



European Space Policy Institute

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Space Policies, Issues and Trends in 2009/2010

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1. Global Political and Economic Trends

In 2009 the global financial crisis entered a new stage, in which the adverse effects of last year's credit crisis started to weigh on worldwide economic activity. The year was marked by a fall in global industrial production and trade activity and a consequent steep rise in unemployment. However, the first signs of improvement also made their appearance, as bank earnings and capital levels began to rise again and GDP growth started to return, although it is not expected to reach pre-crisis levels for several years. In 2010 this trend is expected to continue, but economic recovery will be slow and precarious. This year's economic policies are expected to focus on continuing the reform of the financial and banking system, rebalancing the patterns of global trade, boosting private consumption, enhancing international cooperation and restraining unemployment rates before they change from cyclical to structural. The pace of economic recovery is expected to be slow and very different from country to country. Emerging economies will exit the crisis at a quicker pace than advanced ones, but the whole process will remain fragile and extremely vulnerable to adverse events such as rising commodity prices, geopolitical events, or a resurgence of protectionism.

1.1 Global Economic Outlook

In 2009 the global economy appears to be expanding again and this trend is expected to continue in 2010. At present, Asian economies seem to be the driving force behind global economic recovery, whereas stabilisation and modest improvement is the case elsewhere. Apart from Asia however, recovery is projected to be weak and slow by historical standards and GDP growth will remain well below pre-crisis levels until 2014 at least¹. For 2010 global activity is expected to expand by approximately 3%, after a 1% contraction in 2009. Growth in emerging economies will be significantly higher². This sluggish recovery will be marked by long

lasting post-crisis characteristics such as low inflation, a drop in private consumption and investment, and a steep rise in unemployment which may become structural. Markets and financial institutions have been stabilising and will continue to do so in 2010. Nevertheless, market financial stress and risk aversion will remain elevated for the foreseeable future, which will put considerable stress on households and medium-size enterprises, and will consequently continue to increase bank loan delinquencies. On the upside, international capital flows are on the way to recovering³.

In the financial sector the year has been marked by a slow return of risk appetite that has led to considerable currency fluctuations, with the Euro strengthening its position against both the Dollar and the Yen on the second half of 2009, before falling again in 2010. Bank loans to the private sector however are still stagnating, especially in advanced economies. In fact, credit risks remain elevated and the sustainability of bank earnings is still precarious at best: in October 2009 global bank write-downs were estimated to reach \$2.8 trillion and more than half of this amount has not yet been recognised. The bulk of these losses are attributed to U.S., UK and Euro zone banks. In addition to this, a further \$1.5 trillion wall of maturing debt will have to be met by 2012⁴. By comparison to European banks, U.S. banks have deleveraged faster and this may help credit conditions in that country to ease sooner. Nonetheless, financing conditions for consumers and medium-size companies in developed countries are expected to remain difficult.

In the second half of 2009 global markets continued to stabilise and this is expected to continue in 2010. Even though investment will not attain pre-crisis levels in the foreseeable future, a certain risk appetite has returned. For the moment, however, market recovery seems fragile, a number of financial stress indicators remain high and the fear of a possible reversal weighs heavily on investors. In the context of the credit conditions described above, global markets are thought

¹ International Monetary Fund. World Economic Outlook: Sustaining the Recovery. Washington D.C.: IMF, October 2009: 1.

² Ibid: xiv–xv+29.

³ Ibid: 2–4.

⁴ Ibid: 5–6.



to remain extremely sensitive to external factors such as geopolitical events or real-estate-related shocks. Real-estate in particular will continue to put pressure on bank balance sheets, whereas subsequent low construction activity is expected to create additional risks for the financial sector in general⁵.

On a global scale inflation moderated to 1% in mid 2009 down from 6% a year earlier and is expected to remain low in 2010 as well. Inflation rates in emerging economies varied considerably from region to region, dropping in Asian countries and rising in East European ones. Advanced economies are still facing mild deflation risks as the pace of economic recovery remains slow, even though inflation rates are expected to rise above zero in 2010. Deflationary dangers in these countries are aggravated by the fact that interest rates have been brought close to zero and there is little room left for additional financial stimulus from monetary policy measures⁶.

Unemployment rose throughout 2009 and is anticipated to continue rising in advanced economies throughout 2010. Both in the U.S. and the Euro zone, unemployment rates are anticipated to exceed 10% in 2010. Non-financial corporations and medium-size companies will continue to lay off workers due to the aforementioned difficult financial conditions. Countries with proportionately greater construction sectors will suffer even greater job losses. Euro zone countries are projected to face higher unemployment rates than the U.S. (up to 12% in 2010) due to a more sluggish recovery and a less adjustable job market. In the medium-term, historical evidence suggests that in the aftermath of major economic crises and the protracted recovering period that succeeds them, unemployment can become structural and difficult to deal with. This might be the case in the Euro zone, where unemployment rates are not expected to fall below 10% before 2014 at the earliest⁷. In any event, rising unemployment will pose a major challenge to all advanced economies throughout 2010⁸.

As a result of the above-mentioned factors, governments worldwide will continue to implement extraordinary public support measures for financial institutions well into 2010. These measures however will have to face the challenge of transforming from short-term financial stimulus schemes to medium-term comprehensive reform policies. Formulating these policies faces three major challenges: rallying the necessary public support,

choosing the right timing, and respecting as much as possible macroeconomic budgetary and fiscal constraints. Indeed in 2009 and the first half of 2010, public support for the recapitalisation of financial institutions diminished considerably, especially in advanced economies. Public opinion is becoming more and more sceptical on measures that are perceived as generous government bailouts for firms that were largely responsible for the credit crisis in the first place⁹. This development, in conjunction with increasing unemployment, will make governments reluctant to increase recapitalisation measures in the face of mounting political pressure to do the opposite.

In 2010, political considerations together with an improving financial environment will push governments to consider lifting the extraordinary monetary accommodation that they offered to financial institutions in 2008. It seems that the most difficult task ahead will be to carefully choose the timing of this decision. If the unwinding of public intervention comes too soon, it will place the progress made in 2009 in jeopardy. If it is protracted for a longer period than necessary, it will distort market incentives and create fiscal problems for national budgets¹⁰. Although monetary accommodation measures are likely to stay in force throughout 2010, governments will probably have to decide on this matter before the end of the year.

Finally, lifting recapitalisation measures will have to be accompanied by medium term policy decisions on reforming the financial sector framework, while restructuring fiscal policies to accommodate the large public debt that the crisis generated in many countries. Prudent macroeconomic decisions will have to be made on both issues in 2010 and this development is already under debate both on a national and an international level. In fact in 2009, there has been an unprecedented level of international cooperation in tackling the credit crisis aftermath. In 2010, this cooperation is expected to expand into taking specific regulatory decisions on reforming the financial sector operating framework, stabilising the economic circle, and avoiding financial protectionism. Indeed, protecting public finances and especially central banks' balance sheets already became a key plank of economic measures in the second half of 2009, and this is expected to continue. In conclusion, the main challenge that advanced economies are facing in 2010 is the need to find room for adequate macroeconomic countercyclical policies in the face of fiscal prob-

⁵ Ibid: 4+12+18+39.

⁶ Ibid: 18+29-30.

⁷ Ibid: 7+31-32.

⁸ Ibid: 49.

⁹ Ibid: 28.

¹⁰ Ibid: 42-47.

lems caused by accumulated public debt during the crisis period¹¹.

One of the key trends in 2009 and 2010 has been that emerging economies have entered recovery much faster and easier than advanced ones. This is particularly the case for China and India, which escaped a severe recession. With considerable help from its robust fiscal position and the overall health of its banking sector, China has initiated large policy stimuli (up to 5% of its GDP in 2009) and successfully managed to overcome the fall of its exports, which in 2009 were reduced by 30% compared to 2008. This was mainly achieved through boosting domestic demand (private credit rose by 25% in the first half of 2009) and undertaking major infrastructure and industrial retooling projects. This led to an 8.4% GDP growth in 2009 and a continued expansion in 2010¹².

In fact, China has been the driving force behind the recovery of the entire SE Asia region, where capital flows resumed in 2009 and markets rose sharply. Nevertheless, given the slow pace of recovery in advanced economies, it remains unclear whether Chinese growth will be able to sustain itself beyond 2010 without an adequate increase in exports. At the same time, boosting domestic demand by prolonged credit growth may increase inflationary pressure in the medium term. The Indian economy grew at a somewhat slower pace in 2009 and 2010 as well, at an annualised rate a little above 6%. Growth has been facilitated by adequate monetary policies and a relatively smaller dependence of the Indian economy on exports¹³.

In 2009, Russia experienced an estimated 8.7% contraction of its GDP¹⁴. This development was the result not only of the world credit crisis, but also of the fall of the oil price that occurred. Low oil prices caused a considerable surge in capital flows in the first half of 2009, which led to an important 5.9% depreciation of the ruble, but this trend was reversed in the 4th Quarter, following a rise in oil prices and a considerable increase in exchange and gold reserves¹⁵. Domestic de-

mand in the country fell sharply, followed by production (-12.6% in tradable goods in 2009) and investment. Unemployment adjusted to 7.6% at the third Quarter of 2009, from 9.2% at the beginning of the year and it is projected to remain stable in 2010 as well. From the fourth Quarter of 2009 industrial output has been improving slowly and consumption has been regaining lost ground, but real wage reductions and tight credits have caused non-tradable goods production to continue stagnating. At the same time the credit market is not expected to ease throughout 2010¹⁶.

In economically advanced countries the pace of economic recovery has been considerably slower. In the U.S. the financial situation has been stabilising throughout 2009 and the first Quarter of 2010. GDP contraction has been slowing down from -6.4% at the beginning of 2009 to a 2.2% increase in the third Quarter¹⁷. On an annual basis, the U.S. economy is expected to contract by 2.45% in 2009, but a modest growth of 1.5% is expected for 2010. Although economic stabilisation is likely to continue, growth will probably not exceed the rate of 2% in the medium term. In the mean time, credit conditions remain uncertain and unemployment has risen to the highest rates since the early 1980s (in 2009 it is expected to reach 10% on an annual basis). The greatest challenge for the U.S. economy in 2010 is to prevent high cyclical unemployment rates from becoming structural, as well as addressing long-term imbalances in public, corporate and household expenditures¹⁸.

In Europe, recovery seems to be more sluggish than in the U.S. The Euro zone did not emerge from recession before the end of 2009, and it is predicted to attain growth rates less than 1% in 2010. Further growth will only be attained gradually and in the medium-term. Unemployment reached 10% in 2009 and might reach 12% in 2010. Credit in the Euro zone remains tight due to the greater role of banks in the financing system, as well as major exposures to cross-border risks regarding banking activity in Eastern Europe. Emerging EU economies, such as those of the Baltic States, Bulgaria and Romania, have been hit particularly hard by the crisis, whereas countries with moderate current account deficits or surpluses have shown more resilience¹⁹. In 2010, public expenses in

¹¹ International Monetary Fund. World Economic Outlook: Sustaining the Recovery. Washington D.C.: IMF, October 2009: 46–50.

¹² Ibid: 11+72.

The World Bank. China Quarterly Update. Beijing: WB, Nov. 2009: 1–7.

¹³ International Monetary Fund. World Economic Outlook: 71–75.

¹⁴ The World Bank. Global Economic Prospects 2010. WB: Washington D.C., 21 Jan. 2010: 17.

¹⁵ International Monetary Fund. World Economic Outlook: 79–82.

The World Bank. Russian Economic Report No 20. Moscow: WB, Nov. 2009: 2+9.

¹⁶ Ibid: 2–9.

¹⁷ Bureau of Economic Analysis, U.S. Department of Commerce. Press Release: GDP 3rd Quarter 2009 Estimate. BEA: Washington D.C., 22 Dec. 2009.

¹⁸ International Monetary Fund. World Economic Outlook: 67–71.

¹⁹ Ibid: 75–79.



most EU countries are deteriorating sharply, and addressing this problem will be of great importance. Containing the rise of unemployment and supporting demand under strict budgetary restrictions will prove a major challenge in 2010 for most European countries.

In Japan, stabilisation started in the second half of 2009 and continues in 2010²⁰. After a steep GDP drop (-11.9%) in the first Quarter of 2009, modest growth (2.7–1.3%) returned during the rest of the year and continued in 2010²¹. Unemployment rates throughout the aforementioned period remained high by Japanese standards, hovering above 5% on an annual basis in 2009, while at the same time real wages continued to decline. Corporate and bank profits were substantially reduced and mild deflationary pressures appeared on prices. Business investment continued falling and uncertainty about the future of the economic outlook remained high among both investors and consumers. Nevertheless, industrial output has been increasing since the third Quarter of 2009, profiting mostly from the rise of regional commercial activity, and consumption has been increasingly showing signs of improvement²². In general terms, recovery in Japan is following the slow and gradual path witnessed in the rest of the advanced economies, with the addition of a relevantly elevated deflation risk²³.

1.2 Political Developments

1.2.1 Security

Security is a field in which space systems are vital. For the purposes of this report, security is defined in its traditional narrow definition related to defence and the ability to effectively engage in military operations. A broader definition of security is briefly discussed in section 1.2.5. Satellite systems are identified as key enablers of military capabilities. These space applications include image and electronic surveillance gathering, communications, meteorological and navigation/positioning data, among others.

A major development in 2009 and 2010 was the rapid deterioration of the security situation in Afghanistan. Taliban insurgents considerably improved their operational and logistics capabilities in the aforementioned period, resulting in a record high number of casualties for the ISAF coalition forces in the country. These amounted to 520 dead in 2009, a significant increase from 295 in 2008. During the same period, U.S. forces casualties marked a 100% increase, to 316²⁴. The bulk of fatalities was attributed to improvised explosive device attacks, which were up by 60% from the year before. Civilian casualties also increased by 12%²⁵. The total number of such incidents exceeded 7,200 from 4,169 in 2008, whereas their average explosive charges and destructive capability doubled²⁶.

For the first time since August 2009, Taliban insurgents launched a series of suicide attacks inside Kabul. On 28 October 2009 a United Nations personnel residence came under an attack that resulted in the loss of 5 U.N. staff members. As a direct result of this incident, more than 340 U.N. personnel members were relocated outside the country, seriously downgrading the U.N. assistance mission's performance in the area²⁷. Taliban forces also resumed their intimidation tactics against the local population with a series of targeted assassination attempts. The overall deterioration in security conditions crippled the United Nation's humanitarian aid and reconstruction programmes²⁸.

Security conditions in the country were also affected by mounting political instability. On 19 November 2009, Afghanistan's President H. Karzai was finally inaugurated for a second term. This development ended two months political turmoil between the President and his principal political opponent Dr. Abdullah over the latter's accusations of electoral fraud in the 20 August presidential ballot. President Karzai was proclaimed the winner of the electoral process only because his opponent refused to participate in the second round. However, the run-up to the finalisation of the result increased civilian unrest and paralysed the government. Consequently, public confi-

²⁰ Ibid: 71–75.

²¹ Cabinet Office of Japan, Economic Social and Industrial Research Office. GDP Quarterly Estimates. Tokyo: ESRI. 9 Dec. 2009. <<http://www.esri.cao.go.jp/jp/sna/qe093-2/main1.pdf>>.

²² Cabinet Office of Japan. Monthly Economic Report. Tokyo, Jan. 2010. 21 May 2010. <<http://www5.cao.go.jp/keizai3/getsurei-e/2010jan.html>>.

²³ International Monetary Fund. World Economic Outlook...: 71–75.

²⁴ "iCasualties.org: Operation Enduring Freedom." 22 May 2010. <<http://www.icasualties.org/oef/>>.

²⁵ United Nations Secretary General. The Situation in Afghanistan and its Implications for International Peace and Security. Report to the U.N. General Assembly Security Council, New York: 28 Dec. 2009: 5–8.

²⁶ Schifrin, Nick. "Intel Official: Time is Running Out in Afghanistan". ABC News Report 27 Dec. 2009.

<<http://abcnews.go.com/International/Afghanistan/intel-official-time-running-afghanistan/story?id=9429416>>.

²⁷ United Nations Secretary General. The Situation in Afghanistan...: 7+10.

²⁸ Ibid: 6.

dence in the country's reconstruction and future also waned²⁹.

In the midst of these negative developments, the U.S. President announced on 1 December 2009 a new strategy for Afghanistan. He announced the dispatch of an additional 30,000 troops reinforcement to the country. At the same time, President Obama reiterated his plan to begin the gradual withdrawal of U.S. forces from the country by July 2011. The additional forces proposed would increase annual war costs by \$30 billion, or almost by 50% in comparison to the current budget³⁰.

The new U.S. policy in Afghanistan followed from a comprehensive strategy document released on 27 March 2009. The new strategy widened the scope of U.S. objectives in the region by including neighbouring Pakistan in its scope of operations. It also recognised that the Taliban principal logistics and command posts were concentrated in Pakistan's border regions with Afghanistan. The proposed action plan included disrupting terrorist operations inside Pakistan, while at the same time increasing military and political assistance to that country. Supporting Pakistan would also involve increased financial cooperation and government building measures to promote democratic rule in that country. The new U.S. policy also called for state building actions in Afghanistan itself, including a new strategic communications and joint civilian-military counterinsurgency strategy³¹.

Another issue that continued to provoke tensions on the international scene was the negotiations regarding the Iranian nuclear programme. On 18 February 2010, the International Atomic Energy Agency (IAEA) published its latest regular two month revue of Iran's atomic energy related activities, in the framework of the relevant U.N. Security Council resolutions. In this document, the IAEA clearly stated that Iran was not cooperating in the verification of the peaceful purposes of its nuclear programme. Furthermore, the Agency found that Iran had failed to meet the requirements set by the U.N. Security Council in order to provide assurances for the nature of its programme. Fi-

nally, it particularly took notice of the continued operation of the enrichment facilities in Natanz³².

In a considerable departure from its past reports, the IAEA explicitly claimed for the first time that Iran could have possibly started the development of a nuclear payload for a missile. It also went on to give specific technical details of Iran's possible nuclear weapons development capabilities, based on its information³³.

1.2.2 Environment

Space applications have an important role in environment monitoring and protection. Space assets are uniquely positioned to offer a global perspective on climate change. They often also represent a common multinational platform for collecting relevant meteorological and environmental data. This characteristic makes them ideal promoters of international understanding and cooperation in this field.

Climate change and the concerted international effort to control it continued to be the main issue in environmental policy in 2009 and 2010. Global warming remains a major threat not only to the environment, but also to long-term economic growth and prosperity worldwide. It can potentially disrupt food supply, cause major humanitarian catastrophes, destabilise developing countries and consequently endanger their population³⁴. From a political point of view the most important development was the UN Climate Change Conference held in Copenhagen from 7 to 18 December 2009. Its proceedings included the 15th conference of the 193 parties to the UN Framework Convention on Climate Change (UNFCCC/COP) and the fifth meeting of the 189 parties that have adhered to the 1997 Kyoto Protocol (CMP)³⁵. The Conference was attended by more than 15,000 participants, including 119 Heads of State on its

²⁹ United Nations Secretary General. The Situation in Afghanistan...: 1–5.

³⁰ The White House. President Obama Statement: The Way Forward in Afghanistan. Washington D.C.: 1 Dec. 2009. <<http://www.whitehouse.gov/issues/defense/afghanistan>>. Landay, Jonathan S. "Analysis: Focus on Withdrawal Could Jeopardise Afghan Mission". McClatchy 4 Mar. 2010. <<http://www.mcclatchydc.com/2009/12/01/79879/analysis-focus-on-withdrawal-could.html>>.

