercial GEO satellite orders won in 2006 by manufacturers

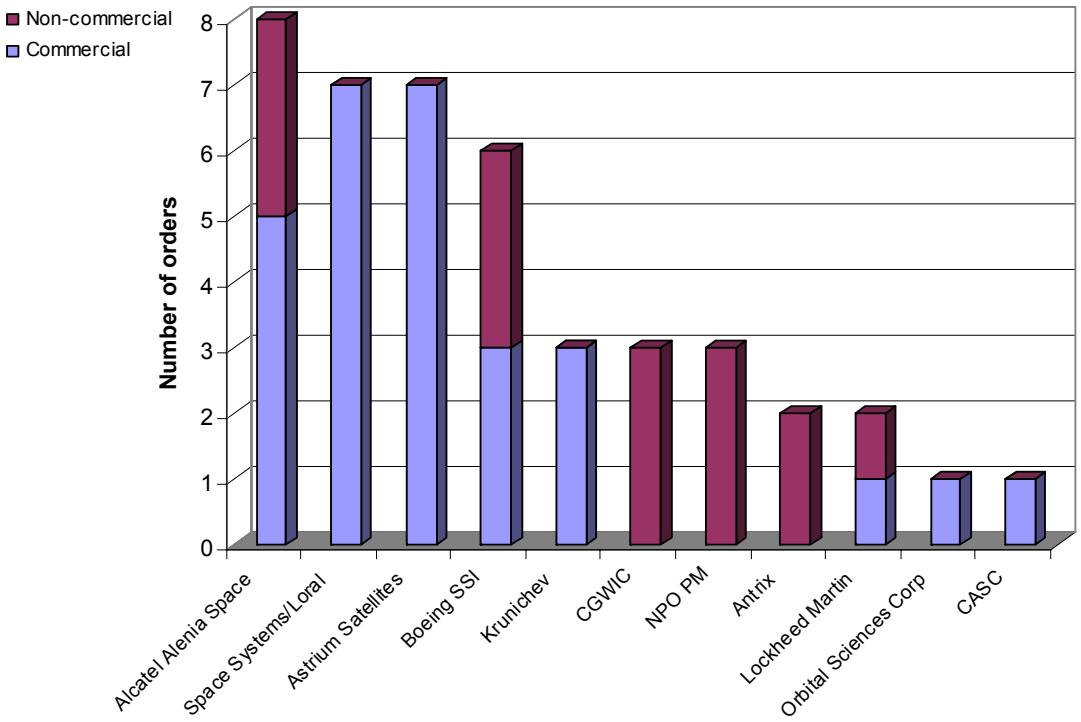

Figure 5.18 GEO commercial and non-commercial satellite orders won in 2006 per satellite manufacturers

Satellite Operators

As indicated in Chapter 2 space-based telecommunications is the major source of revenues in the value-added services sector, with a major role played by the FSS segment. As such this segment is therefore a main driver for the space industry. In 2006, the consolidation in the sector of satellite operators witnessed in recent years continued. PanAmSat and New Skies Satellites were purchased by Intelsat and SES Global respectively. Consequently, the Top 26 of the largest companies in 2006 that leased transponders on satellite they operate in geostationary orbit was dominated by Intelsat which is headquartered in Washington D.C. Despite the purchase of New Skies Satellites by SES Global, the Luxemburg-based company has fallen to the second rank in 2006. Intelsat has now become the world's largest operator in front of SES Global and Eutelsat. The combined Intelsat-PanAmSat has 51 satellites in orbit and 8 satellites on order, compared to 36 satellites in orbit for SES and 23 for Eutelsat. Behind this trio, there is an important quantitative gap, with other FSS operators having only between 11 and 3 satellites in orbit (Table 5.3). The top three companies were responsible for more about 64.5% of the 7.9 billion U.S. dollars (about 6 billion euros) generated by the FSS industry in 2006 with the top two alone accounting for more than half.

Rank	Company	Location	2006 Revenue in million $	Satellites in Orbit	Satellites on Order
1	Intelsat Ltd	Bermuda/USA	2100	51	8
2	SES Global	Luxembourg	1900	36	9
3	Eutelsat	France	1050	23*	4
4	Telesat Canada	Canada	411	7	2**
5	JSAT Corp	Japan	326	8	1
6	Star One SA	Brazil	195,8	5	2
7	SingTel Optus	Australia/Singapore	191,8	4	2
8	Loral Skynet	USA	164	5	1
9	Hispasat	Spain	159,1	3	1
10	Russian Satellite Communications Co	Russia	152	11	4

* including some satellites partially owned / ** satellites under construction

Table 5.3 Top 10 FSS operators in 2006
(Adapted from: de Selding P.: "Top Fixed Satellite Service Operators" Space News 25/6/2007)

6. The Defence perspective

It has been recognized for a long time that space assets form a system that is central to the requirement of modern armed forces. Consequently, over the last decades a considerable number of military assets, principally reconnaissance and telecommunications satellites, have been sent into space, mainly by the United States and the U.S.S.R and now Russia. But, recent geopolitical events have demonstrated convincingly the importance of information supplied by space technologies, both in peace and in war, as shown in the military operations in Iraq, Afghanistan, and Kosovo or in the December 2004 Tsunami disaster relief operations[213]. And, apart from the traditional space powers there are now more and more countries that have committed significant efforts to obtaining dedicated defence satellites programmes or "multi-purposes assets", particularly in the field of Earth observation and reconnaissance leading therefore to an "internationalization of the militarization of space"[214].

6.1 Recent trends in military expenditure

The overall economic value of the global space sector is estimated at about 173 billion U.S. dollars for 2006 (about 133 billion euros), including an estimated 61 billion U.S. dollars (about 47 billion euros) in institutional space budgets (including civil and military budgets). On the other hand, according to the Stockholm International Peace Research Institute (SIPRI), global military expenditure in 2006 is estimated to have reached 1204 billion U.S. dollars[215] or about 926 billion euros.

However, despite the difference in overall size, like in the space sector, world military expenditure is extremely unevenly distributed between countries. There is a process of concentration of military expenditure where together the 15 countries with the highest military spending account in 2006 for 84 % of the world total (Table 6.1).

The United States is by far the biggest spender in the world and its military expenditure now accounts for almost half of the world total (Table 6.1). It is distantly followed by the UK, France, Japan and China with 4-5 % each. A factor that has aided the upward trend in military expenditure in 2006 is the high and rising world market prices of minerals and fossil fuels. This is reflected especially in Russia where increased revenues from oil and gas exploitation have boosted government revenues and therefore freed up funds for military spending. China and India are also demonstrating a sustained increase in their military expenditure and contribute to the growth in world military spending. In 2006, for the first time China surpassed in terms of military investment Japan and hence has become the biggest military spender in Asia and the fourth biggest in the world.

When comparing the space and military sector it appears that out of the top-15 defence spenders all but Saudi Arabia and Australia have a space programme, illustrating therefore the link between military and space activities.

Rank	Country	World Share Spending (%)
1	USA	46
2	UK	5
3	France	5
4	China*	4
5	Japan	4
6	Germany	3
7	Russia*	3
8	Italy	3
9	Saudi Arabia	3
10	India	2
11	South Korea	2
12	Australia	1
13	Canada	1
14	Brazil	1
15	Spain	1
Other Countries		16

* Figures for China and Russia are estimates

Table 6.1 World Defence Expenditure by Country in 2006 (Source SIPRI)[216]

[213] Peter N. "Space and security: the emerging role of Europe". Journal of Astropolitics 2005;3 (3):265–96

[214] The terms "military" and "security" are used interchangeably in the text when referring to space issues as beyond the minor semantic difference the use of space assets for military or security purposes overlap considerably

[215] SIPRI Yearbook 2007. Oxford University Press: Oxford, 2007

[216] Ibid

6.2 Global space military context

The trend of "internationalization of the militarization of space" witnessed in recent months is linked to three distinct elements.

Firstly, declining costs for access to space, as well as the multiplication of launch services providers, but also the proliferation of manufacturing capabilities are enabling more states to develop and deploy their own military satellites often using the launch capabilities and manufacturing services of others.

Secondly, traditionally, governments have been principally involved in civilian space activities with limited military content due to the consideration of the "peaceful nature" of space activities morally precluding having dedicated military space assets. However, many countries have in recent years revised this interpretation. And, due to the absence of a clear definition of "peaceful purposes," this term and concept is now being interpreted as "non-aggressive" rather than "non-military", which means that military uses are allowed and lawful as long as they remain "non-aggressive" and don't threaten others.

Thirdly, not all space systems used for defence and security purposes are dedicated military space systems. Space techniques and technologies are often dual in nature. The use of civil capacity by the military has therefore grown dramatically during the last six years following the conflicts in Afghanistan and Iraq, particularly in the field of space-based Earth observation and space-based telecommunications. Consequently, civil bandwidth usage or commercial purchase of satellite imagery tends to multiply with each new military conflicts and security intervention[217].

While traditional, as well as new institutional actors are increasingly procuring new space assets, world space military expenditure is like the overall military spending, extremely unevenly distributed between countries. Military space budgets are highly concentrated in the U.S. who spends more than 95% of the (known) world public funding[218]. Only a limited number of countries devote a substantial amount of money on security-related space activities those are: Canada and the United States in North America; Belgium, France, Germany, Greece, Italy, Spain, the United Kingdom in Europe; Iran, Israel and Turkey in the Middle East; China, India, Japan, Russia and South Korea in Asia; and Argentina and Brazil in South America. Other countries pursue some military space activities but with a very limited size and scope.