³¹ The White House. White Paper of the Interagency Policy Group's Report on U.S. Policy Toward Afghanistan and Pakistan. Washington D.C.:

³² International Atomic Energy Agency. Implementation of the NPT Safeguards Agreement and Relevant Provisions of Security Council Resolutions 1737 (2006), 1747 (2007), 1803 (2008), and 1835 (2008) in the Islamic Republic of Iran. Vienna: IAEA 18 Feb. 2010.

³³ Ibid: 8.

³⁴ United Nations Framework Convention on Climate Change-Secretariat. "Fact Sheet: Copenhagen-Why is a Deal so Important?" UNFCCC Fact Sheet Nov. 2009. 23 May 2010. <http://unfccc.int/files/press/application/pdf/fact_sheet_copenhagen_deal.pdf>.

³⁵ United Nations Framework Convention on Climate Change-Secretariat. "Historic United Nations Climate Change Conference Kicks Off in Copenhagen with Strong Commitment to Clinch Ambitious Climate Change Deal and Unprecedented Sense of Urgency to Act". UNFCCC Press Release 7 Dec. 2009. <http://unfccc.int/files/press/releases/application/pdf/pr_cop15_20091207.pdf>.



final day, and it attracted unprecedented public attention and press coverage³⁶. The conference's principal aim was to discuss appropriate measures against global climate change that will have to be implemented before the Kyoto Protocol's provisions expire in 2012³⁷.

Despite the great expectations nourished before the conference and the fact that all participants acknowledged the urgent nature of the measures that had to be taken, progress during the conference was modest and decisions did not arrive until its very last day. The conference's main declared objectives were: to set new long-term emission reduction rates for 2020; to adopt appropriate mitigation actions for developing countries; to initiate a long-term funding commitment from developed countries to sustain these actions; and to set up an appropriate institutional framework for addressing the needs of developing countries³⁸. The key objective was to cut down emissions to 25–40% lower than 1990 levels by the year 2020³⁹.

Reaching an agreement proved difficult due to the different views between developed and developing countries. The final result of the deliberations was the "Copenhagen Accord", an agreement for industrialised countries to voluntarily limit their emissions by 2020 and for developing countries to muster their efforts to reduce emissions and to communicate their results every two years. All voluntary pledges to limit emissions were listed in the accord by the end of January⁴⁰. It was also agreed that the accord would be reviewed before 2015. Raising funds among developed countries for appropriate actions also proved more difficult than expected. However, a dedicated fund (the "Copenhagen Green Climate Fund") was established to support immediate action against climate change over the next three years, with a total budget of \$30 billion. At the same time, the long-term goal of raising \$100 billion by 2020 was also reiterated. The next UNFCCC conference is scheduled to take place by the end

of 2010 in Mexico City, after two preparatory negotiating sessions in Bonn in 31 May and 11 June⁴¹.

In addition to this, the 3rd World Climate Conference (WCC-3) was held by the World Meteorological Organisation (WMO) in Geneva between 31 August and 4 September 2009, almost 20 years after the last one in 1990. Participation included an expert panel as well as high-level government representatives. Its main scope was to enhance international cooperation and global capabilities in the field of climate information and weather prediction. In a way, it gave scientists the opportunity to review climate related scientific practices ahead of the Copenhagen Conference. WWC-3 concluded its work with a high-level political declaration and a separate conference statement⁴². Participants agreed on establishing a Global Framework for Climate Services, in order to coordinate and strengthen production and availability of climate prediction services worldwide. They also decided to set up an independent task force of experts that will deliver recommendations on the structure of this Framework within 12 months. These recommendations will then be presented for adoption at the next WCC Conference in 2011.

At the EU level several initiatives were taken by the Swedish Presidency in the first half of 2009. The key subject was preparing the EU's participation in the Copenhagen conference. EU policy objectives for the conference were ambitious. They focused on making considerable progress towards a new comprehensive and binding global treaty to replace the Kyoto Protocol after 2012. In order to achieve this, EU members looked forward to obtaining tangible emission reduction commitments from all conference participants; assuring public finance to implement these reductions until 2020; adopting a new institutional framework for international cooperation on climate change; and implementing a strict follow-up process to monitor the progress made⁴³.

In spite of the fact that the EU offered to contribute €2.4 billion by 2012 to meet its funding obligations, its expectations for the

³⁶ Ibid.

United Nations Framework Convention on Climate Change-Secretariat. "Copenhagen United Nations Climate Change Conference Ends with Political Agreement to Cap Temperature Rise Reduce Emissions and Raise Finance". UNFCCC Press Release 19 Dec. 2009.

<http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/pr_cop15_20091219.pdf>.

³⁷ United Nations Framework Convention on Climate Change-Secretariat. "Fact Sheet: Copenhagen..."

³⁸ Ibid.

³⁹ United Nations Framework Convention on Climate Change-Secretariat. "Historic United Nations Climate Change Conference Kicks Off..."

⁴⁰ United Nations Framework Convention on Climate Change-Secretariat. "Copenhagen United Nations Climate Change Conference Ends with Political Agreement..."

⁴¹ Ibid.

⁴² World Meteorological Organisation. World Climate Conference 3-Conference Statement. Geneva: 8.9.2009. <http://www.wmo.int/wcc3/documents/WCC3_Statement_07-09-09_mods.pdf>.

World Meteorological Organisation. WCC-3 High Level Declaration. Geneva: Sept. 2009. <http://www.wmo.int/wcc3/documents/WCC3_declaration_en.pdf>.

⁴³ Council of the European Union. "The Copenhagen Climate Change: Key EU Objectives". EU Council Memo/09/534. Brussels: 2 Dec. 2009. <<http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/534&format=HTML&aged=0&language=EN&guiLanguage=en>>.

conference were not met. Although the conference's decisions were considered a positive first step, emission reductions rates were considered insufficient, long-term financing was not secured and the overarching objective of negotiating a new legally binding treaty was not attained⁴⁴. However, EU Member States associated themselves with the Accord's provision for a 20% emission reduction and offered to increase cuts to 30%, if developing countries would agree to contribute to gas emissions as well⁴⁵. Other key environment policy objectives during the Swedish presidency included protecting biodiversity and promoting the EU's transition into an eco-efficient economy based on renewable energy sources, energy-efficient systems and adequate community planning. Eco-efficient economy in particular is now seen as a possible competitive edge for EU that will enable it to develop new technologies and to become more self-sufficient in terms of energy and natural resources supply⁴⁶.

1.2.3 Energy

Space systems can contribute from orbit to the exploitation of Earth's energy resources. Imaging satellites help determine surface resources and underground deposits alike. Communication and space observation satellites help operate and monitor fossil energy transport corridors. Space applications provided motivation for solar panel technology improvements that are now at the forefront of renewable energy technologies. With recent developments in solar energy gathering satellites, space could become a source of energy for terrestrial use itself.

In 2009 and 2010 energy demand began to rise again. After a turbulent 2008, when oil prices fluctuated violently, oil prices in 2009 and the first half of 2010 have stabilised to roughly \$75–82 bbl⁴⁷. This price level represents a 15 month high and a significant rise from December 2008's \$33bbl⁴⁸. Rising oil demand in the developing countries and a

particularly cold winter in the northern hemisphere drove the prices up by the end of 2009. This trend continued in 2010, fuelled mostly by economic recovery in SE Asia, as well as by increasing investment flows to commodity assets. Oil supply has been rising mildly throughout this period (roughly by 0.4 billion barrels) while demand was declining. As a result, commercial oil inventories remain significantly high, to approximately 60 days of forward cover. This development, in conjunction with rising demand in 2010, has driven spot and freight prices up⁴⁹.

Although oil demand is increasing in developing countries and it has stopped decreasing in developed ones, global oil consumption remains considerably lower than pre-crisis levels (app. -2.3mb/d) and this trend is expected to continue throughout 2010. The continued upward trend of the oil market price in spite of sufficient production and increasing inventory volumes is mainly attributed to increasing investment flows in commodities markets. In fact, the financial sector's exposure to energy commodity assets rose by 70% in the period between December 2009 and January 2010. Since oil production fundamentals do not support these prices, we might be facing the possibility of a downward price spiral in the second half of 2010⁵⁰.

In the medium-term these trends are not expected to change. Oil consumption will not attain pre-crisis levels before 2012, provided that recovery continues. In OECD countries it will remain particularly sluggish and global consumption will mainly be sustained by SE Asia's emerging economies. Almost 80% of the projected increase in oil consumption until 2030 is expected to come from these countries, and the transportation sector will be the driving force behind this demand. Supply is expected to rise modestly, mostly thanks to increasing output by non-OPEC countries. This increase will be the result of exploitation of non-conventional oil sources (e.g. Canadian oil sands). Although OECD countries' supply is expected to decline, natural gas and renewable sources' exploitation will compensate for this loss and overall spare oil supply capacity will remain adequate. Nevertheless, since current price levels do not encourage investment decisions in oil supply, OPEC countries are projected to slightly increase their share of the market and a new price boom cannot be excluded in the medium-term⁵¹.

⁴⁴ Swedish Presidency of the European Union. "Summary of the Work in the Environment Council of 22 Dec. 2009". EU Presidency: 23 Dec. 2009.

⁴⁵ EU Council. "EU Associates Itself with Copenhagen Accord and Submits Emissions Reduction Target". EU Council Press Release 5762/10. Brussels: 28 Jan. 2010.

⁴⁶ Swedish Presidency of the European Union. "Summary of the Work..."

EU Commission. "Options for an EU Vision and Target for Biodiversity Beyond 2010". EU Commission, Brussels: 19 Jan. 2010.

⁴⁷ International Energy Agency. "Oil Market Report 2010" Highlights. Paris: IEA, 15 Jan. 2010. <www.oilmarketreport.org>.

⁴⁸ Organisation of the Petroleum Exporting Countries. Monthly Oil Market Report. Vienna: OPEC, 19 Jan. 2010: 1–9.

⁴⁹ Ibid.

⁵⁰ Ibid.

⁵¹ Organisation of the Petroleum Exporting Countries. World Oil Outlook 2009. Vienna: OPEC, 8 Jul. 2009: 1–16.



Gas prices declined considerably in 2009, due to limited industrial demand, which dropped by up to 10%. Gas-generated power demand, in particular, fell by up to 8% because of its position in the merit order. However, cold weather has kept domestic and commercial heating demand strong and this fact has partially compensated for the decline in industrial use⁵². Price fluctuations varied from market to market. U.S. prices were relatively stable in 2009, because they had already adjusted to the crisis in late 2008. Oil-based prices in Continental Europe and Japan dropped sharply in 2009 as a result of the 2008 crisis, due to the fact that inbuilt time lags in supply contracts did not allow them to adjust earlier. Gas prices in Europe, in particular, remained considerably higher (up to 100%) than those in the U.S. where production actually increased in 2009, mostly thanks to unconventional gas production growth. This development actually allowed U.S. liquid natural gas shipment to be diverted to the Pacific market and to fuel booming industrial demand there. Nevertheless, U.S. future gas output remains one of the main uncertainties concerning future market behaviour⁵³.

Another major development in gas markets in 2009 and 2010 was the dramatic increase in LNG supply capacity. Many LNG production development plans started production in 2009, leading to an unprecedented increase in output capacity (over 370 billion cubic metres). Excess supply capacity will probably test the market's flexibility and resilience in 2010⁵⁴. As with oil, the main issue will be inadequate investment for future projects, under the adverse current financial conditions. With the pace of economic recovery remaining very slow in advanced economies, any prediction for future LNG demand is risky. As a result, most supply development projects are likely to be put on hold for a while, thus creating a shortage of new output capacity after 2012. Obviously, the longer the recovery takes, the greater the LNG supply shortage will be in the medium-term and the higher its price⁵⁵. As gas use in advanced economies is stagnating, developing economies like China or India are emerging as major gas users. In the medium-term, both countries are expected to exceed 100 bcm in

annual consumption rate. At the same time, new gas suppliers from the Middle East such as Qatar and Iran are appearing, although the latter is not expected to become a significant exporter before 2015⁵⁶.

In Europe, the early 2009 gas supply crisis left its mark on the entire year and well into 2010 as well, making paramount the issue of strategic gas supply security. The crisis underlined chronic interconnectivity, reverse flow and storage capacity deficiencies in many European countries, especially in Central and Eastern Europe. Better and time-efficient cooperation among European countries in this area has become a key subject of discussion in 2009 and 2010. The objective for the EU in particular is to enhance energy security through varying gas sources and routes, increasing storage capacity and diversifying electrical power sources. However, implementing these policies will require considerable funding in the short-term that is not guaranteed in the current financial conditions. Furthermore, diversifying power supply by embracing renewable energy sources might actually increase gas consumption in the medium-term, as environmentally poor power sources will be abandoned and renewable ones will not yet be able to entirely substitute for them⁵⁷.

In conclusion, global and especially European energy policies in 2009 and 2010 are facing multiple challenges with often contradictory solutions. Improving environmental efficiency will necessitate adequate funding that is difficult in times of financial insecurity. Limited investment will result in greater dependency on imported gas supply in the medium-term and limited energy security. Advanced economies will have to improve energy efficiency, while at the same time coping with the price fluctuations caused by booming demand in emerging economies. Increasing gas demand in SE Asia combined with stable or declining demand in the U.S. (and possibly Europe) will raise international pressure to disassociate their price index⁵⁸. In general, long-term policies designed to improve the environmental impact and efficiency of energy resources will decrease energy security in the medium-term by consolidating the market power of traditional resource suppliers, such as Russia and the Middle East countries. Consequently, an unprecedented level of international cooperation, prolonged investments and strict market transparency

⁵² International Energy Agency. Natural Gas Market Review 2009-Executive Summary. Paris: IEA, 29 June 2009. <<http://www.iea.org/Textbase/npsum/gasmarket2009SUM.pdf>>.

⁵³ Ibid.

⁵⁴ Ibid.

⁵⁵ Ibid.

International Energy Agency. World Energy Outlook 2009 – Executive Summary. IEA: Paris, 10 Nov. 2009: 3–7. <<http://www.iea.org/Textbase/npsum/weo2009sum.pdf>>.

⁵⁶ International Energy Agency. Natural Gas Market Review...: 15.

International Energy Agency. World Energy Outlook...: 13.

⁵⁷ Ibid: 10–13.

⁵⁸ International Energy Agency. World Energy Outlook...: 13.

measures will be indispensable, in order to tackle all of these issues simultaneously.

1.2.4 Resources

Space applications can also be useful for accommodating international trade and improving the exploitation efficiency of other natural resources as well. Imaging and meteorological satellites can make agricultural output bigger and more reliable. Furthermore, communication satellites are indispensable for making international business transactions and payments, which continue to grow in today's globalised commercial environment.

After a sharp drop in 2008 and in the first half of 2009, international trade and commodity prices began to rise again from the third Quarter of 2009. This development was principally due to industrial output recovery in the emerging economies of Asia, and especially China. However, the slow pace of economic recovery in developed countries is still limiting commodity demand and pushing prices down. Overall global trade in 2009 contracted by approximately 17.6%⁵⁹. As a result of weak recovery and weak base effects, commodity prices are not expected to reach pre-crisis levels before 2011 at the earliest⁶⁰. For 2010, global trade growth is not expected to exceed 4.2%⁶¹. Low industrial production levels caused metal prices to plummet in 2009 (aluminium: -1%, copper: -9%). Chinese demand supported price levels considerably, mostly thanks to extensive restocking. If Chinese demand were excluded, metals price decline would have exceeded 20%⁶². In 2010, the modest price raise is expected to continue. In general, demand from China had a rather stabilising effect on commodity prices throughout 2009⁶³.

Although agricultural products declined by 22% in 2009 compared to their 2008 peak, they still remain almost twice as high as the lows recorded earlier in the decade. Higher oil prices and bio fuel demand, together with an increase in stockpiling, contributed to an upward trend in prices in 2009 and 2010. Lower production costs, however, helped counterweight this tendency and keep prices stable. At the same time, most countries have eliminated export restrictions in agricultural prod-

ucts that were put in place at the peak of the crisis⁶⁴. Demand for food commodities is generally insensitive to the cycles of economic activity. As a result, agriculture has been more resilient than other sectors of the economy to the effects of the global economic crisis. Agricultural commodity prices are therefore expected to rise modestly but steadily throughout 2010⁶⁵.

In spite of a relatively stable price environment, price volatility in the commodities market remained high in 2009 and the first months of 2010. This has proven to be a major trend in the aftermath of the financial crisis and it is mainly attributed to two factors: the volatility of the dollar exchange rate through most of this period and the increasing "financialisation" of commodity markets. As commodity prices are typically denominated in dollars, its exchange rate has a bearing on their prices by intensifying pro-cyclical price movements. For example, dollar depreciation in the second half of 2009 was accompanied by a steady increase in prices⁶⁶. For this reason, real commodity prices fluctuation has been much more moderate than nominal prices.

The second trend is related to the increasing participation of financial investors in commodity futures exchanges, in order to diversify their portfolios and hedge against possible inflation risks. Recent statistical evidence indicates that financial investors accelerated and even amplified pro-cyclical price movements, especially in food commodities⁶⁷. This was particularly evident in cases where placements were purely speculative and tended to ignore the commodity market fundamental values. Consequently, their involvement may be considered partially responsible for both the boom in commodity prices before the financial crisis and their rapid decline afterwards, at least to the extent that it cannot be attributed to changes in demand and supply. With financial market movement remaining unpredictable and recovery slow, investor participation in commodity markets in 2010 is increasing again and with it price volatility as well. In addition to this, investor involvement in the commodities market complicates price hedging for traditional commercial users, with all the negative effects that this could have on future commodities supply⁶⁸.

⁵⁹ The International Bank for Reconstruction and Development. *Global Economic Prospects 2010*. Washington DC: World Bank, 21 Jan. 2010: 37.

⁶⁰ *Ibid*: 31–34.

⁶¹ *Ibid*: 37.

⁶² *Ibid*: 31–34.

⁶³ United Nations Conference on Trade and Development. *Trade and Development Report, 2009*. Geneva: UNCTD, 7 Sept. 2009: 10.

⁶⁴ The International Bank for Reconstruction and Development. *Global Economic Prospects...*: 34.

⁶⁵ United Nations Conference on Trade and Development. *Trade and Development Report ...*: 6–12.

⁶⁶ *Ibid*: 10.

⁶⁷ *Ibid*: 66–74.

⁶⁸ *Ibid*: 74.



In conclusion, market speculation in 2009 and 2010 has increased price volatility and pro-cyclical effects in commodity prices, bringing an element of cyclicity even in markets where it traditionally did not exist, such as the food market. This development, in combination with the fact that agricultural productivity in poor countries is still short of keeping pace with increasing population, might create further food emergencies in the short-term.

1.2.5 Knowledge

Space systems play a key role in promoting scientific research and development in three ways. First, they are the means for taking scientific discovery beyond the boundaries of our planet, expanding our knowledge of astronomy and physics through space exploration. Second, space assets themselves are very demanding engineering inventions, the development of which motivates scientific innovation across the board in multiple disciplinary fields. Third, by offering worldwide communication services space systems contribute to the global flow of information and the free exchange of scientific knowledge. Consequently, they help promote scientific cooperation and they distribute its benefits to all of mankind.

An important step in developing a European scientific and innovation policy occurred in December 2009, when the European Security Research and Innovation Forum delivered its final report. Its plenary council of 65 members from 32 countries was mandated by the European Union Commission and the 27 EU Member States in September 2007 to propose a future European Security Research and Innovation Agenda (ESRIA) for the next 20 years. During its two years deliberations, the panel was supported by more than 600 experts from various government and industry sectors, making it the only high-level initiative of its kind in Europe⁶⁹.