Despite the increasing number of space military actor the leadership of the U.S. in military space budgets is unlikely to be challenged in the near future. While Russian space military capabilities are being refurbished and modernized, and covers the whole spectrum of activities they are no match, and so are the other countries to the United States in terms of capabilities and financial allocation, as well as political support, except maybe China in the later case (i.e. political support), but with no official document supporting this assumption.

6.3 Space military activities in 2006

In 2006, 18 dedicated military satellites or explicitly recognized "dual-use" satellites, have been launched in space, representing 15% of all payloads launched in space. Eight countries (China, France, Germany, Japan, Russia, South Korea, Spain and the United States) launched dedicated military space assets in 2006 compared to more than 20 for civilian space. Furthermore, two countries launched their first military-related assets: Germany and South Korea[219].

When comparing the levels of activity country by country in 2006, Russia was the world's space leader in military space activities according to the number of payload launched, followed by the United States with four payload launched. Europe launched 3 space military assets while China, Japan and South Korea launched only one satellite (Figure 6.1).

[217] However, as indicated in the February 2007 GOSPS report not all military requirements and demands can be addressed using civilian or commercial systems, as there might be no commercial demand for the required services (e.g. intercept electromagnetic signals), the cost of the required services could be too high for the commercial market, or there could be confidential and for all these reasons demand the procurement of specific assets

[218] Tracking space security-related budget in details is difficult, as space is often not identified as a distinct budget items in the various national defence budgets. Furthermore, large parts of the defence budgets are confidential

[219] South Korea asset is considered a military spacecraft due to its explicit "dual-use" nature

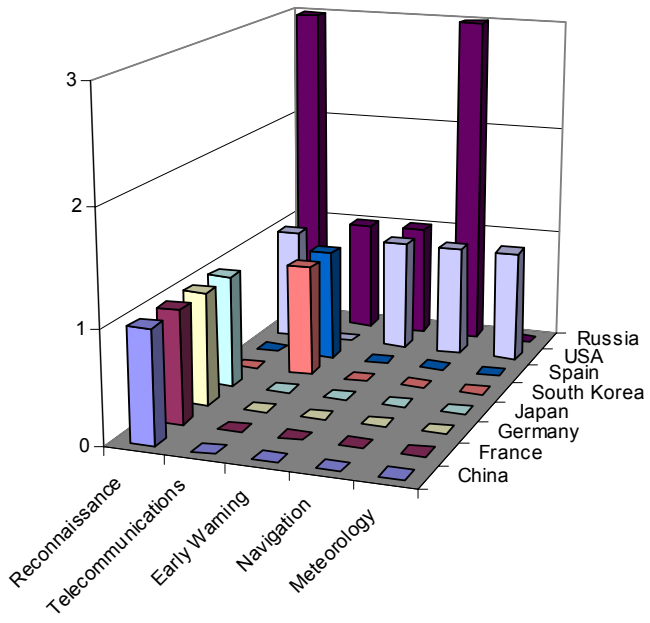

Figure 6.1 Military payloads launched in 2006 per country

Russia and the U.S. were therefore the more active player in military space. This quantitative domination is completed by the fact that they are also the ones with the more various and advanced capabilities, covering both operational and tactical missions. They were for instance the only ones to launch early warning and navigation satellites to refurbish their respective space infrastructures.

6.4 European space military context

Europe has significant assets which give it the credentials of a recognized civilian space power, but even though European governments have combined their non-military activities since the 1960s, military programmes and assets have remained essentially confined to national ventures[220]. This means that security space activities have been fragmented both organizationally and financially and have been accorded different degrees of importance in the various countries[221]. However, an increasing number of European countries are now acknowledging the strategic character of space for political, economic and industrial reasons, but also for military reasons. Nonetheless, this view is not equally shared by all member states in Europe[222].

National initiatives

Only seven countries are involved substantially in military space activities (Belgium, France, Germany, Greece, Italy, Spain and the United Kingdom). European national space projects related to security and defense include Earth-observation systems, satellite communications assets, and space surveillance radars and telescopes. Signals intelligence and missile early warning programmes are also been developed individually by France on an experimental basis[223]. However, when compared with the United States or Russia, the focus of these activities is similar to their early military space programmes rather than to new tactical applications. Furthermore, besides the difference in scope of military space activities, the amount spent on space security programmes are also dwarfed by U.S. expenditures in this domain[224]. Europe spends about 30 times less than the United States on a yearly basis on space defence issues, illustrating the important imbalance regarding space military attention devoted on both sides of the Atlantic. Total European spending on military space hovers between 650 and 750 millions euros depending on the year, versus about 5 billion euros being spent annually on civil space projects.

[220] Peter N. "Space and security: the emerging role of Europe". Journal of Astropolitics 2005;3 (3):265–96
[221] Ibid
[222] Because military and "hard security" activities are part of the so-called second pillar they are mainly left to EU member states with limited Community activities
[223] Esssaim for electronic intelligence and Spirale for missile warning
[224] It is difficult to estimate the Russian military space budget

France has the largest military space programme in Europe both in terms of budget and capacity, but also for its "political will" and policy developments. For instance the French Ministry of Defence (MoD) released in February 2007 a new report based on the work of the strategic directions of Defence Space Policy (GOSPS) on the strategic dimension of space for defence activities (Cf. Chapter 3). Nonetheless, it is France's technical and financial lead in Europe that is the most striking. During the period covered by its 2003-2008 Military Programme Law, France is planning to devote 2.6 billion euros for military space systems with about 489 million euros in 2006. The French space military funding comprises satellites, launch costs, associated ground segment and their maintenance, as well as initial R&D work (replacement of Helios 2, technology demonstrators in the field of electromagnetic interception and early warning). In this context, on 11 August 2006 France launched a new-generation military communications satellite Syracuse 3B, joining the Syracuse 3A satellite launched in October 2005 to complete the Syracuse III system. Despite its strong domestic capabilities, France has also been pushing its European partners to embrace cooperation for the development of shared capacities and develop multinational efforts, as illustrated by the new GOSPS report, or the BOC and Musis initiatives (see below).

Other countries have been developing and procuring national dedicated military systems, particularly Italy, Germany, the United Kingdom and Spain. Their respective space-based military systems cover two main domains: Earth observation and telecommunications.

Italy has been a long user of satellites communications and Earth observation services provided by third parties, but it has decided in the 1990s to acquire dedicated systems for military telecommunications (Sicral) and radar imaging (COSMO-SkyMed[225]). SICRAL-1 was launched in 2001 (SICRAL-1 B is planned to be launched at the end of 2007). On 7 June 2007 the first of four Italian COSMO-SkyMed X-band radar satellites was placed into orbit. The three other Cosmo-Skymed satellites will be launched in the next two years.

Germany has also decided to secure its telecommunications needs via a national military communication satellite system (SatcomBW to be launched in 2008) rather than continue to relay on third-parties military satellites or lease transponder capacity from commercial satellites operators. In the same vein, in the domain of Earth observation, Germany's dependence on foreign military systems for imagery has led the Government to decide to acquire a domestic satellite reconnaissance capability. The first SAR-Lupe satellites have been launched on 19 December 2006, and the second satellite on 3 July 2007. The remaining three will be launched by 2008. Those satellites are the initial two in a planned constellation of five satellites

The United Kingdom was the first European country to acquire a domestic satellite communications system for defence purpose in the 1970s (Skynet 4). While the UK is upgrading its satellites communications system, it is also procuring new services through a innovative model of Private Financing Initiative (PFI) for the three Skynet 5[226] satellites. The first Skynet 5 spacecraft (Skynet 5A) was successfully launched in Mars 2007 onboard an Ariane 5. The UK have also an optical Earth-imaging demonstrator system funded by the British Ministry of Defense and the BNSC in orbit since 27 October 2005[227].

Spain has demonstrated recently new ambitions in military space with the launch of its own dedicated telecommunication military satellite Spainsat in March 2006 which provides X-band capacity to primarily the Spanish Ministry of Defence on a leasing contract. It has also back up capacity with XTAR-EUR launched in 2005. Spain is also involved in the French-led Earth observation programme Helios II, and is considering acquiring a dedicated national reconnaissance capability.

Besides these five countries having dedicated military space assets, other relies on cooperative programmes to develop and ensure their access to military satellite applications. European countries can join national programmes by paying their share to the programme's leader, and receiving a proportional part of the services offered. The pooling of financial resources and the exchange of data or even sometimes

[225] Constellation of Small Satellites for Mediterranean Basin Observation

[226] A Private Finance Initiative (PFI) is a method to provide financial support for "Public-Private Partnerships" (PPPs) between the public and private sectors. These projects aim to deliver hardware and services for the public sector. In return, the private sector receives payment, above the price that the public sector could have achieved linked to its performance in meeting agreed standards of provision

[227] The United Kingdom relies nonetheless primarily on U.S. intelligence to access satellite imagery

satellite-tasking time is thus a well integrated and common procedure in Europe.

Europe's peculiarities

Europe due to its limited military space infrastructure depends heavily on civilian and commercial space systems for military and security activities. This European characteristics draw up mainly from limited budget capabilities devoted to space capabilities. However, this policy follows also a technological logic, since many space systems have both commercial and security applications, as for instance Earth observation systems. But also a particular heritage, as unlike in the U.S. the civilian sector has pioneered the development of the technology capabilities in Europe. Due to the increasing cost of military systems and because of the aforementioned thigh defence budgets there is thus a trend in Europe to increasingly develop "multi-use" programmes (projects used for both civilian and military purposes). For instance, the future "Pleiades - COSMO-SkyMed" project will be an explicit dual-use programmes[228].

However, the real new trend emerging in the last few years is that some of the European security related programmes are managed under Public-Private-Partnership (PPP) schemes (yet solely for telecommunications systems) such as Skynet 5 (UK) and Spainsat or XTAR-EUR (Spain)[229]. In the PPP approach the system is fully dedicated to the national authorities in times of crisis, but the managing organization can commercialize the capability for the rest of the time. This "European approach" to procure military space assets[230] is unique in the world but needs to be validated in the long-run; nonetheless an increasing number of European countries are considering such avenues for their future military needs (i.e. France).

No single European country can afford to develop a wide range of space assets like in the United States or in Russia on its own. As a result, European stakeholders are starting to realize that if they want access to greater variety of space-based military systems they need to pool resources both financial and technical. Current efforts of coordination, harmonization, and consolidation of the different space activities within Europe are thus taking place to avoid the duplication and minimize unwanted redundancy. As aforementioned so far cooperation exists in the form of exchange or lease of capacity of national systems. For instance, data collected by SAR-Lupe will be provided to the French government in exchange for data from Helios. In an innovative approach for European military assets in 2006 Italy and France launched a new cooperation aiming to develop a dual-use telecommunications satellite called Athena-Fidus dedicated to military telecommunication, as well as civil government and potentially commercial applications[231]. The satellite envisioned to be launched in 2011 has also spurred the interest of Belgium and the U.K authorities.

However, because European space capabilities are both modest and very fragmented there is a need to rationalise the activities of different national entities to complement each other's capabilities and avoid unwanted duplication of capabilities. In this context, since 2001 an initiative by a group of EU states known by the French acronym BOC ("Besoins Operationnels Communs" or "Common Operational Requirements for Global European Earth Observation System by Satellites" in English) is a major tangible step toward an eventual autonomous European capability in strategic geospatial imagery to support the ESDP. The document has been signed so far by six European Chiefs of the Defence Staff (Belgium, France, Germany, Greece, Italy and Spain) and aim to go beyond simple cooperative financing agreements to setting common objectives and operational requirements prior to determining any technical developments for next-generation satellites. Although such effort cannot guarantee a better use or interoperability of existing or currently planned systems it nonetheless prepares the ground for common planning regarding next generation systems to be launched in the middle of the next decade. Then, on 13 December 2006 an agreement between the same six aforementioned countries (plus Sweden as an

[228] Pleiades will be a French two-satellite optical military reconnaissance system and COSMO-SkyMed will be an Italian constellation of X-band SAR satellites

[229] In the case of Skynet programme, Paradigm Secure Communications (a subsidiary of Astrium Services) signed a contract in 2003 (and then revised in December 2005) with the British Defence Ministry that could be worth up to 3.66 billion British pounds (about 5.4 billion Euros) through May 2021 provided a number of options are exercised. In addition to the purchase and operation of the Skynet 5s (three guaranteed Skynet 5 spacecraft) the contract covers the purchase, management and running of the Skynet 4 fleet and the provision of the ground segment. This PPP is the first involving full outsourcing of military satellite telecommunications to the private sector.

[230] Europe is trying to replicate the Skynet 5 PPP model with the Galileo Programme but is having trouble to do so (Cf. Chapter 3)

[231] The Franco-Italian Athena-Fidus agreement was signed on 22 June 2006 by the Heads the French and the Italian Space Agencies

observer) was signed calling for common development of a future space-based reconnaissance satellite system called Musis (MUltinational Space-based Imaging System for surveillance, reconnaissance and observation). This future system will aim to answer the whole range of data collection requirements, from the political decision making support to the military operation support. MUSIS is therefore a further step in the definition of a future European architecture for military space-based Earth observation.

European Union-level

Since 11 September 2001, security has been pushed to the top of the agenda across the globe, including in Europe[232]. Indeed, the EU has identified in the 2003 EU Security Strategy (ESS) a number of security challenges for Europe, including: external border controls, peacekeeping duties, and fighting trans-border and internal crime and terrorism. In recent years the EU has therefore become increasingly aware of its security and defence environment as it has taken on a growing international profile. Nonetheless, at the difference of European countries, the EU is currently only involved in "soft" security operations such as humanitarian missions rather than military or "hard" security missions. However, numerous and varied ESDP operations were conducted in 2006 and 2007 confirming the increasing role of the EU as a global actor.

While the argument that Europe should develop an integrated defence and security related space capabilities is not a recent one, it has however been given a new impetus in recent years following the developments of the construction of European defence and the increasing willingness of the EU to share its responsibility for global security. At the EU level, initiatives are being developed to respond to new security requirements, and space-based systems are acknowledged as an answer to emerging security needs. Space is now recognized as being an "enabler" that can give the EU the full capability to act independently in conflict prevention and crisis management tasks to support its CSFP and the ESDP and is an important asset to ensure its own security[233].

Since the 1990s different EU institutions have been involved in this issue, illustrating clearly the extent to which EU's posture has evolved in recent years. To illustrate this increasing political ambition for developing security space efforts several important texts and programmes have been approved at the EU-level over the last years such as in the June 2003 conclusions of the European Council or the document adopted by the Council in November 2004 entitled "ESDP and Space". Furthermore, the newly European space policy covers also several aspects linked to space security. The Resolution adopted on 22 May 2007 by the fourth Space Council deals prominently with security and defence issues, and while recognizing the intrinsic dual nature of space activities it affirms the need to set up a "structured dialogue" with the competent bodies of the member states and within the EU Second and Third Pillars including the European Defence Agency for optimizing synergies between defence and civil space technologies and programmes[234]. Along the same lines the Resolution does not preclude the use of GMES and Galileo by military users and therefore recognizes the implicit dual-use nature of the future services proposed by those programmes. In overall terms, the Resolution clearly states the strategic importance of space for Europe in demonstrating its independence and its readiness to assume global responsibilities.

The recent EC decisions to launch and support security-oriented programmes, such as the "Preparatory Action on Security Research" (PASR)[235] and the larger share of FP7 for R&D devoted to the security research, must be therefore interpreted in this context and illustrate the effort at the EC level to link security, including space, and the European construction process[236].

GMES is the principal space programme of the Commission that is seen as having a clear security mandate to support the CFSP and ESDP. Consequently, with the interest in the use of GMES information services for security applications a series of programmatic activities have been taking place in recent months. And, out of the three GMES "Fast Track Services" (land monitoring, marine

[232] Peter N. "Space and security: the emerging role of Europe". Journal of Astropolitics 2005;3 (3):265–96
[233] Ibid

[234] Council of the European Union "Resolution on the European Space Policy" DS 471/07 16/5/2007
[235] PASR had a project aimed at studying how Earth observation, reconnaissance, navigation and telecommunications satellites can improve European military operations particularly those outside Europe: the Advanced Space Technologies to Support Security Operations (ASTRO+) programme
[236] At the EU-level the Galileo project is considered as a civilian system with civilian user even if some civil protection forces might be using the Public Regulated Service (PRS) which will provide position and timing to specific users requiring a high continuity of service, with controlled access for "low security" activities

monitoring and emergency response) aiming to develop pre-operational services that will be introduced by the end of 2008[237], of particular relevance for the security aspects is the emergency response Fast Track service. It aims at reinforcing the European capacity to respond to world-wide emergency situations associated to natural hazards (e.g. storms, earthquakes, volcanic eruptions, landslides etc.), as well as man-made humanitarian disasters. This Fast Track is a first step in developing operational services applicable in the area of security, as emergency cannot be seen decoupled from an overall "security" context. Several other GMES projects related to security have therefore been introduced in recent months:

- GMOSS – Global Monitoring for Stability and Security (FP6-Space)
- ASTRO+ - Advanced Space Technologies to Support Security Operations (PASR)
- LIMES – Land/Sea Integrated Monitoring for European Security (FP6-Space)
- RESPOND – Support to humanitarian relief, disaster reduction and reconstruction (ESA GSE)
- MARISS – European Maritime Security Services (ESA GSE)

The work done during the past few years through the FP6 and ESA's GMES service element (GSE), as well as member states programmes in the aforementioned projects have shown the relevance of Earth Observation combined with in-situ-data in assisting emergency-related issues on the ground. Furthermore, in January 2006, the Presidents of the Commission and of the Council of the European Union, asked Michel Barnier, former French minister and European Commissioner, to prepare a report on the EU response to major cross-border emergencies. This report entitled "For a European civil protection force: Europe aid" released in May of the same year stresses that the price of non-Europe in crisis management is too high, and specific reference is made to the role of GMES in remedying the fragmentation of national observation systems. GMES is therefore foreseen as an enabler allowing increasing the availability of geospatial information to support a variety of EU policies, in particular: the CFSP including the ESDP, but also as other policies relevant to European citizens' security at Community and national levels, notably justice, home affairs and customs, including surveillance and management of external borders.