In conducting its research, ESRIF set up different working groups to investigate future technologies that could have an impact on European security, including one on Situational Awareness and the Role of Space in it. Its report identified key capability areas where space systems would be indispensable. These included Integrated Communication Networks, Information Management and Decision Support Systems, Command and Control etc. The report also listed a number of required space based systems that would be essential to the future EU security capabilities

⁶⁹ European Security Research and Innovation Forum. ESRIF Final Report. Brussels, Dec. 2009: 11.

and prioritised them according to European needs⁷⁰.

The panel's recommendations proposed better coordination in the use of existing space assets through collaborative and multiple uses of space services, information and data. It also stressed the importance of interoperability and the creation of common European operational picture and information distribution platforms. It asserted the crucial role of space based communications, Earth observation and satellite navigation, timing and positioning for European security. In this perspective the report praised the importance of the Global Monitoring for Environment and Security (GMES), Galileo and the European Geostationary Navigation Overlay System (EGNOS) programmes⁷¹.

In addition to these, the panel devoted particular attention to the creation of a European Space Situational Awareness (SSA) system. It identified the SSA programme as a major driving force for technology innovation in relative fields, such as automated satellite operation, formation flying architectures, multi-sensor fusion, protection of critical infrastructure and in-orbit networking, among others. Finally, ESRIF recognised that building the SSA infrastructure would require a cooperative approach from all stakeholders, including the European Space Agency (ESA), the EU Commission and the European Defence Agency (EDA)⁷².

In conclusion ESRIF adopted a holistic approach to security, calling for making security related innovation an EU priority, developing common European rules and procedures and exploiting knowledge synergies for security purposes whenever possible. Its key recommendation was that technological innovation and security planning should interact systematically, with the latter being an integral part of the former.

1.2.6 Mobility

Mobility is another activity area revolutionised by space technologies and their applications. Maritime commerce accounts for the bulk of global trade, whereas airplanes carry most of the world's passenger traffic. Space assets are indispensable to both, as they provide meteorological, navigation and communication services that make sea and air transport safer and cheaper.

The transport sector continued to suffer from the effects of the global financial crisis in

⁷⁰ Ibid: 155–166.

⁷¹ Ibid: 166–169.

⁷² Ibid.

2009 and 2010. As the crisis has proved, the global economy works in a completely interdependent and concerted fashion, to the point where a crisis in any place can affect the entire system. As the transport sector is the epitome of this global trade interconnectivity and interdependence, it was hit particularly hard by the current economic crisis. As supply and demand fell sharply, the transport of materials and goods followed suit⁷³. Furthermore, the financial crisis put a strain on the credit flow that is essential to international commerce transactions, with several banks refusing even to issue letters of credit. According to some sources, unmet demand for trade financing in developing economies is estimated between \$100 and \$300 billion⁷⁴.

Maritime transport that represents the bulk of global transport (90%) suffered the greatest blow. The financial crisis put an end to a constant growth in maritime trade since 1993, one of the longest in recorded maritime history. The timing of the crisis was particularly adverse, as ship owners had enjoyed the most profitable financial results of all time before the crisis, and had an unprecedented number of vessels under order, accompanied by an equal increase in shipyard capacity⁷⁵. During the last 12 months decreased maritime activity has led to a wave of cancellations of ship orders, an unprecedented level of distress demolitions (projected to reach 15–18% of world fleet capacity in 2010) and an almost six-fold contraction in shipping revenues. If these estimates materialise, all sectors of the maritime industry will suffer from considerable unemployment. A further medium-term consequence of the financial crisis for sea trade could be the appearance of protectionist measures that would further hinder world trade⁷⁶.

Another challenge for the maritime industry in the past 12 months has been the increased number of piracy incidents, especially off the Somalia coast. Although international military presence in the region has somewhat increased security, piracy incidents have persisted. This surge in piracy acts at the Gulf of Aden has generated considerable costs, especially for Europe as 80% of shipments that pass through the area are coming from or to

this continent. Re-routing shipments around the Cape of Good Hope alone is estimated to generate over \$7.5 billion of additional shipping costs annually. At the same time, insurance costs for ships passing through Suez currently stand at 40 times their normal price, because of the war risk coverage included⁷⁷. The problem has taken such proportions that on 2 December 2009 the International Maritime Organisation Assembly in London adopted a resolution calling for more international cooperation in the fight against piracy, quicker adoption of the Djibouti Code of Conduct by all states in the region, and an enhanced role for the United Nations⁷⁸.

Air transport was equally struck by the crisis' repercussions. According to ICAO, 2009 saw the worst performance of airline traffic in history. International passenger traffic declined by approximately 3.9% and domestic traffic by 1.8%. However, domestic flights traffic decreased primarily in advanced economies, with emerging economies maintaining a positive albeit modest growth rate, especially in SE Asia and the Middle East⁷⁹. In Europe and North America, low cost carriers performed somewhat better than more traditionally operating airlines. A modest increase of 3.3% in passenger traffic is expected for 2010 according to some observers, but full recovery will have to wait until 2011 at the earliest. Furthermore, cargo traffic also contracted by 15% in 2009, including in developing regions of the world. It is noteworthy that air traffic activity contraction in 2009 even exceeded that of the 9/11 aftermath⁸⁰.

This drop in airline traffic translated into approximately \$9 billion revenue losses in 2009. As with the shipping industry, bank financing became scarce and customer confidence waned. Most analysts agree that the picture will remain unchanged in 2010 as well, on a yearly basis. The biggest challenge ahead for airline companies is to manage excessive passenger capacity, which might lead to an increasing liberalisation of the market worldwide and possibly to major job cuts. Cutting costs throughout the chain of supply, increasing capital flow, abolishing ownership restrictions and encouraging international regula-

⁷³ United Nations Conference on Trade and Development. Review of Maritime Transport 2009. Geneva: UNCTD, 2009: 3. <http://www.unctad.org/en/docs/rmt2009_en.pdf>.

⁷⁴ Ibid: 5.

⁷⁵ International Maritime Organization, Maritime Knowledge Centre. International Shipping and World Trade Facts and Figures. London: IMO, Oct. 2009: 6–9. <[http://www.imo.org/includes/blastDataOnly.asp/data_id%3D26834/International Shipping and World Trade – facts and figures final 26 October 2009_.pdf](http://www.imo.org/includes/blastDataOnly.asp/data_id%3D26834/International%20Shipping%20and%20World%20Trade%20facts%20and%20figures%20final%2026%20October%202009_.pdf)>.

⁷⁶ United Nations Conference on Trade and Development. Review of Maritime Transport...: 6.

⁷⁷ Ibid: 8–11.

⁷⁸ International Maritime Organization Assembly, 26th Session. Piracy and Armed Robbery Against Ships in Waters Off the Coast of Somalia (Res. A.1026 [26]). London: IMO, 2 Dec. 2009.

<http://www.imo.org/includes/blastDataOnly.asp/data_id%3D27087/1026.pdf>.

⁷⁹ International Civil Aviation Organisation. Air Transport Records Worst-Ever Performance in 2009. Montreal: ICAO News Release, 18 Dec. 2009.

<<http://www.flightglobal.com/assets/getasset.aspx?ItemID=32168>>.

⁸⁰ Ibid.



tory convergence will probably be the keys of this liberalisation concept that is becoming known under the name of "Open Aviation"⁸¹.

1.3 The Financial Crisis and Its Consequences for the Space Sector

As demonstrated by the global economic and political outlook presented above, the time period under consideration has been marked by the consequences of the financial crisis that started in 2008. 2009 saw the spreading of these consequences from the financial sector to the entire economy. In 2010, we are witnessing the geopolitical repercussions of the economic downturn.

One resilient characteristic of the 12 months in question has been the quicker recovery of emerging economies, by comparison to developed ones. The main cause behind this fact seems to be the emerging economies' greater adaptability to the crisis conditions. In particular, when faced with rapidly decreasing demand for their manufactured products, developing economies were fast in directing a greater part of their output to regional and domestic demand. Developed economies apparently did not react as quickly. One possible explanation could be that in their case regional and domestic demand was already saturated before the crisis, because of their greater degree of economic/social development and regional economic integration (as in the case of Europe, for example). In other words, the current economic crisis may be interpreted as a slowdown of global economic integration in favour of a more regional one, especially in the case of regions where principal emerging countries cluster, such as SE Asia and the Middle East. Consequently, the different pace in which developed and developing countries exit the crisis may accelerate the already evident slow migration of the global economic centre from the western edge of the Eurasian Continent to the eastern one.

The above conclusion implies that the economic crisis will certainly have global geopolitical consequences of a currently unpredictable nature and magnitude. No country has been left untouched by the crisis and they have all entered it at approximately the same time. However, each one of them seems to

be exiting the crisis at a different pace. The relative pace at which countries will recover will also determine their power and influence on the international scene. Economies that have some kind of "edge" seem to respond better to the crisis conditions. The first in line for recovery seem to be countries with rich natural resources, especially in the Middle East. Russia could also potentially fall under this category. Second are countries with huge internal markets and a relatively cheap working force, like China, India, or Brazil. Third are countries with strong industrial output and accumulated profits from positive commercial balances. Finally, the last to recover would be countries that have relied heavily on the financial and services sector for their development.

In addition to this, the different pace in which recovery comes in different parts of the world will probably exacerbate global and regional antagonisms and increase the centrifugal forces in the international relations system. In regions where recovery is more or less homogenous, as in SE Asia, regional economic cooperation and commercial relations will develop further. In regions where the pace of recovery differs from country to country, as in Europe, the resulting economic disparity could impede further regional economic integration and it might even encourage protectionist measures. In general, the crisis has created a very fluid and unpredictable situation on the international scene, where the relative economic as well as geopolitical value of countries and even entire regions can change rapidly.

As far as space activities are concerned, the financial crisis seems to have two distinct effects. On the up side, the commercial space sector could profit from the various financial stimulus funding that governments distribute to the private sector to boost recovery. Some of these measures for example include communication infrastructure development, which could certainly involve satellite communication services operators. On the down side, the credit crunch has made banks more risk wary and investing in space systems still entails a great deal of development and operational risks.

The greatest difficulties, however, might be encountered in the public funding of space activities. After last year's generous recapitalisation aid to financial institutions failed to keep the crisis from spreading to the "real" economy, public opinion in developed countries may become increasingly sceptical of indiscriminate government spending.

In the face of rising unemployment, people could demand that more government funding

⁸¹ Giovanni Bisignani. "State of the Air Transport Industry". International Air Transport Association Annual General Meeting. Kuala Lumpur, 8 Jun. 2009. <<http://www.iata.org/pressroom/speeches/2009-06-08-01.htm>>.

is directed to creating jobs and mitigating the effects of the crisis to the “real” economy. In this context, space programmes that have high development costs, a slow technological maturity process and long-term benefits, could be considered as superfluous in the face of other, more urgent fiscal needs. In this sense, expenses that have no immediate effect on economic recovery could come under public scrutiny, and space budgets could fall under this category.

In order for the space sector stakeholders to successfully avert such a development, they would have to engage public opinion more than ever before. Explaining to people how space activities produce concrete financial and social benefits that are worthwhile should become a principal task for all actors involved. Furthermore, future space programmes should demonstrate their capacity to produce such positive results for society even from their conceptual phase of development.



2. Global Space Sector Size and Developments

In the following chapter, there will be a brief discussion of space related public budgets and commercial revenues. This should allow for a quantitative assessment of the overall market value and financial performance of space activities in the last 12 months. However, providing an accurate estimate of global space activities' financial and market figures is a complicated task. In the absence of internationally uniform standards, most countries and space research institutions have adopted slightly different ways of categorising and distributing funding for space activities. The relative lack of transparency in certain government space programmes, such as military space projects, further complicates calculations. Commercial companies on the other hand publish their financial figures regularly, but not in a uniform and synchronised way that would allow direct horizontal industry comparisons. Punctual industrial and market developments in the past 12 months are further discussed in chapter 5.

2.1 Global Space Budgets and Revenues

Although it was not clear if the trend of increasing institutional space spending would continue in times of financial crisis, it can be observed that the previous year's trend persisted during the last 12 months. The institutional spending on space activities is estimated to have reached \$68 billion. A more detailed view on institutional budgets can be found in the following paragraph 2.2.

In terms of commercial revenues of space activities, the Space Report 2010 indicates the total revenue of commercial satellite services to have been about \$91 billion comprising telecommunications, Earth observation and positioning services. The revenue of space-related commercial infrastructure including manufacturing of spacecrafts and in-space platforms, launch services as well as ground equipment is estimated to have reached around \$84 billion. In conclusion, the commercial space revenues of 2009 can be sum up to \$175 billion⁸². A closer look on the

commercial revenues is provided in paragraph 2.3.

2.2 Overview of Institutional Space Budgets

The total institutional spending on space in 2009 can be estimated to be approximately \$67.8 billion, a figure which shows a nominal increase of 9% compared to 2008⁸³. This space spending is comprised of \$36 billion in civil expenditures (or 53.1% of the total) and \$31.8 billion in defence expenditures (or 46.9%). Consequently, the share remained virtually the same compared to last year's figures. Out of the estimated \$31.8 billion of defence related space expenditures worldwide, \$28.7 billion were spent by the United States, representing a share of 90% and indicating a minor percentage decrease compared to the year before. These funds came from the Department of Defence (DoD), the National Reconnaissance Office (NRO), the National Geospatial-Intelligence Agency (NGA) and other government entities. It should be borne in mind that not all relevant funding is made public, resulting in a degree of uncertainty regarding the exact figures of expenditures on defence space activities.

Adding up civil and defence space expenditures, the United States had the biggest institutional space budget in 2009, spending \$48.8 billion (\$20 billion civil expenditures and \$28.7 billion defence expenditures). The total U.S. public space budget constituted 72% of the global institutional spending in 2009. The next largest space budget does not belong to a state but to the European Space Agency, which coordinates civilian space programmes on behalf of its Member States. ESA's budget in 2009 reached approximately \$4.8 billion. The next largest national space budgets are furnished by Japan (\$3.0 billion), Russia (\$2.8 billion), France (\$2.8 billion), China (\$2.2 billion), Germany (\$1.4 billion) and Italy (\$988 million), all a considerable distance from the United States. A noteworthy fact was the enormous increase in Russian space spending that nearly doubled, compared to the \$1.5

⁸² The Space Foundation. The Space Report 2010. The Space Foundation: Colorado Springs, 2010: 30.

⁸³ Figures in this section are based on Euroconsult data.

billion spent in 2008. Looking at the rest of the European countries, their accumulated total public spending on space activities in 2009 reached \$7.2 billion, representing a 10.6% share of global institutional spending in 2009.

Combined, the United States and Europe accounted for almost 83% of the global institutional spending on space in 2009 (Figure 2.1).

Consulting the absolute numbers alone only tells one side of the story, as comparisons between countries with different economic conditions like prices or wages levels can be misleading. It therefore makes sense to relate the amounts spent to the GDP or to population size. This gives a better indication

of the comparative value assigned to space spending in different countries. Figure 2.2 shows the space budget share of GDP for selected countries⁸⁴.

The United States devoted the biggest share of its GDP to public space expenditure with a value of 0.34%. Russia was second with a share of 0.23%, followed by France (0.10%) and India with a value of 0.07%. Noteworthy again is the increase in Russia's space budget. Whereas in 2008 Russia's space effort consumed 0.08% of their GDP, in 2009 Russia spent 0.23% of its GDP whose value remained nearly even. Most European countries featured values between 0.01% and 0.06% and did not change the share compared to 2008.

As another relative measure, figure 2.3 shows the institutional spending per capita for selected countries in 2009.

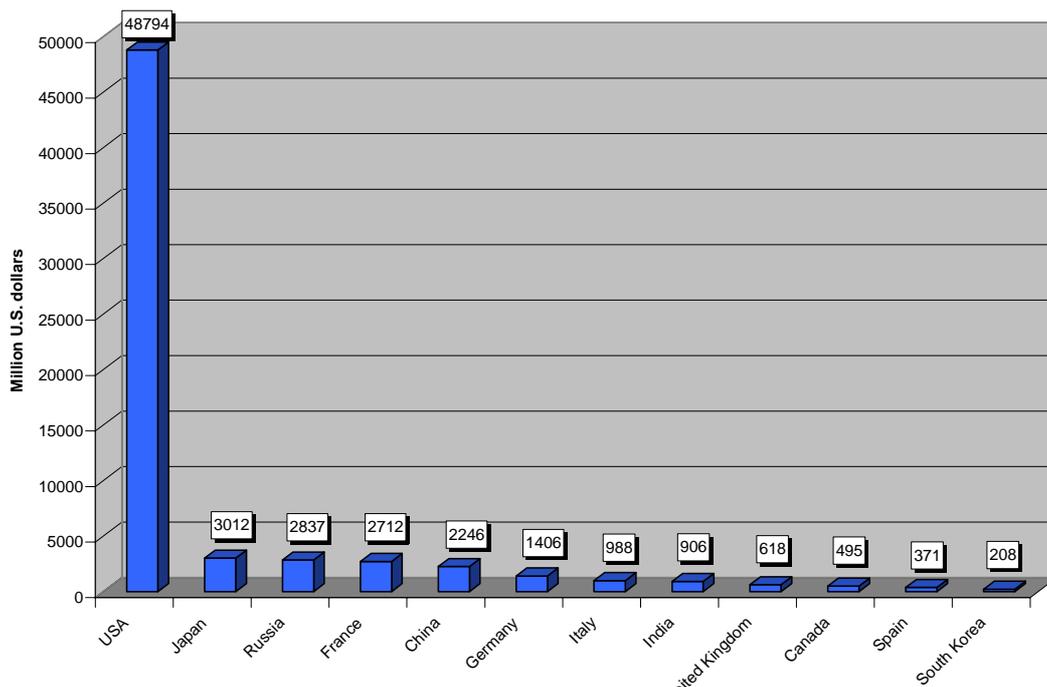


Figure 2.1: Public space budgets of major space powers in 2009 (Based on Euroconsult data)

⁸⁴ The data used is the nominal GDP converted to current U.S. dollars using the official exchange rates as indicated by the International Monetary Fund.

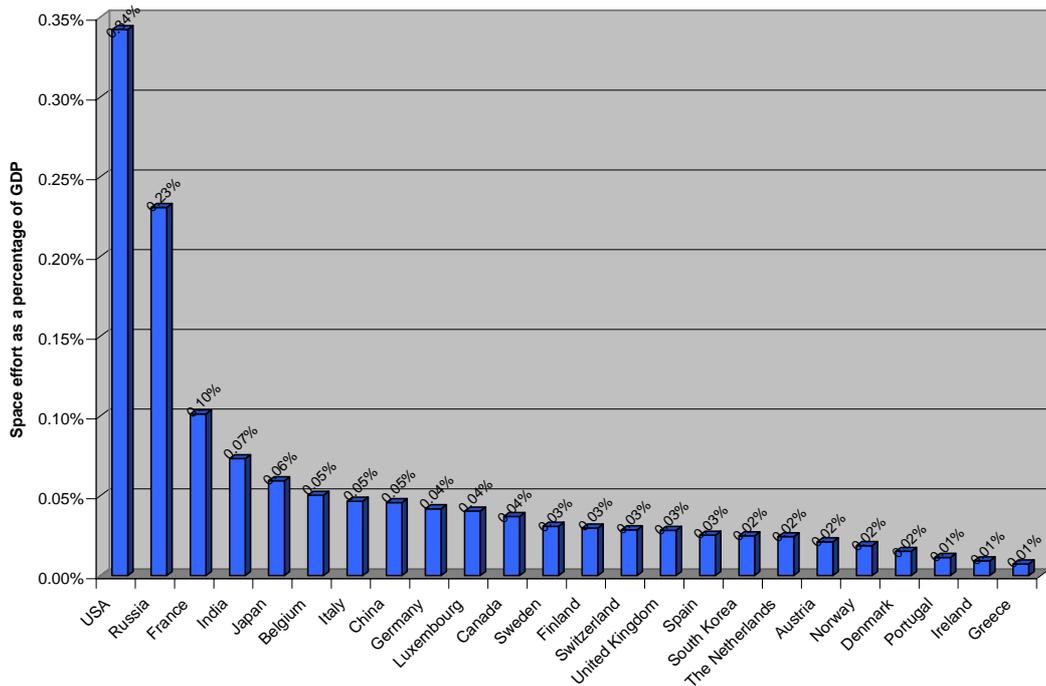


Figure 2.2: Public space budgets (selection) as a share of nom. GDP in 2009 (Source: Euroconsult data, IMF⁸⁵)

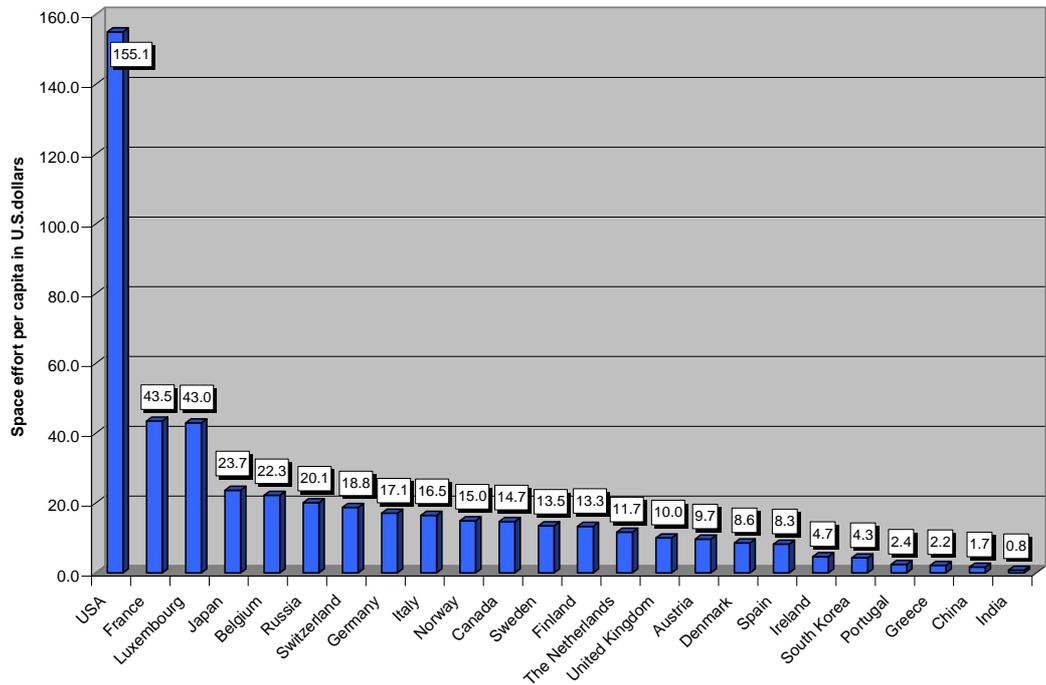


Figure 2.3: Public space budgets per capita (selection) in 2009 (Source: Euroconsult data, UN World Population Prospects⁸⁶)

⁸⁵ "Gross domestic product, current prices." April 2010. International Monetary Fund. 04 May 2010. <<http://j.mp/aL2sTZ>>.

⁸⁶ "World Population Prospects: The 2008 Revision." United Nations. Department of Economic and Social Affairs – Population Division. 04 May 2010. <http://www.un.org/esa/population/publications/wpp2008/wpp2008_text_tables.pdf>. 15.

Again, the United States spending more than \$155 per capita in 2009, led by far. France and Luxembourg completed the podium with each spending around \$43 per capita. Japan and a number of European countries spent in the vicinity of \$20 per capita. It is also possi-

ble to rate the GDP share of public space funds against the public space funds per capita. This is done in figures 2.4 and 2.5, with the latter excluding the United States and Russia to display the other countries more clearly.

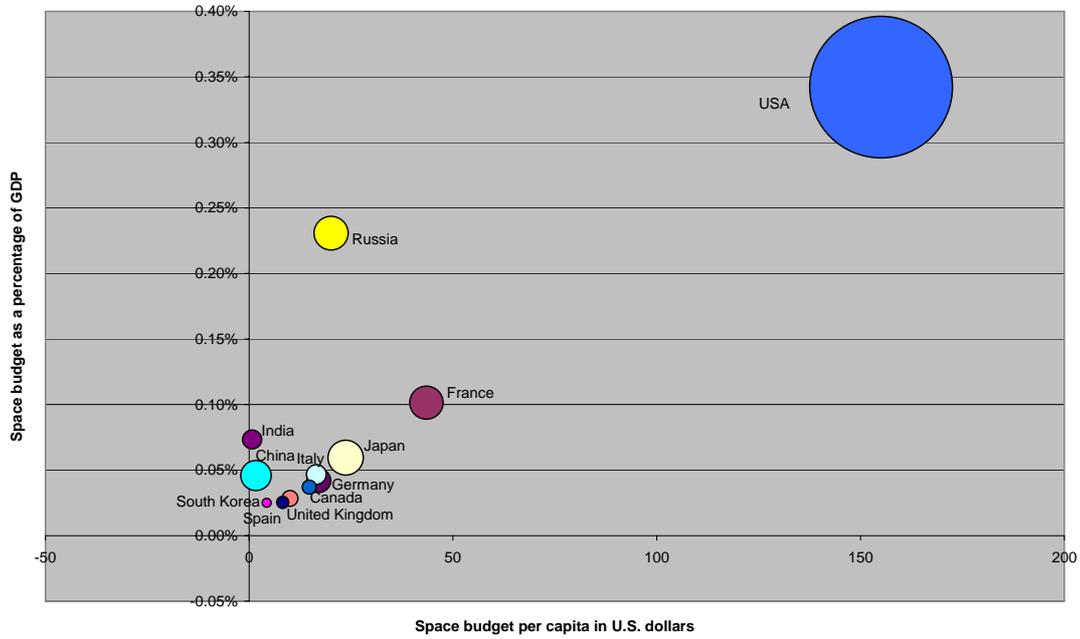


Figure 2.4: Public space budgets as share of GDP mapped against space budgets per capita in 2009 with the bubble size indicating the absolute space budget (Source: Euroconsult data, UN World Population Prospects⁸⁷)

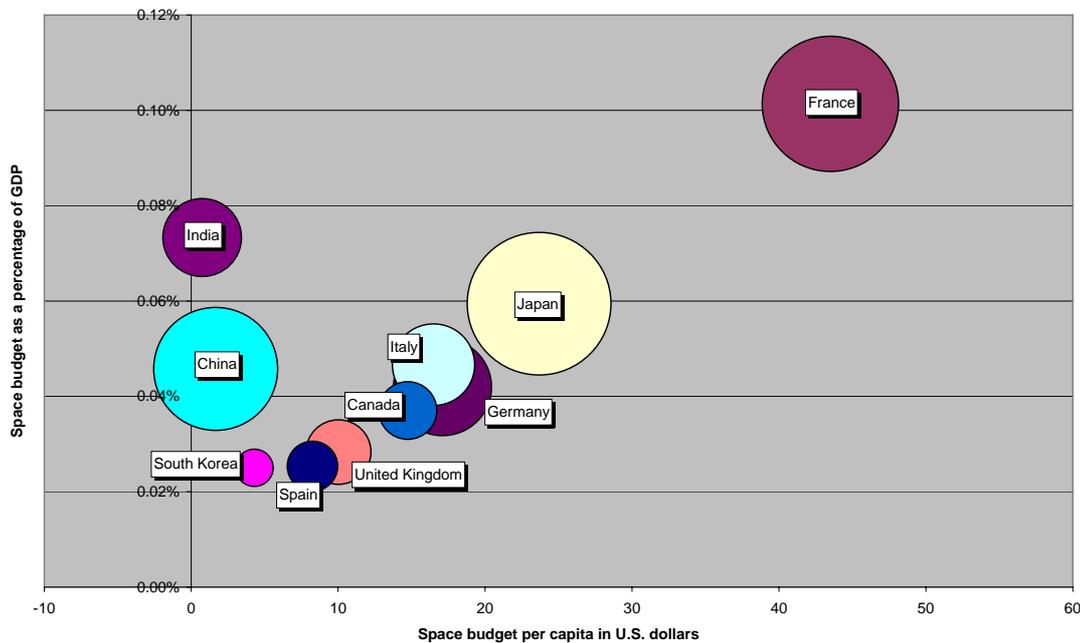


Figure 2.5: Public space budgets as a share of GDP mapped against space budgets per capita in 2009 with the bubble size indicating the absolute space budget, excluding the U.S. and Russia (Source: Euroconsult data, UN World Population Prospects⁸⁸)

⁸⁷ "World Population Prospects: The 2008 Revision." United Nations. Department of Economic and Social Affairs – Population Division. 04 May 2010. <http://www.un.org/esa/population/publications/wpp2008/wpp2008_text_tables.pdf>: 15.

⁸⁸ Ibid.

The United States is unique by evidently excelling in both dimensions, i.e. in the public space fund share of GDP and in space budget per capita. France and Russia follow. While France is also way ahead of the other countries in both dimensions, Russia has made big efforts and now has a very high and remarkable position in the share of GDP. Although Russia nearly doubled the space budget per capita, it still remains far behind the U.S. and has a noteworthy proportional discrepancy between per capita spending and GDP share, compared to most other countries that are approximately lined around the same proportion. India and China show average values in regard to space budget as a share of GDP, but lag behind in regard to space budget per capita. This is probably due to their large population. There is a cluster of countries like Japan, Italy, Germany, and the United Kingdom that display comparable values in both dimensions.

2.3 Overview of Commercial Space Markets

This section presents key elements and financial figures of the principal commercial space companies, divided into different categories according to their field of activity.

2.3.1 Satellite Services

Satellite services revenues, as depicted by the principal market actors' accounting statements, manifested robustness and resilience to the financial crisis' effects throughout the last 12 months.

On 5 November for example, Eutelsat, the world's third largest commercial satellite operator based on revenue, announced an 11.6% increase in revenue in the 3rd Quarter of 2009. This result was mostly attributed to a 46% increase in multi-usage revenues to €22.9 million, driven by increased sales in the Middle East and Central Asia regions. The announcement confirmed that major commercial satellite operators were largely untouched by the financial crisis⁸⁹.

On 16 November EADS Astrium also announced €3.23 billion revenue from the first three quarters of 2009, an increase of 17.4% over the previous year. Pre-tax profits however were down to 4.8% of revenue (€155 million) from 5.1% during the same period in 2008. According to the same announcement, Astrium Space Transportation accounted for

41% of total revenue, Astrium Services for 38% and Astrium Satellites for 21%. Astrium Services were severely curtailed by the drop in the British Pound, as the company's principal revenue source is its contract with the UK military to provide the Skynet 5 satellite communication services⁹⁰.

Earlier, in July, EADS Astrium had reported a 29% revenue increase (at €2.19 billion) and a 22% backlog increase (at €15.6 billion) in the first half of 2009. These results were attributed, among other factors, to the acquisition of Spot Image the previous year. Astrium's pre-tax profit margin however was down to 4.5% from 5.2% the previous year. This decrease was attributed by Astrium officials to restrictions due to government procurement rules relating to space systems⁹¹.

Direct Broadcast Services

Direct Broadcast Services (DBS) refer to direct-to-home satellite television and radio broadcasts. This business category manifested considerable improvement in the period under examination, fuelled mostly by growing demand in Europe and emerging markets, such as India. On the contrary, demand in the U.S. market showed signs of stagnation, probably because of its rapid expansion during recent years, in conjunction with the financial crisis' effects.

Eutelsat for example, the world's third-largest satellite fleet operator, announced a 7.2% revenue increase (at €940.5 million) in the 12 month period from June 2008. According to the company's statement, this increase could sustain 7% annual growth throughout 2012. According to the same sources, satellites operated by Eutelsat were filled to capacity (over 97%) and efforts were undertaken to reposition some of them in order to reduce the fill rate to 80%. Strong television demand in Europe and U.S. government bandwidth demand in the Middle East contributed mostly to these financial results⁹².

The second largest satellite fleet operator, SES, also reported record gross profit margins in July and announced that it was still on track with its target to attain a 5% annual growth rate throughout 2010. However, the company's recurring revenues in the first half of 2009 were up by only 2% from last year, to €843 million. These results were attributed to SES's lower than expected growth in North America, the opposite of its satisfactory per-

⁸⁹ De Selding, Peter B. "Eutelsat Fleet Expansion Fuels Double-Digit Sales Growth". Space News 9 Nov. 2009: 4.

⁹⁰ "Astrium Sales on the Rise But Profit Margins Decline". Space News 23 Nov. 2009: 9.

⁹¹ De Selding, Peter B. "Astrium Revenue Soars, Margins Dip". Space News 3 Aug. 2009: 17.

⁹² De Selding, Peter B. "Eutelsat's 7.2 Percent Revenue Growth Exceeds Forecast". Space News 3 Aug. 2009: 6.

formance in Western Europe. In total, 81% of the company's revenues were attributed to satellite lease operations⁹³.

On the other hand, satellite services and space hardware provider Thales Alenia Space reported a flat revenue growth rate and a drop in pre-tax profits for the same period. New orders however were up 30% from the previous year, at €904.6 million. Company officials attributed these mediocre results partially to the destruction by earthquake of one of its satellite component facilities in L'Aquila, Italy⁹⁴.

In another development, the Indian space agency ISRO announced in July an 18% increase in the number of direct-to-home (DFH) pay television subscribers over the first quarter of 2009. Although India has been long considered one of the greatest potential DTH markets, its protectionist regulatory environment and excessive import taxes have limited foreign access to that market. Antrix, ISRO's commercial arm, has only recently introduced non-Indian satellite systems to the market, on the condition that it acts as their reseller⁹⁵.

Fixed Satellite Services

Fixed Satellite Services (FSS) refer to the use of spacecrafts that utilise land terminals in fixed positions to broadcast. They include broadband internet, communications and network televisions and radio broadcasts. FSS business demonstrated considerable resistance to the crisis' consequences. Demand was fuelled by long-term agreements for communication services that were largely unaffected by the crisis, as well as a steady increase in satellite broadband internet demand. However, risk aversion created among service providers by the general financial conditions led some of them to reconsider their medium-term plans for broadband internet development, mainly because of the considerable up-front investments related to it.

In a 22 September report to the London Stock Exchange for example, satellite broadband service provider Avanti Communications of Britain announced a return to pre-tax profits during the 12 months ending in June 2009, after reported losses the year before. The company reported £8 million annual revenue (up from £5.9 million) and pre-tax

gains of £1.8 million, from £1.4 million losses last year. Avanti also reported it was receiving penalty payments from Astrium Satellites for the delay in the delivery of the Hylas broadband satellite. Hylas would be the first dedicated broadband satellite in Europe, scheduled to be followed by Eutelsat's Ka-Sat later in 2010. In the meantime, several European governments have announced financial incentives to stimulate commercial satellite broadband projects⁹⁶.

The same trend was evident in the U.S. as well, where in May 2009 the Federal Communications Commission issued a report on the future expansion of broadband services in rural areas in that country. The report made an appeal to President Obama to increase the project's budget beyond the \$7.2 billion already allocated to it under the American Recovery and Reinvestment Act of 2009. The report also underlined the importance of satellite communications in reaching the project's objectives in the near future, reminding that their use would be indispensable in order to achieve full coverage of rural areas. Finally, the Commission urged greater coordination among U.S. federal agencies involved, as well as for a review of all existing broadband programmes⁹⁷.

In general, the global financial crisis has tightened credit supply throughout the satellite industry. As a result, national export-credit agencies were stepping in more and more often to help finance commercial space projects, usually by guaranteeing their bank loans. In September, for example, France's export-credit agency Coface approved a loan guaranty to Gazprom Space Systems of Moscow for acquiring two Yamal-400 communication satellites. The spacecrafts would be built by Thales Alenia Space and launched onboard an Ariane 5 rocket. Coface's U.S. counterpart, the Export-Import Bank, is also engaged in similar schemes. Although both agencies are set up as private companies (Coface is owned by Natixis) they often finance projects based not only on financial reasons, but also on the need to support critical industrial space infrastructure in their respective countries⁹⁸.

In a related development, SES and Eutelsat announced on 31 July that they were rethinking their involvement in providing S-band satellite services in Europe. The two companies had formed the joint venture So-

⁹³ De Selding, Peter B. "SES Sticking with Growth Projections Despite Soft Spots". Space News 3 Aug. 2009: 6.

⁹⁴ "Thales Orders Rose, Revenue Remained Flat". Space News 3 Aug. 2009: 9.

⁹⁵ "India Reports Big Rise in Satellite TV Subscribers". Space News 20 July 2009: 9.

⁹⁶ De Selding, Peter B. "Avanti Finances Improve In spite of Tardy Satellite". Space News 28 Sept. 2009: 12.

⁹⁷ Werner, Debra. "FCC: Stimulus Not Enough for Broadband Plan". Space News 1 June 2009: 14.

⁹⁸ De Selding, Peter B. "National Export-Credit Agencies Stepping up Satellite Financing". Space News 14 Sept. 2009: 10.



laris Mobile and won one of the two European Union Commission licences to operate S-band satellite services in Europe. After a failure in deploying an S-band antenna onboard Eutelsat's W2A satellite in April however, the two companies would have to launch a new satellite in order to abide by their licence obligations. Representatives from both companies expressed their concern over making such an investment and announced that they would wait to receive their insurance claim before they made their decision⁹⁹. One possible solution to this financial impasse, they said, would be a possible merger of the two licensed S-band providers in Europe, Solaris Mobile and Inmarsat of London. Such a solution however had been explicitly ruled out by the European Union Commission at the time of the licensing process¹⁰⁰.

In October, the market research firm Tauri Group issued its annual report on the state of the personal spaceflight industry in the U.S., commissioned by the Commercial Spaceflight Federation. The report found that although the sector grew by a modest 6% (to \$261 million) in 2008, total investment rose by more than 20% (to \$1.46 billion). Of that, individuals provided more than 50%, private equity funds 30% and government only 15%. However, government clients still accounted for over a third (or \$126 million) of the industry's revenues. The report's findings confirmed the growing investor interest in commercial spaceflight, as well as the increasing involvement of bigger companies that enter the industry as vendors or services providers¹⁰¹.

At the same time, NGA is moving forward to increase the amount of imagery provided by commercial optical reconnaissance satellites. In April 2009, Director of National Intelligence Dennis Blair announced that NGA would be purchasing images from at least two satellites equipped with 1.1 metre apertures. DigitalGlobe and GeoEye are among the principal candidates for acquiring these contracts¹⁰². In September 2009, NGA also announced that it would launch a new contracting vehicle for acquiring image data, called EnhancedView. This project will be similar to the current NextView programme, with the difference that NGA will be requesting 0.25 metre resolution products, instead of 0.5 metre that was the usual standard until

now. This would require operators to fly their satellites in lower altitudes, at the expense of their operating life span. It would also complicate operations for private companies as U.S. legislation prohibits the sale of better than 0.5 metre resolution images outside U.S. government agencies¹⁰³.

In spite of this development however, U.S. satellite broadband providers expressed scepticism over how much funding they would get from the broadband stimulus package. In a 30 September submission to the Commission, the U.S. Satellite Industry Association (SIA) urged officials not to focus on local labour-intensive terrestrial installations. In all, satellite operators have applied for \$2.2 billion in loans and grants under the programme, out of a total \$28 billion funding requests. Among them, Echostar has applied for \$483 million under a joint venture with ViaSat Inc. intended to launch a dedicated broadband satellite by 2012, as well as for \$530 million for a similar venture with WildBlue Communications of Denver. Other contenders include Skyterra, Spacenet Inc. and AtContact Communications LLC¹⁰⁴.