A 5th GMES service related to security applications is also currently under consideration. In this context, a preliminary workshop "GMES: the security dimension" organized by the EU Institute for Security Studies (EU-ISS) in cooperation with the Council (DG E VIII), the Commission, the EU Military Staff, the EU Satellite Centre and the European Defence Agency was held on 16 March 2007 in Paris. Over 100 experts and EU officials attended this seminar whose main purpose was to study the security applications and implications of GMES. Participants looked at building synergies around common interests in GMES across the three pillars, the applications that could be used to enhance European security, and finally the issues of governance associated with dual use capabilities.

In the FP7 a call dedicated on "GMES and security" has been published in 2007[238].This call aims to stimulate the development of further GMES core services including "Information services for Security related activities". In particular, it aims to provide services to respond to EU needs for improved early warning and crisis management tools, based on timely Earth Observation data (rapid mapping and tailored geo-information products) combined with ground information, secure and reliable communications, as well as navigation systems. The rationale for this call is that reliable and continuously updated geospatial information to respond to the challenges identified in the 2003 ESS is the basis for early warning and therefore for early action and possible conflict prevention, but also to achieve an adequate level of operational capabilities and readiness to conduct Crisis Management Operations.

The EU has also set up dedicated agencies to carry specific technical, scientific and management tasks within the framework of EU's CFSP, the so-called second pillar. Two agencies are involved in space and defence issues: the European Union Satellite Centre (EUSC) and the European Defence Agency (EDA), however at distinct levels.

The EUSC is an established agency in charge of Earth observation data analysis. It has increasingly been working in recent years on projects supporting the ESDP in cooperation with ESA and the Commission such as the Global Monitoring for Security and Stability (GMOSS), Telecommunications Advanced Network for GMES Operations (TANGO) and ASTRO+ programmes. It cooperates also with other agencies like the EDA or the European

[237] A 4th GMES Pilot service is now being set-up focusing on air quality-monitoring and climatology

[238] SPA.2007.1.1.02 Developing pre-operational GMES pilot services in new application fields

Maritime Safety Agency (EMSA).

The EDA is a more recent agency in charge principally of defence capability development, armaments cooperation, research and technology (R&T), as well as the defence technology and industrial base and defence equipment market. It has been involved so far remotely and indirectly into space activities particularly in the framework of its "C3 programme" aiming to create cooperative architecture and links with civil and military sectors by relaying among others on satellite communication. However, with the endorsement by all EDA member states of the aforementioned Resolution on the European Space Policy it is expected that space capabilities will be one of the major issues in EDA's work plan in the near future.

Besides the EDA and the EUSC other agencies (community agencies) involved in security issues like the newly established European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union (so-called FRONTEX) or the EMSA are increasingly relaying on space-based information to fulfil their mandates, but they are just users of space rather than directly involved in space alike the EUSC.

European Space Agency

According to the terms of its founding convention (Article II), the purpose of the ESA shall be to "provide for and promote, for exclusively peaceful purposes, cooperation among European States in space research and technology and their space applications, with a view to their being used for scientific purposes and for operational space applications systems"[239]. Traditionally, governments have interpreted this to mean that ESA could not run programmes with any security or military content and ESA was to be solely a civilian space agency. But they have since revised this interpretation. Due to the absence of a clear definition of "peaceful purposes," this term is now interpreted as "non-aggressive" rather than "non-military", which means that security uses are allowed and lawful as long as they remain "non-aggressive". This led to the evolution of ESA's position regarding security activities. European governments now agree that ESA may develop systems and run space programmes, which European institutions could use for non-aggressive security activities like peacekeeping. For instance, on 2 March 2007 an agreement between ESA and the EMSA[240] was signed, strengthening the framework for cooperation in the field of maritime security, particularly for oil spill monitoring in all European waters and adjacent high seas. ESA's Director General released also in October 2006 its new five year plan entitled Agenda 2011 which among others looked at future programmes including the synergies between civil and defence services.

ESA has also initiated in 2006/07 a series of projects dedicated to security issues. In particular, ESA is pursuing a study on space debris, as well as an activity to define the European needs for a Space Situational Awareness Architecture as a first step towards its realization. ESA is also involved in the GMES programme and has initiated in recent years a series of GMES projects such as RESPOND which aims to provide support to humanitarian relief, disaster reduction and reconstruction or MARISS that aims to support European Maritime Security Services through ESA's GMES service element.

Others European Initiatives

In 2006/07 several parliamentarians initiatives focused specifically on space defence and security issues illustrating that space is now seen by decision-makers as an essential asset for Europe. In September 2006, the Western European Union (WEU) Assembly and the European Interparliamentary Space Conference (EISC), in association with ESA, CNES, and Arianespace, jointly held a seminar on "Space, Defence and European security" in French Guiana. Delegations of the national European parliaments, members of the WEU Assembly and the NATO Parliamentary Assembly, representatives of the different institutional players, as well as defence and security experts and representatives of the national governments, participated in this seminar. The WEU Assembly engagement in this conference by acting as the Interparlementary European Security and Defence Assembly focusing on the ESDP gave an implicit political support for space capacities to ensure European security in the context of the ESDP. In 2006/07, the European Parliament through the work of its Subcommittee on Security and Defence

[239] Convention for the Establishment of a European Space Agency accessible at http://www.esa.int/convention/

[240] The EMSA was founded in 2002 and is a European Union agency charged to reduce the risk of maritime accidents, marine pollution from ships and the loss of human lives at sea by helping to enforce the pertinent European Community legislation

prepared or requested reports on space security issues such as "Europe's Space Policies and their relevance to ESDP" and "The cost of Non-Europe in satellite-based observation" (Cf. Chapter 7).

6.5 United States

In 2006, the U.S. launched 22% of all military satellites without taking into consideration several technology demonstration projects aiming at validating new concepts, or its activities in ballistic missile defence. The U.S. launched one reconnaissance satellite, one military meteorological satellite, one early warning satellite, as well as one GPS satellite (Figure 6.1). It is estimated that the U.S. spent about 30 billion U.S. dollars on military space activities (including intelligence related activities).

While the U.S. is the country investing the most in space, it is also the one the most conceptually advanced in military space affairs. A series of recent high level documents released in 2006/07 underlining the strategic nature of space activities. In the new U.S. National Space Policy it is asserted that the U.S. assets must be unhindered in carrying out their space duties, and that "freedom of action in space is as important to the United States as air power and sea power."[241] The new space policy is designed to ensure that U.S. space capabilities are protected in a time of increasing challenges and threats. While the document is largely similar in the area of space security to its 1996 predecessor[242], one significant change declares that "the U.S. will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to or use of space; and that proposed arms control agreements or restrictions must not impair the rights of the U.S. to conduct research, development, testing, and operations or other activities in space for U.S. national interests"[243]. In this new space policy the Bush Administration has also announced its determination to sustain its effort in military space and states that it "considers space capabilities – including the ground and space segments and supporting links – vital to its national interests"[244]. Because, despite the fact that the United States has considerably more capabilities than the next most capable actors and mobilizes means with no common measure to those of all the other countries, it is also the actor the most dependent on its space capabilities. In this context, the U.S. military space doctrine has begun to focus on the need for "counterspace operations" to prevent adversaries from accessing space as the policy states explicitly that "the United States will: preserve its rights, capabilities, and freedom of action in space; dissuade or deter others from either impeding those rights or developing capabilities intended to do so; take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, its adversaries the use of space capabilities hostile to its national interests"[245]. However, while the new policy appears to be more focused on unilateral national security concerns than its predecessor, it does nonetheless identify new areas for international military cooperation, in particular the sharing of intelligence and capacity for improved space situational awareness.

Several other major documents were also released by other U.S. Federal Agencies. The National Geospatial-Intelligence Agency (NGA) released on 12 January 2006 a document entitled "National System for Geospatial-Intelligence Statement of Strategic Intent" emphasizing the importance of using geospatial intelligence information to effectively respond to global threats[246]. The DoD unveiled also its new Quadrennial Defense Review (QDR)[247] in February 2006[248], whereby space activities are dealt with in three parts: enhancing existing intelligence, surveillance and reconnaissance (ISR) capabilities; achieving greater "jointness" and network-centricity; and reshaping the defence enterprise as a whole. The QDR acknowledged explicitly the United States' existing superiority in all space capability areas and pledged to maintain this advantage by keeping at least one technology generation ahead of any foreign or commercial space power. The DoD announced also it will continue to develop responsive space capabilities to ensure reliable access to space while increasing the survivability of space assets via improved space situational awareness, protection and "other space control measures."[249] The QDR aimed also to remedy to existing procurement problems in

[241] U.S. National Space Policy accessible at www.ostp.gov/html/US%20National%20Space%20Policy.pdf
[242] Presidential Decision Directive/NSC-49/NSTC-8
[243] Ibid
[244] Ibid
[245] Ibid
[246] The NSG Statement of Strategic Intent is available on the NGA Web site, at http://www.nga.mil
[247] The QDR analyses strategic objectives and potential military threats. It is the main public document describing the United States's military doctrine
[248] QDR accessible at http://www.defenselink.mil/qdr/report/Report20060203.pdf
[249] Ibid

DoD space programmes through a comprehensive reorganization of the acquisition process to ensure stable cost while maintaining schedule and performance.