Faced with financing difficulties and unsure government backing, companies involved in broadband satellite services have shown a tendency to consolidate their market positions. Apart from the joint ventures mentioned above, ViaSat Inc. announced in September the purchase of satellite broadband services provider WildBlue. The transaction cost \$443 million in cash and \$125 million in stocks. With this purchase, the future market for broadband services in the U.S. will most likely be contested by two companies, ViaSat and Hughes Network Systems. Both companies have scheduled launches of dedicated broadband service satellites, ViaSat of ViaSat-1 in 2011 and Hughes Network Systems of Jupiter in 2012. Both Satellites are developed by Space Systems/Loral and they should field an over 100 GB Ka-band capacity¹⁰⁵.

In August, the U.S. government announced its intention to simplify contracting arrangements for purchasing commercial communications satellite capacity. The plan involves consolidating the government and defence purchasing contracts into one common

⁹⁹ De Selding, Peter B. "SES, Eutelsat May be Rethinking Mobile S-Band Services Venture". Space News 10 Aug. 2009: 1.

¹⁰⁰ De Selding, Peter B. "Solaris Stymied by Antenna". Space News 14 Sept. 2009: 10.

¹⁰¹ Klamper, Amy. "Report: Commercial Spaceflight Investment on the Rise". Space News 12 Oct. 2009: 14.

¹⁰² Brinton, Turner. "Low-Cost Imaging Satellites Encouraged in Defence Bill". Space News 13 July 2009: 7.

¹⁰³ Brinton, Turner. "NGA to Seek Higher-Resolution Commercial Satellite Imagery". Space News 28 Sept. 2009: 4.

¹⁰⁴ De Selding, Peter B. "U.S. Satellite Firms Vie for Broadband Stimulus Funds". Space News 5 Oct. 2009: 5.

¹⁰⁵ De Selding, Peter B. "With WildBlue Acquisition, ViaSat Doubles Bet on Satellite Broadband". Space News 5 Oct. 2009: 1.

De Selding, Peter B. "Design of Rival's Satellite Has ViaSat Asking Questions". Space News 5 Oct. 2009: 4.

scheme by 2011. By doing so, U.S. government will be able to buy bandwidth directly from commercial satellite operators, something that is not currently possible. The new contracting vehicle is known as "Future Comsatcom Services Acquisition" (FCSA) and it will greatly simplify contracting procedures. In 2008, the U.S. government spent \$397 million on satellite transmission contracts, of which \$350 million were for defence purposes¹⁰⁶.

Remote Sensing

Remote sensing refers to commercial companies that provide optical and radar images to the open market, mostly to government entities that have been increasingly outsourcing such capabilities over the past few years. Although image procurement is usually conducted through short-term agreements that acquire data at spot market prices, their demand was not considerably affected by the crisis, mostly because of growing corporate and public demand for these products. This trend has also led to an increasing simplification of related public procurement policies and a consequent ease of existing export controls applied to satellite image data.

The U.S. government announced on 7 October, for example, that it would relax its commercial radar satellite data restrictions. This should allow commercial operators to offer high quality images of up to one metre ground resolution to the open market, instead of the existing three metre limit. Northrop Grumman Aerospace Systems of Los Angeles would be the first company permitted by the U.S. Department of Commerce to operate a Synthetic Aperture Radar (SAR) image satellite under the new regulations. Company officials claimed that the proposed satellite, called Trinidad, would be based on components from the Israeli TecSAR satellite, tested by the USAF earlier in the year. According to the same sources however, the satellite's development would require firm government purchasing commitments to start. With this development, European SAR image commercial providers will be facing U.S. competitors within the next two years¹⁰⁷.

Mobile Satellite Services

Mobile satellite services (MSS) relate to applications delivered to mobile terrestrial termi-

nals such as ships, aeroplanes, automobiles, cell phones etc.

According to a market forecast published by Euroconsult of Paris in October, mobile satellite services revenue growth is expected to average 8% over the next decade, reaching some \$2.5 billion by 2018. Satellite broadband services should account for the bulk of this increase, as they were projected to rise by 25% annually over the same period. Smaller growth rates were expected in machine-to-machine applications (+16%), maritime mobile satellite services (+7%) and aeronautical services (+13%)¹⁰⁸, among others.

In July, mobile satellite services provider Globalstar Inc. completed a life-saving financial rescue package, which included a \$586 million credit from a consortium of French banks guaranteed to 95% by Coface, the French export-credit agency. This package would allow Globalstar hardware providers Arianespace and Thales Alenia Space to resume deliveries of the 24 second-generation Globalstar satellites due for launch onboard Soyuz rockets in 2010¹⁰⁹. After this development, Globalstar announced to investors on 8 July that it expected to return to a 30% annual revenue growth rate by the end of 2010, when its new 32 satellite constellation (including eight existing ones) would become operational, putting an end to the service degradation of the past three years caused by satellite problems¹¹⁰.

The market for mobile satellite telephone calls is expected to experience intensification in the next months. Thuraya, United Arab Emirates-based satellite telephone provider, is offering cheap handhelds, the new Thuraya XT model, and also Inmarsat is to step into the handheld market with the aim to gain a 10% share¹¹¹.

¹⁰⁶ Brinton, Turner. "U.S. To Consolidate, Modify Bandwidth Buying Programs". Space News 10 Aug. 2009: 4.

¹⁰⁷ Brinton, Turner. "U.S. Loosens Restrictions on Commercial Radar Satellites". Space News 12 Oct. 2009: 4.

¹⁰⁸ "Rosy Revenue Forecast for Mobile Satellite Services". Space News 12 Oct. 2008: 8.

¹⁰⁹ De Selding, Peter B. "\$738M Financing Package Gives Globalstar a New Lease on Life". Space News 6 July 2009: 1.

¹¹⁰ De Selding, Peter B. "105,000 Globalstar Telephone Subscribers Await Return of Full Service." Space News 10 May 2010: 5.

De Selding, Peter B. "Globalstar Predicts Return to Growth Once New Satellites Launch". Space News 13 July 2009: 10.

¹¹¹ "Thuraya Escalates Fight for Satellite Phone Customers." Space News 3 May 2010: 9.

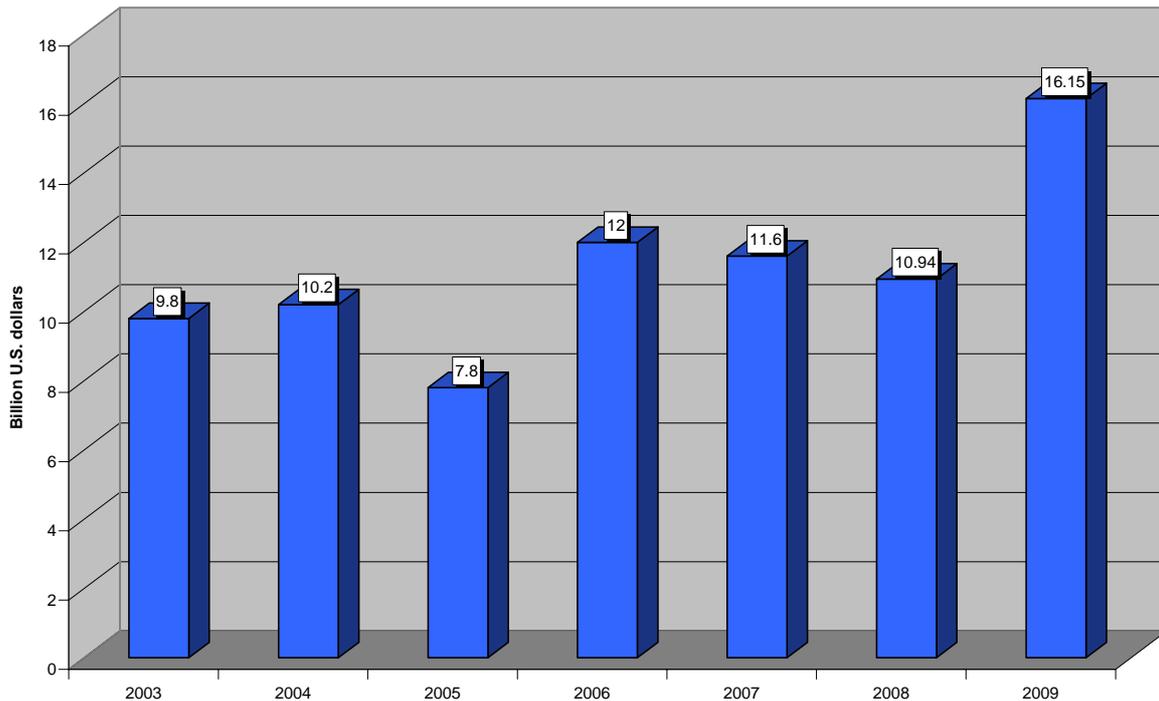


Figure 2.6: World satellite manufacturing revenues (Source: SIA/Futron¹¹², The Space Foundation¹¹³)

2.3.2 Satellite Manufacturing

The satellite manufacturing revenues in 2009 experienced a significant increase compared to 2008. The total revenues of satellite manufacturers that built satellites both for governmental and commercial launches are estimated to have reached \$16.15 billion in 2009 which indicates a rise by 48% from the \$10.94 billion gained in 2008. It can be observed in Figure 2.6 that this augmentation marks an abrupt end to the trend of slightly decreasing revenues from 2006 on. The increase of \$5.21 billion is primarily due to the construction of high-value defence satellites, whereas the share of the manufacturing revenue of the commercial satellites slightly decreased from \$5.2 billion in 2008 to \$5.14 in 2009¹¹⁴.

2.3.3 Launch Sector

It is difficult to assess the exact annual revenues for launch services or the allocation between partners or countries. This is due on

the one hand to the often complex package of financing mechanisms and industrial structures in some countries, and on the other hand to the reduced visibility of revenues from national institutional launches. These often draw on military budgets and, in addition, commercial launch service prices are usually not disclosed. The Federal Aviation Administration (FAA) estimates commercial launch revenues for 2009 at \$2.49 billion. This represents an increase of \$520 million from 2008 commercial launch revenues. Europe again had the lion's share, with more than \$1 billion, representing 42% of the total annual revenues, followed by Russia (\$742 million and 31% of the total revenues), the United States (\$298 million and 12% of the revenues) and Sea Launch and Land Launch (\$280 million and 12% of the revenues – Figure 2.7). As a whole, commercial launch revenues grew steadily between 2004 and 2009, witnessing an increase of almost 150% from roughly \$1 billion in 2004 to almost \$2.5 billion in 2009¹¹⁵.

¹¹² "State of the Satellite Industry Report". June 2009. Satellite Industry Association and Futron Corporation. 20 May 2010. <http://www.sia.org/news_events/2009_State_of_Satellite_Industry_Report.pdf>

¹¹³ The Space Foundation. "The Space Report 2010." The Space Foundation: Colorado Springs, 2010: 31.

¹¹⁴ Ibid.

¹¹⁵ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

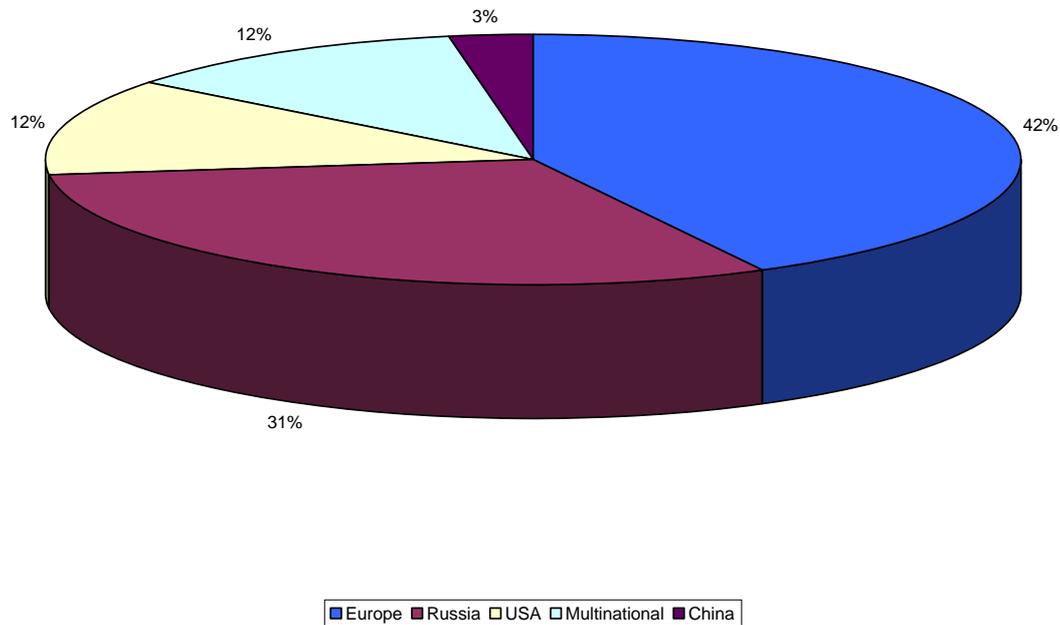


Figure 2.7: Estimated commercial launch revenues in 2009 by country/entity (Source: FAA¹¹⁶)

2.3.4 Ground Equipment

Ground equipment revenues include infrastructure elements, such as mobile terminals, gateways and control stations, and consumer equipment, such as very small aperture terminals (VSAT), ultra small aperture terminals (USAT), DTH broadcast dishes, satellite phones and digital audio radio satellite (DARS) equipment.

Portable Navigation Devices (PND) form one of the sub-segments of end-user electronics incorporating GPS chip sets. Although the PND market grew by more than 30% in 2008, it decreased in the last quarter of 2008. Indeed, growth was affected by the crisis as the PND business is very dependent on the automotive sector. TomTom and Garmin are the two leaders in the PND market. Although both companies experienced reduced revenues in 2009, their expectations for 2010 are optimistic and they assume growing markets. Furthermore, TomTom notes the upcoming threat to their business by free turn by turn navigation on smartphones, as for instance offered by Navigon in cooperation with telecommunication providers.

TomTom reported \$1.48 billion revenue in 2009, which represented a 12% decrease compared to 2008 and indicates a trend of

diminution since 2007¹¹⁷. Garmin had total revenues of \$2.95 billion in 2009, a 10% increase compared to 2008 (\$3.49 billion). It sold 16.6 million units in 2008, which indicates a small decrease. Also, three of its four activities areas (i.e. automotive/mobile, aviation and marine segments) experienced a retracement; only the consumer-related area of outdoor and fitness increased. Accordingly, their revenues considered by region also dropped by 16–18%, however, their small asset in Asia increased by 3%. Garmin itself names the economic crisis and the “depressed global economy” as reasons for its performance and expresses optimism concerning improvements in the global economy and therewith revenues in 2010¹¹⁸.

2.3.5 Insurance Sector

As the space industry continues to demonstrate increased hardware reliability, low accident rates and booming growth in recent years, insurance costs have been decreasing. In fact, the repeatedly good performance of insured commercial space assets has attracted new insurance capacity into the market, pushing premiums to historically low levels. This trend has continued uninterrupted in the past 12 months. For example, insurance companies that cover space

¹¹⁶ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010.

¹¹⁷ “TomTom Annual Report and Accounts 2009.” 11 May 2010. <http://ar2009.tomtom.com/pdf/TomTom_AR09.pdf>

¹¹⁸ “Garmin Annual Report 2009.” 11 May 2010. <http://www8.garmin.com/aboutGarmin/invRelations/reports/2009_Annual_report.pdf>.



launches have demonstrated an increased appetite for risk by raising the maximum underwriting value for a single space launch. In March 2010 in fact, the launch of two communications satellites onboard an Ariane 5 rocket broke all records, with an accumulated liability coverage value of \$700 million. Given that commercial space launches are expected to grow in the following years and the technologies involved have proven their worth in practise, one can expect this trend to continue. Nevertheless, this unusually long period of higher insurance limits and lower rates is beginning to raise concerns among insurers on the long-term viability of their business. Indeed certain commercial space underwriters, such as Paris Re, have announced that insurance rates were approach

ing a level where they may no longer support the assumed risk. In that case, some insurance brokers may consider their withdrawal from the market all together. The global space insurance market currently has a total coverage value of approximately \$17 billion, distributed across 175 insured satellites¹¹⁹.

Also interesting is the development of space insurance activities in the coming years in and with Islamic organisations and countries. In 2009, the satellite fleet operator Yahsat of Abu Dhabi agreed with underwriters to sign the first Shariah compliant satellite insurance package. This could be a first step for further insurance agreements and also more space activities of the Islamic World due to higher security¹²⁰

¹¹⁹ "Recent High Profits Attracting New Underwriters". Space News 8 Mar. 2010: 15.
"Ariane 5 Lofts Amazonas-2, COMSATBw-1 Satellites". Space News 5 Oct. 2009: 3.
De Selding, Peter B. "2009 Shaping up as Profitable Year for Insurers." Space News 07 Sep. 2009: 10.
¹²⁰ De Selding, Peter B. "Yahsat Buys Shariah-compliant Satellite Insurance." Space News 12 Apr. 2010: 29.

3. Space Policies and Strategies around the World

The following sections present an overview and analysis of the space policies of all major space-faring countries. Attention is particularly given to high-level policy developments and general trends that reveal the different actor's strategic rationale. Military space and defence related policies are considered in more detail in chapter 6. Specific industrial and political issues of a more "operational" nature concerning institutional actors are further addressed in chapter 7.

An interesting trend in 2009 and 2010 has been the steady rise in the number of space agencies worldwide. In spite of the global economic crisis' impact, an increasing number of governments have seen fit to create a central administration body for their space activities. This trend has begun in the late 1990's and it has continued uninterrupted ever since. From 2000 to 2009 the number of space agencies worldwide has risen from 40 to 55, according to a study conducted by Paris-based Euroconsult. Space related global spending has also continued its upward trend, reaching \$36 billion for civil (up 9%) and \$32 billion (up 12 %) for military programmes. In 2009 U.S. space related expenditures amounted to \$48.8 billion (or 72% of total), Europe's ESA members to \$7.9 billion, Japan's to \$3 billion, Russia's to \$2.8 billion, China's to \$2 billion and India's to \$900 million¹²¹.

3.1 European Union

The European Union maintained and augmented its engagement in space activities in the second half of 2009 and the first half of 2010, under the Swedish and Spanish EU Council Presidencies respectively. Key developments in this period included the entry into force of the Lisbon Treaty: the considerable progress made in the Galileo and GMES programmes, the increased cooperation between the European Commission (EC), the European Space Agency (ESA) and the European Defence Agency (EDA), in promoting European non-dependence in critical space technologies and infrastructures, the meeting of the 6th "European Space Council" in May 2009, and

¹²¹ "Number of Nations with Space Agencies is Rising". Space News 1 Mar. 2010: 9.

the announcement of the third space-related call for proposals within the 7th Framework Programme for research and development in Europe.

As in many other areas of European Union activities, the key development in 2009 and 2010 was the entry into force of the Lisbon Treaty on 1 December 2009. The new Treaty on the functioning of the European Union is the first document of its kind to set out an explicit EU competence in space activities. Under Article 189 of this Treaty, EU institutions are invited to draw up and implement a long-term European space policy, including the possible creation of a European space programme, in close cooperation with ESA¹²². One of the key features of this article was the fact that it referred not only to the exploration, but also to the exploitation of space by the EU. This addition is thought to allow for the inclusion of a security dimension to EU space activities. It is also thought to push toward a closer cooperation between the EU, ESA and their respective Member States, as well as to create the necessary impetus for further developing the competitiveness of the European space industry on a global scale¹²³.

In another development, on 29 May 2009 the "Space Council" (the EU Competitiveness Council and the ESA Council meeting concomitantly) met for the sixth time in Brussels, in order to assess the progress made on implementing a common European space policy and to identify further objectives. The Space Council noted that the "structured dialogue" among all European institutional space actors was advancing well. It particularly took notice of the cooperation between the European Union Commission, the EDA and ESA on identifying critical space technologies in which Europe should become non-dependent on outside sources. The Council also noted the inclusion of the Multinational Space-based Imaging System (MUSIS) in the EDA programme list, as well as the adoption of the ESA Preparatory Programme for the

¹²² Official Journal of the European Union. Treaty of Lisbon. DOC C115/128 of 9 May 2008. Brussels: European Union. <http://ec.europa.eu/enterprise/policies/space/files/policy/lisbon_treaty_space_en.pdf>.

¹²³ Spanish Presidency of the European Union. Conference on Governance of European Space Programmes: Questionnaire and Background, 3-4 May 2010, Segovia, Spain.



development of the European Space Situational Awareness system (SSA)¹²⁴.

Another area of particular interest to the Council was the potential contribution of space related technological innovation and competitiveness to the overall European Economic Recovery Plan (EERP) for 2010 and 2011. The Council recognised the importance of space activities to economic recovery and recommended their full funding from the €5 billion economic stimulus package of the EERP. The Council paid particular attention to the participation of satellite communications providers in the broadband connectivity promotion programmes of EERP, valued at €1.02 billion¹²⁵. In the same context, it called for the full development of services based on the EGNOS, Galileo and GMES programmes. Especially as far as the latter was concerned, the Council identified the long-term funding of its space segment by the EU Commission as a key objective. In this regard, it also encouraged closer cooperation between the European Union Commission, ESA and EUMETSAT¹²⁶.

In a related development, the European Commission announced in October 2009 that it was considering maritime surveillance as its next major investment in space-based applications after Galileo and GMES. The Commission was already financing pilot projects in this direction, including the space-based Automatic Identification System (AIS) that uses signals emitted by commercial vessels to determine their identity, destination, speed and cargo. However, in order for such systems to become useful for maritime surveillance in the field, they would have to improve their operational response times. All ships over 300 tons displacement are required to have such transponders by international maritime regulations. ESA has also developed two experimental AIS receivers that were launched to the ISS in September 2009¹²⁷.

¹²⁴ Council of the European Union. Outcome of Proceedings from the Competitiveness Council of 29 May 2009: Draft "Space Council" Orientations/Council Resolution. SEC (2009) 10500 of 29 May 2009. Brussels: European Union.

<http://ec.europa.eu/enterprise/policies/space/files/policy/6th_space_council_en.pdf>.

¹²⁵ "Panel: Satellites Should be Part of European Stimulus". Space News 1 June 2009: 3.

¹²⁶ Council of the European Union. Outcome of Proceedings from the Competitiveness Council of 29 May 2009: Draft "Space Council" Orientations/Council Resolution. SEC (2009) 10500 of 29 May 2009. Brussels: European Union.

<http://ec.europa.eu/enterprise/policies/space/files/policy/6th_space_council_en.pdf>.

¹²⁷ "European Commission Eyes Ocean Surveillance". Space News 26 Oct. 2009: 10.

In relation to the GMES programme, the European Commission also had a number of decisions to make during the period in question, including defining a data-access policy and securing future funding. GMES would consist of three dedicated Sentinel surveillance satellites and two payloads on other satellites, for which the Commission has secured a €2.3 billion budget while most of the hardware will be paid for by ESA's 18 Member States. In addition to this, the programme will utilise national satellites built by Member States. However, funding of the future generation Sentinels after 2013 still remained unclear. Although Commission officials were previously leaning towards a user-defined/user-paid approach, press reports indicated that longer operating cost recoupment methods were also considered¹²⁸.

The question of the future funding of the GMES space segment preoccupied the European Commission and Member States throughout the year, as the European Union Commission budget line for the programme would expire in 2013 and further funding would be needed to develop the next generation of its Sentinel satellites. For the time being, six Sentinel satellites and two dedicated payloads onboard EUMETSAT satellites are planned. However, with an expected satellite operational life-span of seven years, the next generation of Sentinels will have to enter into development soon, in order to sustain operations after 2020¹²⁹.

As far as future funding is concerned, all possible options were investigated by the European Commission. The conclusion was that only an adequate long-term budget for GMES operations after 2013 would guarantee a profitable return for the investment already made on the programme. In other words, backing away from the project now would defeat its declared objective of a sustainable Earth observation capability for Europe. Furthermore, without additional future funding the programme would not reach its full research and development potential and it would not produce any significant technological returns for the European space industry¹³⁰. An independent ESA long-term analysis of the programme also reached the same conclusion. According to this, a €600 million annual

¹²⁸ De Selding, Peter B. "Uncertainty Besets GMES Data Policy and Satellite Contributions". Space News 26 Oct. 2009: 10.

¹²⁹ Commission of the European Communities. Global Monitoring for Environment and Security (GMES): Challenges and next steps for the Space Component. COM (2009) 589 final of 28 Oct. 2009. Brussels: European Union.

¹³⁰ Commission of the European Communities. Summary of the (GMES) Impact Assessment. SEC (2009) 1441 of 28 Oct. 2009. Brussels: European Union.

budget between 2014 and 2020 would be required, including €470 million for operational activities and €170 million for future research and development, (R&D)¹³¹.

Several other issues concerning GMES also remained open, including ownership of the system, data policy, procurement policy and governance arrangements. The most probable scenario contemplated would be for the transfer of the Sentinels' ownership from ESA to the European Union Commission (EC). Such an arrangement would make the EC the operator of the system's space segment, thus assuring a free and open access policy to its data. It would also normalise the project's governance, with the EC acting as the programme manager deciding on system upgrades, ESA working as the development and procurement agent on behalf of the EC, and EUMETSAT operating oceanographic and meteorological components onboard its satellites¹³². Finally, another milestone for the programme's governance was accomplished on 5 February 2010, with the European Commission's decision to set up the GMES Partners Board. The 27 member board (one from each EU member country) would function as a panel of experts, monitoring the GMES project's implementation and providing strategic guidance for its future development¹³³.

The increasing importance of space activities for the EU was made even more evident on 15 October 2009, when the European Commission President José Manuel Barroso made for the first time a speech dedicated entirely to the European Space Policy. During his presentation in a conference on this subject in Brussels, he reiterated the usefulness of space systems for EU policies and the need to achieve autonomy in relevant space technologies. An independent EU capacity in the field of Earth and near space observation should be a top priority, he said. Furthermore, he maintained that EU space activities should not be confined to producing direct financial results, but should seek to implement broader European policies as well. Finally, he called for further developing space

programmes, including an independent European human spaceflight capability¹³⁴.

Another European programme that saw considerable progress in 2009 and 2010 was the Galileo satellite navigation and positioning system. As early as June 2009, discussions among the European Space Agency (ESA), the European Union Commission and industrial partners were approaching their conclusion over the best way to contract the deployment of the system's satellites. The contract for the building of the 28 spacecraft required was due for signature later in the year and the two companies bidding for it were Astrium Satellites and OHB System. European authorities were disputing whether they should order all satellites from one manufacturer or split the contract between them. Another undecided issue was whether the entire constellation should either be ordered from the beginning, or split into two procurement stages to allow for last minute modifications. Finally, the question of which launcher to use remained open, with ESA preferring an exclusively Soyuz launching campaign and Astrium Space Transportation pushing for the use of Ariane 5 as well. Although a decision has not been reached yet, ESA and European commission seemed favourable to dividing the contract into two phases and splitting each phase between the two bidders¹³⁵.

A decision on deploying the system's first fully operational constellation was repeatedly delayed, most recently in October, when ESA's Director General Jean-Jacques Dordain announced that last-minute satellite manufacturing difficulties were reported by its principal contractors, Astrium Satellites and Thales Alenia Space. The new timetable given foresaw a first launch in November 2010 and a second early in 2011, always onboard Soyuz rockets launched from the European Spaceport in French Guiana¹³⁶.

In late December however, it was made known that the European Union Commission had finally decided to select OHB Technology of Germany to build at least the first 8 Galileo satellites for approximately €350 million. The EU Commission chose the OHB-led consortium that included Britain's Surrey Satellite Technology Ltd. over its competitor EADS

¹³¹ Commission of the European Communities. Global Monitoring for Environment and Security (GMES): Challenges and next steps for the Space Component. COM (2009) 589 final of 28 Oct. 2009. Brussels: European Union.

¹³² Ibid.

¹³³ Commission of the European Union. Decision of 5 February 2010 Setting Up the GMES Partners Board (2010/67/EU). Official Journal of the European Union doc. L35/23 of 6 Feb. 2010. Brussels: European Union.

¹³⁴ José Manuel Durão Baroso. "The Ambitions of Europe in Space". SPEECH/09/476. Conference on European Space Policy. Brussels, Belgium. 15 Oct. 2009.

"EC President Eyes Space Surveillance Network". Space News 19 Oct. 2009: 3.

¹³⁵ De Selding, Peter B. "With Galileo Contracts at Stake, Disagreement Over Way Forward". Space News 22 June 2009: 4.

¹³⁶ "Last Minute Issues To Delay initial Galileo Deployment". Space News 12 Oct. 2009: 3.



Astrium Satellites consortium that also included Thales Alenia Space, although it was widely considered lacking the industrial depth to build the entire 22 spacecraft constellation. However, the EU Commission's decision to maintain competition in the programme weighed heavily on its decision. The situation was further complicated by its refusal to simultaneously award the remaining 14 satellites contract to the Astrium consortium, due to what was described as the company's non-compliance with the competition's bidding guidelines. Both Astrium and Thales Alenia Space had made considerable industrial investments at the early stages of the Galileo programme, when they were given sole charge of the project¹³⁷.

The official announcement of the European Commission's decision came on 7 January 2010, when a team led by OHB Technology of Germany was selected to build the first batch of 14 Galileo navigation satellites. The consortium would also include small satellite specialist Surrey Satellite Technology Ltd. (SSTL). This decision was a setback for competitor EADS Astrium Satellites that was expected to get the order. The contract was valued at €566 million and launches were scheduled to begin in October 2012 and continue in three month intervals. Eighteen more satellites would be ordered in the near future, through a new open competition. In choosing OHB, the European Commission manifested its intention to double source the programme in order to minimise financial and technological risks.

In the same spirit, the Commission opted for a two launcher scheme to lift the satellites: out of the 14 initial spacecrafts ten would be launched onboard 5 Soyuz rockets, whereas the last four would be carried to orbit on a single Ariane 5 ECA launch. Launching costs however were thought to be considerably higher than expected and their budget override could exceed €1 billion. A third €85 million contract for system support and validation was awarded to Thales Alenia Space. Further contracts on ground control and mission segments were anticipated in mid-2010¹³⁸. Eventually, the first three contracts for the Galileo full operational capability system were signed in the premises of ESA's European Space Research and Technology

Centre (ESTEC) in the Netherlands, on 27 January 2010¹³⁹.

In a related development, the European Commission also announced on 7 January 2010 that the Galileo satellite navigation system's launching campaign was facing a 59% budget override, mostly due to the Soyuz rocket's unexpectedly high cost. In July 2008 the European Commission had announced that launching the 28 satellite constellation would cost €700 million, or approximately €25 million per spacecraft. The new figure announced in January for lifting only the first ten satellites to orbit mounted to €397 million, or €39.7 million per satellite (with each rocket carrying two spacecraft). This substantial budget increase was attributed by the European Space Agency's (ESA) Director General J.J. Dordain in a 14 January interview to higher Russian launchers' prices, as well as to initially underestimating the costs of adapting the Soyuz rocket for the Galileo mission¹⁴⁰.

Another key plank in the European space policy during the past 12 months has been the increased cooperation among different European institutions in the field of space security. The European Defence Agency's (EDA) increased participation in relevant space projects was particularly important. The inclusion of MUSIS in EDA development programmes already mentioned above was significant in this trend. Another positive development has been EDA's participation, together with the European Union Commission and ESA, in a joint task force to investigate European strategic non-dependence in space activities. EDA's contribution was particularly welcome in identifying key security related space technologies that should be developed in the near future within Europe in order to achieve this non-dependence¹⁴¹.

Furthermore, EDA increased its efforts to pool security related space services demand among EU Member States, in an effort to reduce their cost. In this regard, it signed an agreement with satellite communications provider Astrium Services to set up a European common contracting vehicle for commercial bandwidth procurement for military

¹³⁷ De Selding, Peter B. "First Eight Galileo Spacecraft Said to Go to Germany's OHB Technology". Space News 7 Dec. 2009: 1.

¹³⁸ De Selding, Peter B. "European Commission Picks Underdog To Build 14 Galileo Navigation Satellites". Space News 11 Jan. 2010: 1.

¹³⁹ "Major Galileo Contracts Signed". 27 Jan. 2010. European Space Agency Galileo Navigation Website. 30 Mar. 2010
<http://www.esa.int/esaNA/SEMPX0SJR4G_galileo_0.html>

¹⁴⁰ De Selding, Peter B. "Galileo Program Feels Sharp Rise in Russian Rocket Prices". Space News 18 Jan. 2010: 4.

¹⁴¹ EC-ESA-EDA Joint Task Force. European Non-Dependence on Critical Space technologies: List of Urgent Actions for 2009. 6 Mar. 2009.
<http://ec.europa.eu/enterprise/policies/space/files/research/jtf_critical_technologies_list_en.pdf>

use. Astrium Services came under a €130,000 contract from EDA in November 2009 to pool European commercial satcom requests under a common contracting scheme known as the European Satcom Procurement Cell. This scheme would allow Astrium to sign longer term bandwidth lease contracts with commercial operators on behalf of participating European governments through London Satellite Exchange, its subsidiary that acts as an intermediary between commercial satcom suppliers and buyers. In this way EDA hoped to secure a 30 to 50% discount from currently used spot prices that European countries are usually paying. Until that time, five countries had confirmed their participation in this scheme, namely France, Italy, the Netherlands, Poland and the UK. The European Satcom Procurement Cell drew its operating principle from its French counterpart Astel-S, a commercial bandwidth pooling procurement contract set up between Astrium and the French Armed Forces in 2005¹⁴².

Finally, in July 2009 the Commission of the European Union issued its 3rd call for proposals on space related R&D projects within the framework of the 2007–2013 FP7 research funding programme (for a total budget of €114 million). Proposed funding was divided into three categories of activities, namely space-based applications (€47 million), space technologies R&D (€58 million) and cross-cutting activities (€9 million). Space applications mostly referred to developing GMES products, with a special focus on providing multipurpose Earth observation services and down streaming them to European users, especially on a regional level. Space related R&D was approached through the scope of interoperability and harmonisation of products, as well as ensuring their long term sustainability. This budget line also included funding for developing critical technologies to support Europe's independent access to space. Finally, under the theme of cross-cutting issues the European Union Commission aspired to enhance space cooperation with third parties and especially Russia and African countries¹⁴³.

¹⁴² De Selding, Peter B. "European Defence Agency Promoting Long-term Satellite Leases". *Space News* 11 Jan. 2010: 16.

¹⁴³ "The FP7 Space 3rd Call". Commission of the European Union. 30 Apr. 2010. <http://ec.europa.eu/enterprise/policies/space/files/research/fp7_space_3rd_call_en.pdf>.

3.2 European Space Agency

After reviewing the EU space activities programmes in 2009–2010, the crucial role of the European Space Agency in all of them becomes obvious. In fact, from a space policy standpoint, the most significant development has been the de facto transformation of the agency into the implementing arm of the EU space policy. This fact becomes apparent given ESA's increased involvement in shaping and building most of the necessary infrastructure for EU space projects. This gradual process however has not yet acquired a more institutionalised or de jure form. It therefore still remains a more or less empirical and result-driven cooperation process between the EU and ESA, guided by the space policy aspirations of one and the unique capacity to materialise them of the other. This cooperation therefore remains a step-by-step process that still operates under conditions of constantly evolving tasks and the need to produce tangible results for Europe's space activities.

On a policy level, the period in question witnessed the implementation of most of the key orientations given by ESA's Ministerial Council in November 2008. These focused on expanding ESA activities into financing space applications programmes while at the same time increasing space exploration activities. ESA's increased space applications-related workload can be depicted in its participation in several EU programmes described above. Increased funding for the abovementioned projects also accounts for an 18.6% in the agency's budget in 2009, compared to 2008. Total payment appropriations have been increasing at an annual rate of 10% over the last four years, reaching €3.35 billion in 2009. This increase brought the agency's budget to the desirable levels approved by the Ministerial Council.

On the other hand, in 2009 the continuing global economic crisis began to weigh on the ESA Member States' space budgets and contributions to the agency. Acknowledging the new financial realities, ESA Director General J.J. Dordain announced on 14 January 2010 that the agency's budget spending would remain at these levels for the next two years, 2010 and 2011. This decision was not expected to seriously affect ESA's project schedule, as the agency's budget had already attained an adequate level in 2009. Nevertheless, it was a form of recognition of the difficult new financial realities, and a message that ESA would not overstretch itself financially without previous approval by its Ministerial Council, set to convene again in 2011. In order to avoid any programme cancela-



tions due to this freeze, Mr. Dordain explained that from now on ESA would be stretching the payment periods of any new contracts¹⁴⁴.

In general, however, current ESA operations have been relatively little touched by the economic crisis and they have continued as expected. The agency's operations suffered only indirectly from the crisis in November, when it announced it would be freezing payments for contracts valued over €10 million for a month (until 2010) due to a cash-flow shortage. This temporary stop was attributed to a €400 million cash reserves deficit, created by the accelerated pace of contract payments to its industrial partners that was part of a deliberate attempt to counter the effects of the global financial crisis on the space industrial sector. It is unclear however, whether the financial stresses of some of its 18 Member States also contributed to the problem. Instead of delaying €400 million worth of contract payments, ESA officials preferred the possibility of taking out a bank loan in order to cover the gap¹⁴⁵.

Nevertheless, on 18 December 2009 ESA reinstated payments after only a three weeks self-imposed spending moratorium. Financial auditing revealed that the deficit's figure was exaggerated and that it would not exceed €200 million, which ESA officials described as "manageable". The first programmes to be funded (for over €500 million) were the construction of the first three Sentinel Earth observation satellites for the European Commission and preliminary work on a new upper stage for the Ariane 5 rocket that would enable it to lift a 12 tons payload to the GEO transfer orbit¹⁴⁶.

On the other hand, in spite of the financial crisis Galileo's budget overrun of €376 million was approved by the Commission of the European Union in June 2009, after three months of audits. The auditors found that additional charges were reasonable, given the contract modifications ordered by the customer. Their report concurred with a similar investigation performed by ESA earlier that year. After this development, additional payments were approved for Galileo's in-orbit Validation phase, which includes building four satellites as well as most of the required ground control infrastructure by 2010. However these budget and schedule overrides

increased fears that the system might exceed its projected €3.4 billion budget and might not be fully operational by 2013 as planned¹⁴⁷.

Among the ESA's key policy related activities, one can distinguish the joint EU-ESA International Conference on Human Space Exploration, held in Prague on 23 October 2009. During this conference, it was decided that a space exploration road map for Europe should be drawn by the end of 2010. The meeting reaffirmed Europe's determination to remain a principal space-faring player in the face of rising Chinese and Indian space ambitions. But it also concluded that any meaningful future space exploration effort should be of a truly international nature in order to succeed. However, participants did not debate specific space exploration proposals. Of course, a key element of any meaningful new European space strategy should be a considerably increased budget for space activities. The European Union Commission currently has less than a €1 billion annual budget for space projects, which it hopes could triple for the seven-year budget period starting in 2014¹⁴⁸.