6.6 Russia

Russia in the first year of its new Federal Space Programme (2006-2015) has increased it space budget by as much as one-third compared with 2005[250] (Cf. Chapter 3). While this ten-year plan increase considerably the military space budget, other military space funding is also being allocated through the State Armaments (defence and security) Programme for 2007-2015 and the special federal programmes "Global Navigation System" and "Development of Russian Space Centers in 2006-2015"251 This overall budget boost to military space activities for 2006/07 is part of an overall effort to upgrade and modernize Russia's military in-orbit infrastructure.

Russia launched 8 military satellites in 2006 upgrading its reconnaissance, early warning, communications and navigation capabilities (Figure 6.1). It launched three reconnaissance satellites, Kosmos 2420, Kosmos 2421, and Kosmos 2423. Three Glonass M class satellites were launched on 25 December 2006 aboard a Proton rocket[252]. Russian early-warning capabilities were improved with the 21 July 2006 launch of Kosmos 2422 and military communications capabilities were enhanced with the launch of the Meridian 1 satellite.

6.7 Japan

Japan space policy is in a transition. In this context following the changes of security environment in the post-Cold War era[253] (particularly the missile launch of North Korea over Japan) as aforementioned new bill has been submitted to the Diet for the establishment of the "Basic Law of Space Activities" that aims to reconsider the assumption of the "exclusively peaceful purpose" clause in the Diet resolution of 1969. In particular, the second point of this Basic Law focus upon the question of security and the flexible interpretation of the excusive peaceful nature of Japanese space activities. This change of interpretation does not aim to promote an aggressive use of space. This law aims to allow Japan to use space assets for crisis management and disaster monitoring in Asian region or peacekeeping missions in distant territories[254].

While the "Basic Law on Space Activities" is not yet accepted the Japanese Defence Agency (JDA) became the Ministry of Defence in January 2007 (and is now autonomously responsible for strategic planning) and set up a new "Strategy Planning Office" which includes space as one of the pillar of strategic policy, illustrating the paradigm shift of Japanese space activities. The aforementioned policy debate has also been completed with the successful launch of one IGS satellites in 2006 and two in 2007 providing therefore Japan an Earth observation constellation dedicated to "security" issues (Table 6.2).

Launch date	Spacecraft
28 March 2003	IGS 1a and IGS 1b
29 November 2003*	IGS 2a and IGS 2b
11 September 2006	IGS 3a
24 February 2007	IGS 3b and IGS 4v

* failure during launch phase

Table 6.2 IGS launched

6.8 China

It is difficult to evaluate Chinese military capabilities as China is very secretive on its military activities and military space is no exception. In general, it is however recognized that China has access to military communications through its DFH series satellite. It has (so far) limited regional navigation capabilities with five Compass/Beidou navigation satellites on orbit. (Cf. Chapter 3). China maintains also several ZY series satellites in LEO for tactical reconnaissance and surveillance functions.

Contrasting strangely with its long-standing pacifist stance in international fora in an unusual fashion, China has in 2006/07

[250] Popovkin V.: "Russia's Space Defenses Stage a Revival" NOVOSTI 4/10/2006, accessible at http://en.rian.ru/analysis/20061004/54509604.html

[251] Ibid

[252] Russia announced that all precision restrictions on Glonass use would be lifted in 2007 to enable more accurate and unlimited civilian and commercial use of the navigation system

[253] Currently, Japan's use of space is limited to non-military purposes under a strict interpretation of the 1967 Outer Space Treaty as required by the Japanese constitution and a subsequent parliamentary resolution incorporating the treaty into its domestic law

[254] Suzuki K.: "Transforming Japan's Space Policy-making". 57th International Astronautical Congress. Valencia-Spain October 2-6, 2006

demonstrated a more aggressive position in space. First it launched a reconnaissance satellite in April 2006 (Yaogan 1) then reportedly used a ground based laser to illuminate several U.S. spy satellites flying over Chinese territory[255]. These "events", as well as the January 2007 anti-satellite (ASAT) test destroying one of its own aging weather satellites demonstrate Chinese advances in military space and in particular its offensive capabilities. Furthermore, a new report to the U.S. Congress by the U.S.-China Economic and Security Review Commission using open source material highlighted that 30 Chinese ASAT concepts have been formulated by the People's Liberation Army (PLA), and some of these concepts involve covert deployment of anti-satellite weapons system to be used against in a surprise manner[256].

These "events" and developments have been completed by an impressive increase of funds devoted to the PLA in recent years, which is among others in charge of the Chinese military space activities, as well as the national human spaceflight programme. At the Fifth Session of the 10th National People's Congress held in February 2007, it was announced that China's military budget for 2007 would increase by 17.8 % over the previous year to hit 305 921 billion Yuan or about 34 billion euros. While China's military spending remains a low level compared with some other countries[257], especially major military countries (Table 6.1) its increases (publicly acknowledge) over recent years is considerable and can therefore imply a substantial investment in military space activities as Chinese defense planners are investing into new strategic assets.

6.9 India

In 2006/07, India continued to consider a structural change with the possible establishment of a military Aerospace Command, however with a mandate that remains vague[258,259]. This overall reflection is part of a wide process that is considering increasing the role of military applications and defense forces in India's space activities. India has not yet launched any explicitly military satellites, however an operational Aerospace Command would presumably use space-based assets for military needs, but also dedicated military satellites rather than current civilian capabilities such as the Earth observation Cartosat series. In this context, India's armed forces are set to get their first dedicated military satellite, Cartosat 2A, in summer 2007. Furthermore, the internal debate vis-à-vis its increasing involvement in military space affairs seems to have gained some extra momentum following the Chinese ASAT test in January 2007.

6.10 Others space actors

Non-traditional space powers have also been acquiring dedicated military satellites or creating new structures demonstrating the increasing trend of "internationalization of the militarization of space".

In Israel, in February 2006, the Israeli government ended years of heated debate by announcing that the Israeli Air Force will be given the lead role in all military activities in space, as well as the responsibility for designing and operating the nation's future satellites[260]. Consequently, the Israel Air and Space Force's (IASF) mission will be to operate in the air and space arena for purposes of defence and deterrence. This change is a major reorganization of the way Israel manages and operates in space. The IASF will now provide space capabilities to all Israeli users and particularly the intelligence agencies.

Israel successfully launched also its newest optical spy satellite on 11 June 2007 aboard its indigenous Shavit rocket. Ofeq-7 will replace the five-year-old Ofeq-5, which is nearing the end of its operational lifespan[261]. The launch marks the beginning of an expansion of Israeli military space capabilities. If all of the launches expected over the next few years are executed as planned, Israel should have a dedicated force of four military spy satellites by 2011, three from the Ofeq series and the TechSAR satellite. Additionally, the government will

[255] These incidents were reported publicly by the director of the National Reconnaissance Office, Donald Kerr in October 2006

[256] Commissioned Research Study entitled: "An Assessment of China's Anti-Satellite and Space Warfare Programs, Policies and Doctrines" prepared by Michael P. Pillsbury. Presented in January 2007 and accessible at http://www.uscc.gov/researchpapers/2007/FINAL_REPORT_1-19-2007_REVISED_BY_MPP.pdf

[257] At least publicly released

[258] "India Begins Work on Space Weapons Command" Space Daily 12/42006, accessible at http://www.spacewar.com/reports/India_Begins_Work_On_Space_Weapons_Command.html

[259] The Aerospace Command is distinct from the Aerospace Commission that will be the umbrella body for the aerospace industry and will lay down the roadmap to be followed by civilian and military players

[260] Barbara Opall-Rome, "Air Force to Lead Israel's Military Activities in Space" Defense News 27/2/2006

[261] Due to a launch vehicle failure Ofeq-6 failed was destroyed in September 2004

make use of ImageSat's Eros B as well as its follow-up satellite, Eros C. As for communications satellites, Israel does not yet have a dedicated space-based provider, although it uses transponders aboard SpaceCom's Amos-1 and Amos-2 commercial satellites. However, the government plans also to use the two upcoming Israeli commercial telecommunications satellites planned for launch in the same four-year period[262].

South Korea, in the context of tension with its neighbour, North Korea, on 28 July 2006 it launched the Kompsat 2 Remote Sensing Satellite to provide multi-spectral, high-resolution images for Earth mapping with an implicit dual-use capability. Then, on 22 August 2006, it launched its first explicit dual-use satellite, the Koreasat 5 (Mugunghwa 5) communications satellite. These developments demonstrate South Korea's ambition to become a space power able to cover all of it strategic needs.

Turkey's Air Force is also planning to spend at least 200 million U.S. dollars (including the procurement, as well as the launch and the insurance of the satellite), or about 154 million euros, to buy and launch by 2011 Turkey's first military satellite. This satellite will be an optical reconnaissance satellite with a resolution of 80 centimeters under a programme dubbed GOKTURK[263].

Finally, Iran completed the conversion of one of its ballistic missile, the Shahab missile, into as sounding rocket that it tested to fire a research payload into space on 25 February 2007. While the launch of Iran's first space research rocket does not represent a significant development in Iranian rocket technology per se, this event is rather important and is part of a more ambitious Iranian space programme (Iran hopes also to launch five satellites into orbit by 2010). This drive for space is also part of and an overall political push of the Iranian leadership to demonstrate power projection, as well as Iran's S&T capabilities.