Another field where increased EU-ESA cooperation appeared was in the development of the European Space Situational Awareness system (SSA). This programme is simultaneously funded by ESA (through its GST and SSA core element activities) and the European Union Commission (through its dedicated "Space" work programme of the FP7). Both institutions have initiated research and concept demonstration projects related to SSA. Therefore, achieving complementarity between the two programmes and avoiding duplication of development efforts has become a matter of the utmost importance. Consequently, coordination and interaction between the three programmes (SSA preparatory programme, GSTP and FP7) is crucial to minimising development risks and maximising benefit returns¹⁴⁹.

As far as space missions are concerned, on 2 November 2009 ESA launched its Soil Moisture and Ocean Salinity (SMOS) Earth observation satellite and the Proba-2 technology demonstration spacecraft, aboard a Russian Rockot vehicle operated from the Plesetsk

¹⁴⁴ De Selding, Peter B. "ESA Freezes Spending At '09 Level for 2 Years". Space News 18 Jan. 2010: 13.

¹⁴⁵ De Selding, Peter B. "400 Million-Euro Shortfall Prompts Moratorium on Some ESA Contracts". Space News 30 Nov. 2009: 1.

¹⁴⁶ De Selding, Peter B. "ESA Spending Freeze Ends with Deals for Sentinel Satellites, Ariane 5 Upgrade". Space News 4 Jan. 2010: 6.

¹⁴⁷ "Galileo Cost Overrun Passes European Commission Audit". Space News 29 June 2009: 15.

¹⁴⁸ De Selding, Peter B. "EU Reps Express Support for big Investment in Exploration". Space News 26 Oct. 2009: 1.

¹⁴⁹ "Space Situational Awareness: Consolidated Activity Plan for SSA, GSTP and FP7". Commission of the European Union. 30 Apr. 2010.
<http://ec.europa.eu/enterprise/policies/space/files/research/esa_pb_ssa_consolidated_activity_plan_for_fp7_en.pdf>

Cosmodrome. The 658 kg SMOS was put into a near-polar sun-synchronous orbit at an altitude of 760 km. It is equipped with a Spanish Microwave Imaging Radiometer using Aperture Synthesis (MIRAS) instrument, the first major satellite instrument built for ESA in that country. The device is using L-wave microwave frequencies to derive information about soil moisture and ocean salinity levels based on their reflection. Proba-2 is an ESA spacecraft that is set to test future satellite systems and instruments currently under development. Total costs of the programme reached €333 million¹⁵⁰.

Furthermore, on 1 October the European GPS Navigation Overlay Service Egnos was declared ready for use for its freely accessible service. Higher reliability versions, as well as an Egnos Commercial Service were expected to become operational in 2010. The system uses two Inmarsat and ESA's Artemis satellites to augment GPS performance. The programme's budget was €350 million. A French-based consortium of seven European air-navigation agencies, called ESSP, is under contract to the European Union Commission to manage Egnos until 2013¹⁵¹.

3.3 EUMETSAT

On 1 July 2009, the European Meteorological Satellite Organisation, EUMETSAT, decided in favour of a \$90 million contribution to the Jason-3 ocean-altimetry satellite, a joint U.S.-France project. Securing funding was strenuous, as a number of Member States regarded Jason-3 as a bilateral U.S.-France programme. Additional support for the project has been secured from the European Union's GMES programme and ESA, which have both announced they would be purchasing Jason-3 data¹⁵².

On 9 December, the European Space Agency (ESA) bid-evaluation board failed for the second time to select a winner for the €1.4 billion contract to build six Meteosat Third Generation (MTG) satellites on behalf of Europe's meteorological satellite agency EUMETSAT. ESA will cover 75% of the project's budget and EUMETSAT the remaining 25%. The principal competitors for the contract were EADS Astrium and Thales Alenia Space. According to industry sources, the delay could be attributed to political pressure surrounding the

contract as Germany which, together with France, is the programme's main financial contributor, was determined to acquire MTG prime contractor status for its industry¹⁵³.

On 3 February 2010, an ESA evaluation board chose the consortium of Thales Alenia Space and OHB Technology to build the next generation of Europe's meteorological satellites for EUMETSAT. The contract for the six spacecraft (four imaging and two equipped with sounding devices) known as Meteosat Third Generation (MTG) was expected to reach a value of €1.4 billion. The satellites were to include significant improvements compared to their predecessors, including a three-axis stabilization system instead of a simpler spin-stabilised design. Negotiations between the consortium and the European Space Agency (ESA), which had assumed the role of the contracting authority on behalf of EUMETSAT, were expected to start immediately after the announcement of the decision. The full life-cycle cost of the programme was expected to exceed €3.3 billion over a period of 20 years, 75% of which would be covered by EUMETSAT. As the competition for the MTG satellites would likely be the biggest single satellite construction contract to be signed in Europe in 2010, the selection process proved to be a highly contested one. The ESA evaluation board had to convene three times before reaching a decision and the agency's Director General J.J. Dordain publicly admitted to unusually high political pressure surrounding the programme. The other contestant for the project was Astrium Satellites¹⁵⁴.

In November 2009, the European Space Agency (ESA) launched the 130 kg Proba-2, the second in a series of small satellite demonstrators expected to validate future technologies in this field. Proba-1, the first of the series, was launched in October 2001 and is still operational. Its successor, build with a considerable contribution from Belgian government and space industry companies, fields a number of experimental payloads that would be used in future ESA small satellite platforms. These include next generation lithium-ion batteries, a newly designed star tracker and an innovative solar-flux concentrator solar panel. The Proba project is expected to continue with two more missions: Proba-V should be launched in 2012 fielding an Earth observation instrument for environmental monitoring; Proba-3, on the other hand, will consist of two satellites, set to

¹⁵⁰ De Selding, Peter B. "European SMOS and Proba-2 Successfully Launched by Rocket". Space News 9 Nov. 2009: 6.

¹⁵¹ "European GPS Overlay Ready for Operations". Space News 5 Oct. 2009: 3.

¹⁵² De Selding, Peter B. "EUMETSAT Approves Jason-3". Space news 6 July 2009: 4.

¹⁵³ De Selding, Peter, B. "ESA Again Fails to Select a Prime Contractor for Meteosat". Space News 14 Dec. 2009: 6.

¹⁵⁴ "Thales Alenia, OHB Team Win \$1.9 B Meteosat Deal". Space News 8 Feb. 2010:3.



demonstrate formation-flying techniques. This experiment will be the first of its kind for ESA and it will be conducted in close cooperation with the Swedish space agency. Sweden is expected to launch its own two Prisma small satellite formation later this year. This development would be very important for ESA, as small satellite formation flying is one of the promising new technologies that have the potential to revolutionise space application missions¹⁵⁵.

On 21 January 2010, ESA's Envisat Earth observation satellite was nearly struck by space debris, notably a used Chinese upper stage rocket body. ESA was given early warning from the U.S. Space Surveillance Network and it was able to change the spacecraft's altitude in time to avoid collision. If the two objects had collided, the accident would have produced a vast amount of additional space debris, likely doubling their total number. This incident demonstrated once more the clear need for a European Space Surveillance System, as well as the constant danger to space activities posed by orbiting debris¹⁵⁶.

3.4 National Governments

3.4.1 France

In 2009 and 2010, France maintained its ambition to remain the leading European nation in space activities. This effort was reinforced by the successful reorganisation of its national space agency, CNES. Under a renewed six year contract with the French government through 2015, CNES is expected to consolidate France's position in the European space sector. As is the case elsewhere in Europe, the agency's strategic planning focuses on developing downstream services for users, improving the country's space industry competitiveness and leading multinational European programmes, but without duplicating ESA ones. The key strategic objective for France is to maintain its individual status as a principal space faring nation, while at the same time increasing its participation in international cooperative space projects.

More precisely, the French civilian space programme has three major tiers: space applications (with a particular focus on Earth observation), access to space, and space related research and development. In the field of

space applications, French policy is evolving along two axes, with the development of high performance optical imagery satellites (such as Pleiades) on the one hand, and the outsourcing of lower resolution ones to commercial users through the management of the SPOT constellation by AstroTerra (now an Astrium-Spot Image joint venture) on the other. This policy is aimed at maintaining French technological capabilities in this field while reducing operating costs at the same time. In the same spirit of resource economies, dual use space systems and civil-private synergies are consciously and constantly being pursued. It should be recalled that CNES operates under a double mandate under the Ministry of Defence as well as the Ministry of Research.

Two examples of this dual approach can be seen in the following examples. In June, the French Military Intelligence Directorate announced it was leaning towards outsourcing future production of high-resolution satellite images, under a €750 million project to build world-wide digital terrain models by 2020¹⁵⁷. Simultaneously, Astrium Satellites announced that it had secured a €66 million contract with the French military to start development on the next batch of two military observation satellites, set to be launched in 2014–2015. These were poised to replace the current Helios system. The new satellites are expected to be a higher resolution capability version of the civil-military Pleiades constellation. French officials assured, however, that in spite of this development France was still committed to the multi-national MUSIS program to build a common European satellite imaging system¹⁵⁸.

At the same time, on 18 December 2009, Helios 2B, the French new generation optical imaging satellite, was launched onboard an Ariane 5 GS rocket from French Guiana. The 4.2 tons spacecraft was an identical copy of the Helios 2A launched in December 2004, except that it fielded a more accurate optical instrument, believed to provide up to 35cm ground resolution. It was placed in the same 700 km altitude near-polar Low Earth Orbit as Helios 2A, at a 180 degrees distance from it. EADS Astrium Satellites built the spacecraft, while its principal optical imager was built by Thales Alenia Space. The two-satellite Helios system has an estimated cost of €2 billion. Apart from France, four other European countries participate in the programme with a 2.5% stake, namely Italy, Spain, Belgium and Greece. Germany also

¹⁵⁵ De Selding, Peter B. "ESA Embraces In-Orbit Demos with 2 More Proba Flights Planned". Space News 8 Feb. 2010: 11.

¹⁵⁶ "Chinese Rocket Stage Nearly Hits Envisat". Space News 15 Feb. 2010: 3.

¹⁵⁷ "French Intel Agency Eyes Outsourcing Data Production". Space News 15 June 2009: 13.

¹⁵⁸ "France Begins Work on New Surveillance Sats". Space News 22 June 2009: 15.

has access to its data through a bilateral agreement to exchange Helios data with radar imaging data from its own SAR Lupe spacecraft. The Helios satellites are controlled by the French space agency CNES through its Toulouse facility, but their daily tasking is conducted by dedicated centres in the participating countries, each using its own encrypted data links. The system's expected life span is five years¹⁵⁹.

Free access to space is also considered a critical national capability for strategic reasons. France maintains and covers a third of the French Guiana launch facility's operating costs. It is also heavily involved through CNES in the development of future more capable versions of the Ariane 5 rocket, in coordination with ESA (within the frame of the ARTA programme). Unrestricted access to space has been recognised as a priority in the country's national security strategy documents as well. Finally, space launchers have been an area of increased bilateral cooperation with Russia, especially in regard to the development of the country's next generation rocket.

The close cooperation with former soviet republics seems to be expanding, driven by broader government policies as well. During a state visit of the French President Nicolas Sarkozy to Kazakhstan in October, EADS Astrium closed a deal with the country's government to build and launch two observation satellites. The deal, which also included the construction of a satellite integration and test centre, the training of Kazakh satellite engineers and the integration of the satellites with the Spot Image services network, was valued at €230 million. Astrium will also oversee and cooperate with the Kazakh space program, which according to the country's officials should have a \$253 million annual budget¹⁶⁰.

Finally, close cooperation with neighbouring Germany on a bilateral level remained a key plank of French space policy. On 4 February 2010, for example, the French President Nicolas Sarkozy and the German Chancellor Angela Merkel held their regular joint inter-ministerial meeting in Paris. On that occasion, a number of important agreements between the two countries relating to space activities were announced. First, it was agreed that France and Germany would jointly build a methane concentration monitoring satellite, capable of measuring the results of greenhouse effects to global climate change. The

180 kg spacecraft called the CH4 Atmospheric Remote Monitoring Explorer (CHARME) would be based upon the CNES Myriade small satellite platform and it was expected to be launched on a Vega rocket in 2013 or 2014. France and Germany would equally share its €120 million cost¹⁶¹. Second, the two leaders concurred on the timely development of MUSIS, the Multinational Space-based Imaging System that will secure interoperability among European countries' Earth observation satellites ground segments. Third, they agreed that their two countries' space agencies would jointly study the development of a new generation of the Ariane launcher. This programme has been financed by the French government's economic stimulus package. The final decision for the building of the vehicle, known as Ariane 6, would be made by the ESA Ministerial Council in 2011¹⁶².

3.4.2 Germany

In 2009 and 2010, Germany continued its effort to position itself as the European space technology leader. In order to achieve this, the country has developed a two-fold strategy. On the one hand, it takes the lead in key European space technology development projects, both in the frame of the EU and ESA. On the other hand, it constantly increases the visibility and public impact of its technological capabilities, either through its participation in the International Space Station (ISS) or in initiating its own national space exploration programme.

The bulk of Germany's funding for civil space activities is still dedicated to ESA programmes (over 75% of its 2009 space budget). However, the country has been also increasingly allocating funds to exclusively national high visibility space exploration projects, such as a lunar orbiter mission planned for 2015 (LEO project). Although the budget of these projects is still marginal compared to Germany's participation in ESA programmes, they are however considered strategically important in Germany. The drive behind this trend is clearly to demonstrate the nation's technological capabilities through exclusively national projects, which in return would increase the German space industry's reputation and client base, creating profit returns for the entire sector.

The same approach has been adopted in regard to German participation in the ISS. Although European participation in the station is represented by ESA, the German govern-

¹⁵⁹ De Selding, Peter B. "French Helios 2B Spy Sat Sends Back First Test Images". *Space News* 4 Jan. 2010: 16.

¹⁶⁰ "Astrium Inks Two-Satellite Deal with Kazakhstan". *Space News* 12 Oct. 2009: 9.

¹⁶¹ "France and Germany to Split CHARME Cost". *Space News* 15 Feb. 2010: 3.

¹⁶² "France, Germany To Build Methane-monitoring Craft". *Space News* 8 Feb. 2010: 3.



ment was keen on underlining its industry's key role in building ESA's Columbus ISS laboratory compartment. The ISS has indeed a crucial role in the overall German medium-term space strategy: it will facilitate the scientific research and development of the country's future space technologies, it will function as a demonstrator of the German space industry's capabilities, and it will increase the visibility and reputation of the country's national programmes.

Germany has made a strategic investment in the ISS. Although France is currently the European country with the biggest contribution to ISS activities, Germany has subscribed for more future scientific projects onboard the station and has become its largest operating costs contributor. It is therefore the country that has the greatest stake in keeping it in use for as long as possible. An example of this particular interest in ISS operations appeared on 27 January 2010, when the German space agency's (DLR) chairman openly disagreed with ESA's intention to limit the ISS operating budget in order to cut expenses. As ESA was contemplating reducing the number of ISS astronauts, or of its control centres (U.S., Russia, Europe, and Japan each have one), the official DLR position was against any change in future ISS operations¹⁶³.

Another field of particular interest to German space policy is space applications. In the past 12 months, the country has increased its involvement both in communications (Satcom) and Earth observation (EO) satellites. As with space science and exploration, the German strategy consists of developing independent national space technologies and then incorporating them into a larger European system. This method enables German industry to expand its technical know-how and to increase its market share, while respecting the country's engagement in common European policies. This strategic development concept is consistent with German industrial planning and political aspirations at a European level. However, the balance between these two strategic objectives is not easy to maintain, and it could result in Germany duplicating on a national level space capabilities that are already under development on an EU or ESA level.

For example, Germany is a prime partner in MUSIS, the future multinational European optical Earth observation system. In October, however, German industrial and government sources disclosed that they were considering

the development of a national high resolution optical Earth observation satellite as well. According to these sources, the system, known as the High Resolution Optical System (Hi-ROS), would consist of two or three spacecraft featuring a 70 cm ground resolution and a quick operational response time provided by onboard Ka-band communication terminals linked to geostationary data relay satellites. This development was presented as a logical next step in developing German space observation capabilities to complement its existing radar reconnaissance satellites. Hi-ROS was expected to profit from the R&D undertaken for the German-made optical observation payload of Korea's Kompsat-3 optical imaging satellite, which is expected to be launched in 2011¹⁶⁴.

The same situation applies to a certain extent to telecommunications satellites as well. On 13 October for instance, ESA and DLR announced that they had reached an agreement on the management of the planned space based European Data Relay System (EDRS). This should replace the existing Artemis spacecraft. The proposed EDRS would consist of one dedicated GEO satellite and two payloads on commercial satellites. In 2008, ESA had requested €230 million to begin its development, of which Germany had agreed to contribute 50%. Negotiations included resolving the issue of intellectual property rights in the system's German-built laser communication terminals. The system is envisaged to cooperate with the EU's Global Monitoring for Environment and Security Sentinel satellites and could be launched as soon as 2013¹⁶⁵. At the same time, however, Germany is also developing similar technologies on a national level, such as the Heinrich Hertz space broadband demonstration spacecraft and the very high data rate Laser Communication Terminal (LCT) payload. This would imply that complementarity in the Satcom sector between national and European levels is also compromised from time to time.

Finally, in the past 12 months Germany appeared to come closer to a decision to build its first in-orbit satellite servicing demonstrator. More precisely, satellite manufacturer OHB of Bremen announced on 24 February it had been selected as the prime contractor for a technology demonstration experiment of in-orbit servicing and de-orbiting of satellites. The programme, known as the German Orbital Servicing Mission (DEOS in German), is

¹⁶³ De Selding, Peter B. "International Space Station Cutbacks Encounter German Resistance". Space News 1 Feb. 2010: 5.

¹⁶⁴ De Selding, Peter B. "Germany Eyes Teaming With Industry For Its Own Optical Satellite System". Space News 19 Oct. 2009: 1.

¹⁶⁵ De Selding, Peter B. "ESA and Germany Reach Agreement on Data Relay System". Space News 19 Oct. 2009: 6.

run by the German space agency DLR. Although it has been under study for more than a decade, it was recently promoted to more detailed design work. However, the decision to build the first demonstrator, which could cost up to €200 million, had not been made yet. Nevertheless, this development demonstrates the increasing interest of European countries in these potentially revolutionising technologies. In-orbit servicing of LEO satellites would permit the extension of their operational life span at a fraction of their replacement cost. De-orbiting technologies would allow for the clearing of saturated orbital paths from obsolete spacecrafts, thus helping to mitigate the problem of orbital space debris and to minimise the danger of collisions with operational satellites. The DEOS demonstrator envisaged would have the ability to track satellites, autonomously rendezvous with them in orbit and refuel or repair them by the means of a robotic arm. Furthermore, it would be able to capture the target satellite and guide it into a destructive re-entry trajectory. A significant number of critical technologies would have to be validated before an operational system becomes available. In addition to this, the legal problem of determining liability in the case of the servicing spacecraft accidentally damaging its target satellite would have to be resolved¹⁶⁶.

3.4.3 Italy

The recently elected president of the Italian Space Agency (ASI), Enrico Saggese, announced in January that the global economic crisis would not affect the agency's budget for 2010 and 2011, which was expected to remain at approximately €700 million annually (excluding military-related expenditure)¹⁶⁷. However, this would also imply that no increase could be expected in the near future. Given these financial constraints, Italian space policy would probably focus on maintaining currently announced projects, without expanding to new ones. Happily for Italy, the current financial crisis coincides with a period of limited additional budgetary needs, as a number of key programmes are completing their development phase (e.g. the Vega launcher), while others are only starting theirs (e.g. the next generation Cosmo-SkyMed).