[262] Amos-3 and Amos-4 communications satellites
[263] "Bidders vie for Turkey's Military Satellite" Turkish Daily News 19/8/2006, accessible at http://gbulten.ssm.gov.tr/arsiv/2006/08/19/01.htm

7. The Specific role of institutions

Besides domestic institutional structure created to support national space programmes such as space agencies, as well as ministerial or interministerial entities, various other institutions play a role in space affairs, particularly at a regional and international level. This chapter will look specifically at the institutions the most influential for European space affairs in 2006/07.

7.1 European institutions

The main European institutions (Council of the European Union, the Commission and the European Parliament), as well as the Presidency of the Council of the European Union have all been involved in space activities (mainly at a policy level) at different period of European history. In recent years those institutions have been playing an increasingly role in European space affairs.

The Council of the European Union

The Council of the European Union, which is the main decision-making body of the EU[264] was involved in overseeing space affairs principally in the context of the Competitiveness Council and the Transport, Telecommunications and Energy (TTE) Council[265]. In 2006/07, the Competitiveness Council was particularly involved in overseeing the development of the European Space Policy, as well as the development of GMES, while the Transport, Telecommunications and Energy Council has primary being involved in Galileo issues (Cf. Chapter 3).

In 2006, the Competitiveness Council made major statements on space issues. On 21-22 April 2006, European ministers responsible for competitiveness met in Graz, Austria, to discuss the theme "Investing in excellence and innovation". The informal debate, which focused on the EU's upcoming FP7, included exchanges of views on space research, security research, GMES and the first European Space Policy. Then, at the Competitiveness Council held in Brussels on 29-30 May 2006, the Council took note of the information presented by the Austrian Presidency on the main results of the Graz conference as an input for the elaboration of the European space programme. The Council took also note of the information provided by the EC on the developments of the European Space Policy, as well as the roadmap foreseen for future developments in this area.

In 2007 at the Competitiveness Council held on 19 February 2007 under the German Presidency, it was underlined that GMES services should be completed by 2008 to minimize risks of damage to the environment. Finally, on 26 April 2007 at the Competitiveness Council the draft text of the Resolution on the European Space Policy and the accompanying European space programme jointly drafted by the Commission and ESA in consultation with their member states was presented and subsequently adopted on 22 May 2007 at the fourth Space Council[266].

Galileo was a major agenda topic for the Transport, Telecommunications and Energy (TTE) Council in 2006 and 2007. On 27 March 2006 at the TTE Council, the EC briefed the Council on the negotiations with the Galileo concession holder, particularly with issues related to risks. The Council underlined consequently the need for a balanced risk sharing between the private and the public sector. At the June 2006, TTE Council Galileo was again under discussions, and the Council tasked the Commission to present a synthesis explaining the risk sharing over the entire concession period of 20 years, as well as proposal for the financial instruments needed for the development of Galileo in 2007. Then, on 12 October 2006 under Finish Presidency the Council agreed on a proposal for a Council Regulation amending existing regulations[267] regarding the status of the Galileo Joint Undertaking (GJU) to ensure an effective transition with the GNSS Supervisory Authority (GSA) by the end 2006. This would allow to complete the development phase of

[264] The Council of the European Union is different from the European Council, informally called the "European summit", which is a meeting of the heads of state or government of the EU, and the President of the EC, where discussions and decisions take place on the matters of key issues and direction of the EU

[265] The Council of the European Union is made up of the ministers of the Member States that meets in nine different configurations depending on the subjects under discussion

[266] The so-called "Space Council" was established following the entry into force on 28 May 2004 of the Framework Agreement between the European Community and ESA in order to coordinate and facilitate cooperative activities and enable all ESA and EU Member to discuss the development of a coherent overall European Space Policy and Space Programme, leading to the adoption of jointly-endorsed orientations for space

[267] Regulation (EC) No 876/2002 and Council Regulation (EC) No 1321/2004

the Galileo programme and the management of the public interest in both Galileo and EGNOS[268] programmes and allow the GSA to act as regulatory authority during the deployment and operational phase of Galileo. On 11-12 December 2006 Galileo was again a topic of discussion at the TTE Council, including the progress for the concession contract with the concession holder. The Commission presented also some possible modalities for third countries' participation in the GSA.

In 2007, due to the difficult negotiations following the letter of Transport Commissioner Jacques Barrot addressed to the German Presidency, the TTE Council in March 2007 gave the Galileo consortium partners a strict deadline to solve their internal problems linked to distribution of responsibilities, organisational structure, risk-sharing and pending financial aspects (Cf. Chapter 3). In particular was indicated that if by 10 May 2007 the consortium has not managed to agree on the legal structure of a single Galileo Operating Company (GOC) and appointed its Chief Executive Officer (CEO) it would consider looking at all possible alternatives. This TTE Council adopted also a decision authorising the EC to negotiate with non-EU countries with a view to concluding agreements on their associated membership for participation in the GSA. At the TTE Council meeting on 6-8 June 2007, EU transport ministers recognized the failure of the current concession negotiation and the Commission was asked to go into more details concerning the options for the project's completion it laid out on 16 May 2007, and present those findings in September 2007.

The Presidency of the Council of the European Union

The Presidency, which is sometimes informally called the "European Presidency" is the driving force in the legislative and political decision making process and is therefore important for space affairs in Europe[269].

Following to the decisions of the third meeting of the Space Council in Brussels in November 2005, and the ESA Council at ministerial level in Berlin (5-6 December 2005), the Austrian Federal Ministry of Transport, Innovation and Technology considered the convening of a Conference on GMES as a priority of the Austrian EU Council Presidency. Consequently, a GMES conference entitled "A Market for GMES in Europe and its regions - The Graz Dialogue" was held in Graz on 19-20 April 2006 to look at the time frame, funding and governance of GMES. This conference explored the potential market for GMES services and the applications that would be required, and a "Graz Roadmap for GMES service development" was also adopted. This roadmap called for a user-driven approach to ensure the success and long-term sustainability of GMES service development, and for adequate public investments and leadership, as well as a balanced governance structure. This Roadmap called also for developing additional fast-track services such as atmosphere monitoring, security and cross-cutting thematic areas like mountain regions. Finally, the role of regions in GMES was mentioned as essential to the definition and use of GMES services. This was a major event in the implementation process of GMES, marking the end of a series of sectoral preparatory events[270]. Then, under the Finish Presidency, the negotiations on the Seventh Framework Programme of the European Community (2007-2013) were brought to a conclusion allocating 1.43 billion euros for the thematic priority "space".

Following the Graz Conference organized by the Austrian Presidency in April 2006, a year later on 17 April, 2007 the German Presidency organized a high-level symposium in Munich entitled "The Way to the European Earth Observation System GMES – The Munich Roadmap" to achieve a European consensus on the way forward for the GMES long-term issues mainly its governance and operational funding. This symposium unveiled also the consensus that has emerged among the GMES stakeholders and the GMES Advisory Council (GAC) reflected in the "Munich Roadmap" that is intended to serve as a basis for the upcoming political decisions on GMES. The document released at this occasion details the envisaged overall architecture of European Earth observation services building on a network of existing capacities. The aspects of governance and financing scheme to guarantee the long-term sustainability of GMES services operations are also raised to ensure in particular an uninterrupted provision of Fast Tracks services. However, the highlight of the German presidency was the adoption of the first European Space Policy on 22 May 2007.

[268] European Geostationary Navigation Overlay Service

[269] The Presidency of the Council of the European Union refers to the responsibility of presiding over all aspects of the Council of the European Union, when exercised collectively by a government

[270] Following this initiative a series of meetings have been held by European regions in 2006/07. Those meetings aim to develop and structure a "European Network of Regions using space technologies". A formal institutionalisation of this network is expected in Fall 2007 during a Founding Conference to be held in Toulouse, France

The European Commission

The EC which is the executive body of the EU has become over the past decade increasingly convinced that space technologies can bring essential support to the Union's policies and objectives and deliver substantial strategic, social, economic and commercial benefits[271]. Consequently, as it expanded its arena of responsibility towards Research and Technology Development (RTD), it began to encroach upon space technology[272] through the framework programme. Several projects either directly dedicated to space applications and services or indirectly employing the use of space related technology and infrastructure for the scope of research have therefore been funded over the years by the EC. The current Framework Programme (FP7), while reducing the number of research themes, has seen its space emphasis grown with a dedicated "Space" theme, illustrating EU's willingness to enhance Europe's industrial competitiveness in space activities[273]. The Commission is particularly involved in the European flagship programmes GMES and Galileo.

Besides technology developments and infrastructure initiatives the EC has also been increasingly involved in space policy. The EC has been implicated in 2006/07 in drafting jointly with ESA in consultation with member states of the EU and ESA the first European Space Policy (Cf. Chapter 3).

EU Agencies

Following the expansion of the Commission's tasks a number of specialised and decentralised EU agencies have been established to support the EU member states and their citizens. Distinct from EU institutions, these agencies are set up to accomplish very specific tasks and are an answer to the need to cope with new tasks of a legal, technical, or scientific nature.

There are two "EU agencies" with direct and explicit activities in space[274]. The European Global Navigation Satellite System (GNSS) Authority or GSA which is a community agency set up to follow the deployment and operations of Galileo and related programmes[275], and the European Union Satellite Center (EUSC) which is a CFSP agency set up in 2002 to process satellite imagery in support of the CFSP and the ESDP (Cf. Chapter 6). The first "agency" responds directly to the Commission as it accomplishes a specific technical, scientific or managerial task, in the framework of the EU's "first pillar", while a CFSP agency, like the EUSC (and the EDA) report to the Council of Ministers (i.e. member states) as it deals with the "second pillar" of the EU.

The European Parliament

The European Parliament, together with the Council of Ministers, composes the legislative branch of the institutions of the Union. The powers of the Parliament have grown considerably in the last 15 years expanding the Parliament's involvement in passing EU legislation, as well as its say over the EU budget and consequently its role in space affairs has grown tremendously.

In order to do the preparatory work for Parliament's plenary sittings, the Member of Parliaments (MEPs) are divided up among a number of specialised standing committees. There are 20 of these parliamentary committees[276]. The committees draw up and adopt reports on legislative proposals and own-initiative reports. They also prepare opinions for other standing committees. Three principal committees are in charge of space affairs:

- The Committee on Industry, Research and Energy (ITRE) which is a committee of the responsible for industry, especially technology-intensive manufacturing, information technology, and telecommunications
- The Committee on Transport and Tourism (TRAN) which is in charge of all transport issues including Galileo
- The Committee on Foreign Affairs (AFET) which is the committee responsible for the CFSP and ESDP[277].

[271] Peter N. "The EU's emergent space diplomacy". Journal of Space Policy. Volume 23 (2) 97-107 May 2007

[272] Several other initiatives such as the Trans-European Network (TEN) or "Quick Start Programme" has been contributing to financing space activities in Europe

[273] Peter N. "Space and security: the emerging role of Europe". Journal of Astropolitics 2005;3 (3):265–96

[274] The European Defence Agency (EDA) which is a CFSP agency has not expressed publicly and officially its willingness to deal with space issues and is therefore left out of the analysis in this chapter. The activities of EDA are however analysed in Chapter 6

[275] The GSA replaced the Galileo Joint Undertaking (GJU) that was established by the EC and ESA in 2003 with a specific mandate to manage the development phase of Galileo and the selection of the concessionaire. The GJU was disbanded on 31 December 2006, and the responsibility for Galileo was handed over the GSA

[276] A committee consists of between 25 and 78 MEPs, and each committee appoints a chairman, three vice-chairmen and has a secretariat

[277] Two subcommittees assists the Committee: a subcommittee on Human Rights (DROI), and a subcommittee on Security and Defence (SEDE)

These committees prepare or request reports such as "Europe's Space Policies and their relevance to ESDP" and "The cost of Non-Europe in satellite-based observation" both requested by the European Parliament's Subcommittee on Security and Defence (SEDE) and published in 2006 and 2007 respectively. Furthermore, these committees can conduct hearings on particular topics of interest. For instance, in spring 2007, the SEDE conducted a public hearing on the "The Contribution of space to ESDP" on 2 May 2007[278].

Other European instittions

Besides the aforementioned institutions of the Union other bodies and organs linked to parliamentary structures are active and influential for European space activities. Two European interparliamentary structures are particularly important: the Assembly of Western European Union (WEU) and the European Interparliamentary Space Conference (EISC).

The Assembly of Western European Union (WEU)

The Assembly of WEU, is Europe's only interparliamentary security and defence assembly that allows national parliamentarians to monitor security and defence issues[279]. It provides a forum for debate where European political leaders can engage in discussions with national parliamentarians from all the WEU nations and beyond[280]. These include all the EU member states and the European members of NATO, as well as Russia, Ukraine and the Balkan states[281].

To carry out its tasks six permanent committees prepare reports and recommendations. One of them, the Technological and Aerospace Committee, is concerned with matters pertaining to defence and dual technologies and cooperation in the field of armaments and releases periodic report studies on space issues. In the 2006/07 time frame it released a report on "Weapons in space"[282], and adopted on 21 June 2006 at the 4th sitting a Recommendation on weapons in space (Recommendation 7831).

The WEU Assembly also organises and sponsors also conferences, and seminars. For instance in fall 2006 and jointly with the EISC, in association with ESA, CNES, and Arianespace it held a seminar on "Space, Defence and European security" in French Guiana (Cf. Chapter 6)

The European Interparliamentary Space Conference (EISC)

The EISC was established in 1999 as a permanent forum to foster cooperation among European national parliaments. It is composed of MEPs from Belgium, France, Germany, Italy, Spain and the United Kingdom. The Czech Republic joined the EISC as permanent member in 2006, and Poland is expected to join in 2007.

The EISC aims to develop a continuing dialogue on space policy issues and support the national governments and European institutions in their efforts to achieve a common European space policy for the maximum benefit of the European citizens. To foster a exchange of views and opinions it organizes each year a conference in a country holding the presidency on a rotational basis to discuss the latest issues related to space affairs. It releases also at the end of most of its EISC non-binding recommendations and conclusions that represent the general opinion of this body on selected space issues. Besides the members of national parliamentary groups, representatives of the EC, ESA, national space agencies, industry stakeholders and observers from other countries are also participating in those conferences.

In 2006, Belgium hold for the second time the presidency of the EISC with the overarching goal to promote the enlargement of the Conference to member states of ESA and the EU and other European interparliamentary assemblies such as the European Parliament and the WEU Assembly. In particular it organised the 8th EISC which took place on 12-14 June 2006 in the Belgian Parliament. Members of national parliaments of the ESA and the EU member states, as well as the most important space countries outside Europe and representatives of the different

[278] Since 2001 a MEP group the "Sky and Space Intergroup" exist to establish a comprehensive transverse dialogue about aerospace topics between the various political groups represented in the Parliament, and to provide interested MEPs with complete and open information about aerospace topics. It is a forum, which is open to MEPs, members of the EC, representatives from EU institutions and from industry. However, the activity of this intergroup has been limited in 2006/07

[279] It was founded in 1954 and held its first session in July 1955

[280] The Assembly of WEU currently comprises some 400 parliamentarians from the national parliaments of 39 European countries.

[281] Parliamentarians have different voting and participation rights depending on the category into which their delegations fall

[282] WEU Technological And Aerospace Committee "Weapons in space" Alan Meale, Rapporteur 21/6/2006

competent international bodies and industry participated in this event. This EISC focused on the developments of the soon-to-be adopted European space policy and the associated European space programme, as well as space application and exploration issues, space and education, and access to space. The EISC members called also on upon the EC and ESA to work with the EDA to develop a common European position on security and defence issues relating to notably GMES and Galileo. A new charter for the EISC was also adopted giving among others the status of member to the national parliament of Russia.

Italy is holding in 2007 the presidency of the EISC. The VAST Committee (Committee for the Evaluation of Scientific and Technological Options) of the Chamber of Deputies, which is responsible of technological and space issues at parliamentary level will animate and organize a series of events such as parliamentary seminars and national initiatives open to the general public (upon invitation) and to the press including the 9th EISC in October 2007.

7.2 International institutions

The main international institution involved in space affairs is the United Nations (UN). The UN, and its main bodies and agencies (specialized agencies, as well as committees) have been involved in space activities early on, primary at a policy and legislative levels. The United Nations General Assembly (UNGA) was the first UN body to deal with space issues following the successful Sputnik 1 launch. However, in recent years an increasing number of other UN-related bodies have been involved in space fields and particularly in space applications.

The United Nations

The UNGA is one of the UN's principal organs, and is the only in which all members are represented. Consequently the UNGA is the main deliberative organ of the UN and serves as a forum for members to discuss various issues. The UNGA may make recommendations on any matters within the scope of the UN, including space affairs[283].

In 2006, at the 61st plenary session of the UNGA two UNGA resolutions pertaining to space security were passed with an overwhelming majority: the annual Prevention of an Arms Race in Outer Space (PAROS) resolution, A/RES/61/58 and a Russian initiative, "Transparency and confidence-building in outer space activities," A/RES/61/75. Those two resolutions were only opposed by the United States, while Israel abstained from both, signifying therefore the strong international support for those resolutions. Recognizing that space technology and its applications can play a vital role in supporting disaster relief operations in its resolution (A/RES/61/110) of 14 December 2006 the UNGA agreed to establish the "United Nations Platform for Space-based Information for Disaster Management and Emergency Response" (SPIDER) as a new UN programme. SPIDER's mission statement is: "Ensure that all countries have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle". At the difference of recent initiatives that have contributed to making space technologies available for humanitarian and emergency response, such as the International Charter "Space and Major Disasters", SPIDER aims to ensure access to and use of such solutions during all phases of the disaster, including the risk reduction phase which will significantly contribute to an increasing reduction in loss of lives and property[284]. Finally, considering space activities on 15 January 2007, a UNGA resolution on "International cooperation in the peaceful uses of outer space" was adopted (A/RES/61/111).

UNGA Committees

The UNGA subsidiary organs are divided into five categories: Committees (thirty in total, with six main committees), Commissions (seven), Boards (six), Councils and Panels (five), Working Groups and Others. In particular, two committees are involved in space affairs: the First Committee for Disarmament and International Security and the Committee on the Peaceful Uses of Outer Space[285].

[283] Apart from approval of budgetary matters, UNGA resolutions are not binding on the members

[284] SPIDER will be implemented as an open network of providers of space-based solutions to support disaster management activities by the United Nations Office for Outer Space Affairs (UNOOSA), as well as SPIDER offices in Beijing and Bonn, and a liaison office in Geneva

[285] The General Assembly Fourth Committee on Special Political and Decolonization has played a crucial role in advancing space cooperation in the past, but has not been involved in space issues recently

Committee on the Peaceful Uses of Outer Space (COPUOS)

The COPUOS established in 1959 aims to review the scope of international cooperation in peaceful uses of outer space to devise programmes in this field to be undertaken under UN auspices, to encourage continued research and the dissemination of information on outer space matters, and to study legal problems arising from the exploration of outer space[286]. It has two standing Subcommittees: the Scientific and Technical Subcommittee and the Legal Subcommittee. The Committee and its two Subcommittees meet annually to consider questions put before them by the UNGA, reports submitted to them and issues raised by the member states. Furthermore, the Committee and the Subcommittees, working on the basis of consensus, make recommendations to the UNGA[287].

In June 2006 and June 2007 at the 49th and 50th COPUOS sessions the main agenda items were: ways and means of maintaining outer space for peaceful purposes, the implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), as well as the report of the activities of the Scientific and Technical Subcommittee, and the Legal Subcommittee. Review of the benefits of space technology spin-offs, as well as the links between space and society, and space and water and the recommendations of the World Summit on the Information Society were also major topics of discussions.

The COPUOS besides the activities of its two subcommittees and its plenary session is also involved in outreach and promotion and organization of international conferences and symposiums on space related issues. For instance the COPUOS organises the yearly World Space Week in October. In February 2007 it organised also the symposium on "Use of the Equatorial Orbit for Space Science and Space Applications: Challenges and Opportunities". And, in November 2006 the 5th UN Workshop on Space Law was held in Ukraine.

First Committee for Disarmament and International Security

This committee meets every year in October for a 4-5 week session, after the UNGA General Debate. At each meeting Disarmament Counselors and Ambassadors read statements on general or thematic issues, propose draft resolutions, and vote on the resolutions. There is generally an annual PAROS resolution up for vote; and additional resolutions related to outer space are also often proposed and voted on.

At the First Committee's session in October 2006 there was overwhelming consensus on the need to preserve outer space for peaceful and cooperative uses. The majority of states recognized that the key threat to preserving outer space is the likelihood of its weaponization and a subsequent arms race. Several states called consequently for further substantive debate and negotiations on a comprehensive, legally-binding PAROS treaty in the Conference on Disarmament (CD) and for the reestablishment of a PAROS Ad Hoc Committee. Two draft resolutions regarding space security issues were presented and adopted on 25 October 2006: the annual draft resolution on PAROS (A/C.1/61/ L.10), and a Russian initiative, "Transparency and Confidence-Building Measures (CBMs) in Outer Space Activities" (A/C.1/61/L.36).

Other UN bodies and organs that monitor outer space activities

Besides the UNGA and the COPUOS, there are other UN programmes, specialized UN agencies and other organs having activities relevant to space.

Several other UN-related programmes such as the United Nations Environment Programme (UNEP), the World Summit on Sustainable Development (WSSD), the World Summit on Information Society (WSIS) and the United Nations Geographic Information Working Group (UNGWIG) are involved in space activities, primarily in the fields of space applications. However, the UN Space Applications Programme (SAP) which was established in 1971 and that is run by the COPUOS is one of the main bodies in charge of space affairs in the UN system. The activities of the SAP encompass 4 main categories: the

[286] At its creation the COPUOS had 24 members, and since then it has grown to 67 members and is now one of the largest Committee in the UN. In addition to states a number of international organizations, including both intergovernmental and non-governmental organizations, have observer status with COPUOS and its subcommittees

[287] The Office of Outer Space Affairs (OOSA) serves as the executive organ and secretariat of the COPUOS, and implements the decisions of the UNGA and of the COPUOS. OOSA has the dual objective of supporting the intergovernmental discussions in the Committee and its two subcommittees, and of assisting developing countries in using space technology for development. In addition, it follows legal, scientific and technical developments relating to space activities, technology and applications in order to provide technical information and advice to member states, international organizations and other UN offices

identification of areas where space applications could be useful; education and training; the dissemination of the information on the status of space technology; and the promotion of pilot projects that support economic and social development. However, in 2006 a new UN body went operational, the International Committee on Global Navigation Satellite Systems (ICG). It was established on a voluntary basis on December 2005 as an informal body for the purpose of promoting cooperation, as appropriate, on matters of mutual interest related to civil satellite-based positioning, navigation, timing, and value-added services, as well as compatibility and interoperability among the GNSS systems. Its first meeting was held on 1-2 November 2006 to review and discuss Global Navigation Satellite System (GNSS) and their potential applications.

A series of specialized agencies of the UN are also active in space. The two most important are the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Telecommunication Union (ITU)[288].

In 2006/07 the UNESCO was involved in a series of space-related events. Firstly, on July 2006 it presented its Space Education Programme at the 5th Space Conference of the Americas, held in Ecuador. Secondly, the 2nd International Conference on Remote Sensing in Archaeology sponsored by the UNESCO took place on December 2006. The theme of the conference was "From Space to Place" and focused on the study and conservation of archaeological and ancient landscapes, including UNESCO World Heritage Sites through integrated technologies and virtual reality, as well as remote sensing techniques. Finally in March 2007, the UNESCO participated in the organisation of the "50 Years of Space Age" celebration (together with IAF, COSPAR, COPUOS, IAA, IISL).

The ITU is particularly important for space activities as it maintains and extends international cooperation and assistance between all its member states for the improvement and rational use of telecommunications of all kinds, including space-based telecommunications, and aims to promote the development of technical facilities and their most efficient operation. In 2006/07 the ITU was particularly active in the field of disaster response. It organised in December 2006 together with the UN Economic and social development in Asia and the Pacific (ESCAP) a regional workshop on disaster communications were participants discussed technical, policy and institutional issues in the development of networks, systems and possible regional cooperation mechanisms for communications supporting disaster management, with an emphasis on emergency situations for countries in the region. In June 2006 the ITU organized together with the UN Office for the Coordination of Humanitarian Affairs the International Conference on Emergency Communications.

There is also a formal mechanism to coordinate the activities of all related UN bodies and agencies. The United Nations Coordination of Outer Space Activities convenes on an annual basis to discuss current and future activities, emergent technologies of interest and other related matters through the Inter-Agency Meeting on Outer Space Activities with 27 UN-related organizations taking part[289]. The last meeting (27th session) was held in January 2007 and issued a report on it deliberations for the consideration of the COPUOS and produced a report on the coordinated space-related activities of the UN system. It covered the current and future plans of common interest, including consideration of how the activities of organizations of the UN system in the area of space science and technology and its applications relate to their mandated programmes. In June 2006, the Inter-Agency Meeting on Outer Space Activities released also a document entitled "Space Technology and Sustainable Development" which lists all space-related initiatives and programmes carried out by member states of the COPUOS and within the UN system that respond to specific recommendations contained in the Johannesburg Plan of Implementation of the WSSD.

The United Nations Institute for Disarmament Research (UNIDIR) which is an autonomous entity within the UN structure that was established by the UNGA to inform states and the global community on questions of international security and to assist with disarmament efforts is also dealing with space related issues. UNIDIR, through its research projects, publications, small meetings and expert networks tries to bridge the gap between researchers, diplomats, government officials, non-governmental organizations (NGOs) and other institutions to explore both current and future security issues. For instance in March 2006, it hosted a two-day conference on "Building the Architecture for

[288] Specialized Agencies are autonomous organizations working with the UN

[289] ECA, ECE, ECLAC, ESCAP, ESCWA, FAO, IAEA, ICAO, ISDR, IMO, ITU, UN-DESA, UN-DPKO, UN-OCHA, UN-OOSA, UNDP, UNEP, UNESCO, UNHCR, UNIDO, UNITAR, UNODC, World Bank, WHO, WIPO, WMO

Sustainable Space Security". It held also a conference on 2-3 April 2007 on "Celebrating the Space Age: 50 Year of Space Technology, 40 Years of the Outer Space Treaty".

UNIDIR is also the home of the Conference on Disarmament (CD) which is the single multilateral disarmament negotiating forum of the international community including space arms control. In 2006, the CD held a series of sessions, as well as debates on PAROS during its second session. And, like in the General Assembly First Committee for Disarmament and International Security several states called for the negotiation of a new legal instrument on PAROS, and that an Ad-hoc Committee on PAROS should be established in the CD to do the substantive work. However, the United States in a similar fashion that it voted against the two aforementioned proposed resolutions both in the General Assembly First Committee and the UNGA opposed in the CD of the formation of an Ad-hoc Committee and of a new international treaty on PAROS, reiterating its long held position that there is no arms race in space.

Mission Statement of ESPI

The mission of the European Space Policy Institute (ESPI) is to carry out studies and research to provide decision-makers with an independent view on mid- to long term issues relevant to the governance of space.

Through its activities, ESPI contributes to facilitate the decision-making process, increasing awareness on space technologies and applications with the user communities, opinion leaders and the public at large, and supporting students and researchers in their space-related work.

To fulfil these objectives, the Institute supports a network of experts and centres of excellence working with ESPI in-house analysts.