In general, Italian space projects evolve around space applications, with the bulk of the funding going to Cosmo-Skymed ser-

vices. As is the case in other European countries, ASI has focused on increasing the Italian industry's share in efficiently down streaming services to customers. A major milestone for the commercialisation of Cosmo-Skymed products to market customers was achieved in the past 12 months with the creation of E-Geo, a joint venture between Telespazio and ASI set up for this purpose. At the same time, the Italian space agency has begun development of the next generation of Cosmo-SkyMed that is expected to fly in 2016 (for an estimated €600 million budget). As in the case of its other European counterparts, Italy also participates in the effort to effectively downstream Galileo and GMES products (for which the country covers 30% of the budget). For the Galileo data utilisation project, ASI estimates that €100 million to €150 million of additional funding would be required.

Earth observation is also the basis of Italy's bilateral cooperation with France in the framework of the Orfeo programme that should combine Cosmo-SkyMed SAR data with the French Pleiades system optical data. In the mean time, cooperation between the two countries has turned to Satcom projects as well. ASI's president confirmed the upcoming acquisition of two new satellites by ASI in close cooperation with its French counterpart, CNES. The new spacecraft would be the telecommunications satellites Athena-Fidus and Sicral-2 (the second intended for military use). Sicral-2, the newest of the Italian military Satcom spacecrafts, would host a separate French payload to complement its Syracuse 3 constellation¹⁶⁸.

Finally, the Italian space industry is also heavily involved in the development of the future small-satellite launcher Vega, an ESA programme for which ELV SpA of Italy is the prime contractor. ASI is paying for 60% of the project's budget, a fact that reveals its strategic character for Italian space policy. According to ASI's president, the first launch of the rocket is expected in early 2011. After that, he said, ASI would most likely invest further launcher development funding into the next generation Ariane rocket¹⁶⁹.

Italian space exploration initiatives are more modest than that of France or Germany. However, the country has a key participation in the ISS and has adopted an approach similar to Germany's in favour of using ISS facilities to their maximum capacity in the service

¹⁶⁶ De Selding, Peter B. "DLR Takes Step Toward In-orbit Servicing Demonstration". Space News 1 Mar. 2010: 14.

¹⁶⁷ De Selding, Peter B. "Italian Space Agency Expects Budget to Remain Flat for 2010". Space News 18 Jan. 2010:6.

¹⁶⁸ Ibid.

¹⁶⁹ De Selding, Peter B. "Italian Space Agency Expects Budget to Remain Flat for 2010". Space News 18 Jan. 2010:6.



of space science and technology development.

3.4.4 United Kingdom

The year 2009 was a significant one for UK space policy, as it witnessed the decision to replace the British National Space Centre (BNSC) with a dedicated space agency. This development will surely lead to a profound restructuring of UK space activities and their administration. UK space policy has long been oriented towards producing concrete technological and industrial benefits for the country. It is therefore apparent that this decision was driven by the desire to increase value for money in UK space activities and to help the space industry improve its position in the European space market. BNSC, which is not a space agency but a coordinating body, relies on funding from ten different government departments. Through this user-oriented approach, BNSC has not always been able to secure adequate funding for British industrial participation in ESA's space applications programs. Through the creation of a more traditional space agency, UK officials hoped to assure a prime contractor's role for British firms in future ESA projects. Characteristically, the announcement that the government was contemplating its creation was immediately applauded by Astrium Ltd., UK's largest space company¹⁷⁰.

Creating a UK space agency was a gradual process. On 22 July, Lord Drayson, the British Science and Innovation Minister, announced a three months public consultation on the possibility of creating a national space agency in the UK. After several months, the British government finally announced on 10 December that it would create a national space agency to replace BNSC by the end of 2010. According to the rationale of the decision, a dedicated space agency would be a better vehicle for strategic decision making, handling multi-partner programmes, coordinating space-related research and securing long-term funding for it. It would also go further in securing British participation in ESA projects, where 90% of the country's £270 million space budget is currently invested. The decision met the immediate approval of UK aerospace industry officials, who expected it to boost their participation in ESA programs and increase investment returns for their companies from them¹⁷¹. It also seems to be related to a steady increase in UK participation in ESA budgets over the past three years (from

£158 million in 2007 to £205 million in 2009).

On 10 February 2010, the committee of experts finally delivered its study on the future of United Kingdom's space policy. The document, entitled the Space Innovation and Growth Strategy (IGS), was commissioned by the British government to propose reforms in the functioning and scope of UK's space activities administration and policy. The study included 16 recommendations on how Britain could raise the political profile and industrial impact of its space programmes. A first step towards this direction was taken in late 2009, when the creation of a dedicated space agency to overview all of the country's space activities was announced. The current UK space budget stands at £265 million, over 75% of which represents the country's contribution to ESA. One of the report's key recommendations was to double the amount of the British contribution and to manage it in such a way as to maximise industrial returns for the country. In fact, the panel of experts suggested that UK contribution to ESA should reach the levels of its French and German counterparts, if the country was to achieve the full potential benefits of its participation in ESA. Furthermore, the experts concluded that Britain should increase and support the competitiveness of its national space industry. To that effect, it proposed the backing of UK's exports in this field by the country's Export Credit Guarantee Department¹⁷².

Another policy advice included in the document was to expand the future British space agency's area of responsibilities to include military space activities as well. In this sense, the report's authors looked up to the example of France and Italy which both have space agencies with dual civil-military role. For that reason, the committee recommended that the development of national military space application should be considered in the country's new Strategic Defence Review, expected to be published later during the year. Unlike other European nations, Britain does not have national Earth observation (EO) satellites yet. According to the report, this capability gap should be addressed by the creation of a dedicated EO services agency in the UK, which would develop and use its own satellites. Furthermore, the committee included in its recommendations the need to formulate a coherent and explicit national space policy document in order to assure the

¹⁷⁰ De Selding, Peter B. "U.K. Eyes NASA-Style Agency". Space News 27 July 2009: 4.

¹⁷¹ "Britain Replacing BNSC With New National Space Agency". Space News 14 Dec. 2009: 3.

¹⁷² De Selding, Peter B. "Panel Urges Britain To Boost Space Spending, Support Exports". Space News 15 Feb. 2010: 15.

long term strategic guidance of space programmes¹⁷³.

Finally, on 23 March the British government announced it had decided to establish the UK Space Agency on 1 April 2010. The Agency would operate along the general principles mentioned above. It would not however benefit of any additional budget, since the financial conditions in the UK would not allow it. Nevertheless, the new administrative structure was expected to produce immediate benefits for the British space industry's exports. In addition to this, it would certainly secure a more visible presence within the European Space Agency for the UK as well as better industrial returns from ESA programmes for British companies¹⁷⁴.

3.5 United States of America

During 2009 and 2010, the Obama administration moved ahead with a complete revision of the U.S. space programme and restructuring of the NASA budget. The principal characteristic of the new policy was the cancellation of the Constellation manned space-flight programme and the diversion of considerable funds to public-private sector space technology development schemes. These developments will be examined in the following chapter on NASA.

Another issue that preoccupied administration officials was the possible removal of satellites from the U.S. munitions list. On 25 June, Ellen Tauscher was confirmed by the U.S. Senate as the new Undersecretary of State for Arms Control and International Security. During her confirmation statement she suggested that one of the Obama administration's top priorities would be to revise the U.S. export control regime, known as the International Traffic in Arms Regulations (ITAR). She specifically acknowledged the need to consider removing commercial communication satellites from the U.S. Munitions List (USML). The inclusion of such satellites in the list was decided by the U.S. Congress in 1999, when commercial satellites' export control jurisdiction was moved from the Commerce Department to the State Department¹⁷⁵. This situation has created serious obstacles for satellite operators, since clearing USML items for export can take up to 90

days. This has practically obliged satellite operators to launch all satellites built in, or using components made in the U.S., from U.S. territory. Mrs Tauscher said that including satellites in the munitions' list has impeded technological innovation from U.S. companies in this field and it has decreased their competitiveness on a global scale¹⁷⁶.

Earlier in June, the U.S. House of Representatives passed the Foreign Relations Authorisation Act for 2010 and 2011 that enabled President Obama to remove commercial satellites from the USML. However, the bill was still awaiting approval by the U.S. Senate Foreign Relations Committee¹⁷⁷. At the same time, the U.S. House Permanent Select Committee on Intelligence picked up the ITAR issue in its 2010 Intelligence Authorisation Act. In it, the Committee underlined that strict export control of commercial satellites and related technology has had the exact opposite effects from those anticipated. In fact, it had encouraged local research and development of banned items in foreign countries and it had particularly motivated European companies to establish an international non-U.S. collaborative research environment in order to produce them¹⁷⁸. For that reason, the Committee proposed that the administration progressively removes space-related items from the USML.

The Obama administration returned to the subject again on 13 August, when the White House indicated on its official website that it would move forward with export-control reform. The same commitment was reiterated again in a public statement by Assistant U.S. Secretary of State Andrew Shapiro on 9 September. Mr Shapiro asserted that bureaucratic struggle to remove certain items from the USML would be long, but that it had the backing of key officials, including U.S. Secretary of State Mrs Clinton. In the meantime, he said, the U.S. State Department was working on simplifying and speeding up its export licence application procedure¹⁷⁹.

The entire public discussion on export regulations was conducted amongst fears that the U.S. industrial and technology base might erode in the near future because of extensive market consolidation, an aging work force and the absence of new major defence programs. Senior Pentagon officials had already expressed concern over losing irreplaceably skilled defence-related workforce due to re-

¹⁷³ De Selding, Peter B. "Panel Urges Britain To Boost Space Spending, Support Exports". Space News 15 Feb. 2010: 15.

¹⁷⁴ De Selding, Peter B. "New Government Space Agency To Centralise British Space Efforts". Space News 29 Mar. 2010: 11.

¹⁷⁵ Klamper, Amy. "House Intelligence Committee Weighs in on ITAR Reform". Space News 20 July 2009: 16.

¹⁷⁶ Klamper, Amy. "Obama ITAR Reform Could Move Satellites Back to Commerce". Space News 6 July 2009: 6.

¹⁷⁷ Ibid.

¹⁷⁸ Klamper, Amy. "House Intelligence Committee Weighs in on ITAR Reform". Space News 20 July 2009: 16.

¹⁷⁹ Klamper, Amy. "Official Reaffirms White House Support for ITAR Reform". Space News 14 Sept. 2009: 20.



tirement. If this trend continues, it is estimated that in the near future the U.S. industrial base will not be able to support every procurement policy the Pentagon decides. And on the other hand, the U.S. Defence Department will have to be content with facing monopolies in several defence product markets¹⁸⁰.

Throughout the year the debate on removing satellite components from the Munitions List continued in both U.S. legislative bodies. But it proved to be a highly polarising one, with national security “hawks” facing aerospace industry officials that saw their global market share suffer since ITAR controls were imposed in 1999. In this context, on 2 December the President of the U.S. Aerospace Industries Association (AIA) M. Blakey addressed a letter to President Obama urging him to consider loosening the export control restrictions¹⁸¹.

During his state of the Union speech on 27 January 2010, U.S. President Barack Obama confirmed that he considered the reform of the U.S. export control system as one of his top priorities. This reform was the objective of the administration’s National Export Initiative, which foresaw the creation of an Export Promotion Cabinet to assist the President. Further recommendations on how to relax export restrictions were due to be circulated by 29 January within the government by an interagency working group set up for this purpose. The group was mandated to review the entire export control procedure from scratch. The principal objective of this initiative was to increase export volumes in the face of the global economic crisis, as well as to maintain the U.S. industrial competitive edge. The proposed review had reputedly received full backing from the Pentagon. This development was greeted on the following day by Marion Blakey, the president of the Aerospace Industries Association, who highlighted the initiative’s positive impact on employment within the defence and aerospace sector¹⁸².

3.5.1 National Aeronautics and Space Administration (NASA)

On 5 November, the U.S. Senate approved the 2010 Commerce, Justice and Science Appropriations Bill that included an \$18.7 billion budget for NASA. The Senate thus

approved the entire budget proposed by the Obama administration, contrary to the House of Representative’s decision to cut \$670 million from NASA’s requested budget for Space Exploration. The reduction in the House Bill was justified by House members as an attempt to divert funds from the Constellation programme to the development of commercial orbit transportation vehicles. Earlier, the Administration had asked for the funding to be restored, in anticipation of the President’s decision on the future of the U.S. manned spaceflight programme¹⁸³.

On 2 December, as President Obama’s administration was considering outsourcing part of NASA’s human spaceflight programme to the private sector, safety procedures and regulations regarding commercial space flight came under legislative scrutiny on Capitol Hill. On the same day these issues were addressed by the House of Representatives’ Space and Aeronautics and Aviation Safety subcommittees. The former had called upon NASA officials to assess the commercial sector’s safety procedures by comparison to the standards applied to NASA’s Space Shuttle and the Russian Soyuz spacecrafts. At the same time, the Aviation Safety subcommittee invited Federal Aviation Administration (FAA) officials to explain how safety regulations would be implemented on commercial human spaceflights. FAA’s dual role in simultaneously assuring aviation safety and promoting commercial space activities came under particular attention¹⁸⁴.

On 10 December, the consequences of outsourcing the U.S. human space flight to commercial space companies came once more under public scrutiny, during a hearing before the House of Representatives’ Science and Technology Committee. Lawmakers heard industry and government executives argue that any precipitous action in this direction could endanger future development of the skilled space-related workforce currently available in the U.S. By terminating NASA’s human space flight programme, they continued, it would be difficult to maintain the tens of thousands of NASA’s direct and subcontractor employees. Furthermore, apart from losing considerable know-how and expertise related to NASA’s programme, future skilled technical personnel could be discouraged to enter the space sector because of the increased carrier uncertainty that its commercialisation would entail. Speakers at the hearings included former Martin Marietta chief T.

¹⁸⁰ Muradian, Vago and Bennett, John D. “Pentagon Acquisition Chief Says Space Industrial Base May Warrant Protection”. *Space News* 14 Sept. 2009: 18.

¹⁸¹ Klamper, Amy. “AIA Presses Obama on Export-Control Reform”. *Space News* 7 Dec. 2009: 13.

¹⁸² Klamper, Amy. “Obama Repeats Call for Export Control Reform in State of Union”. *Space News* 1 Feb. 2010: 12.

¹⁸³ “U.S. Senate Approves \$18.7 Billion for NASA”. *Space News* 9 Nov. 2009: 3.

¹⁸⁴ “Two Hearings to Examine Private Spaceflight Safety”. *Space News* 30 Nov. 2009: 3.

Young and American Institute of Aeronautics and Astronautics President D. Thompson¹⁸⁵.

On 16 December 2009, the U.S. President also signed the 2010 \$18.7 billion NASA budget, but not without Congress adjusting several budget lines. Scientific research and International Space Station operations were among the ones that received additional funding (\$4.47 and \$2.267 billion respectively), whereas space operations and astrophysics saw their funding slightly trimmed (to \$6.14 and \$1.12 billion respectively). The main political issue behind this year's space budget was the fate of the cancelled Constellation programme that at that moment was still under revision by the White House. Through its proposed appropriations bill, Congress tried to thwart the effort to replace the Space Shuttle by increasing its budget and including language in the bill that would prevent the President from cancelling the project without prior notification and deliberations with the legislative bodies¹⁸⁶.

On 1 February 2010, U.S. President Barack Obama surprised policy and industry officials alike with his NASA budget proposal for 2011 (Figure 3.1). The new budget constituted in fact a major change in the U.S. civil space programme and a radical departure from the pre-

vious administration's NASA policy. The new policy's corner stone was the cancellation of the Constellation human spaceflight programme, including all of its components (namely the Orion spacecraft, the Ares heavy rocket and the Altair lunar lander). Instead, the new policy called for funding the development of radically new human space flight technologies that would enable NASA to venture not only to the moon, but to more distant destinations as well. While waiting for the development of these new technologies, NASA would increase funding to the private space flight industry, effectively outsourcing the entire U.S. programme for manned space flight to Low Earth Orbit. At the same time, a considerably increased budget was foreseen for the American participation to the International Space Station (ISS) so as to maintain the country's current LEO space flight capabilities.

For the purposes of the new civil space programme, the White House requested a slightly increased budget for 2011 (\$19 billion, 1.5% higher than in the previous year). Furthermore, total funding through 2015 was now estimated at \$45.5 billion or \$6 billion more than in the 2010 proposed medium term spending plan¹⁸⁸.

The key plank of the new policy has been the

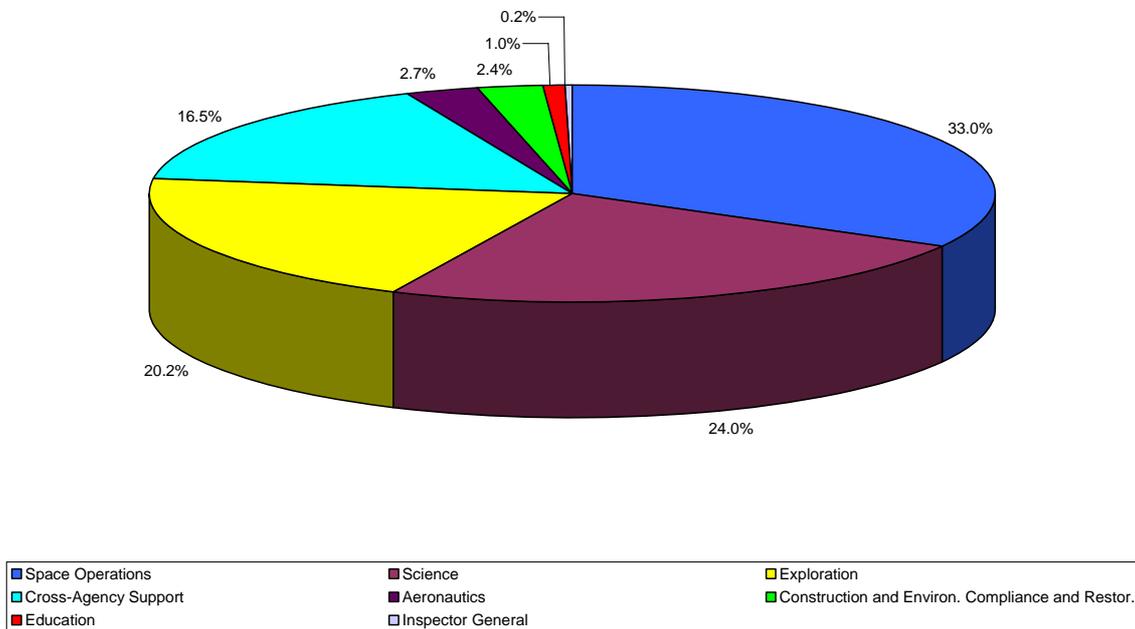


Figure 3.1: NASA budget of the Fiscal Year 2010 (Source: NASA¹⁸⁷)

¹⁸⁵ Klamper, Amy. "Aerospace Leaders Warn of Work Force Impacts". Space News 14 Dec. 2009: 14.

¹⁸⁶ Klamper, Amy. "Lawmakers Redirect Funds to NASA Education, Science in 2010". Space News 4 Jan. 2010: 5.

¹⁸⁷ NASA "Fiscal Year 2011 Budget Estimates." 01 Feb. 2010. NASA. 26 May 2010. <http://www.nasa.gov/pdf/420990main_FY_2011_Budget_Overview_1_Feb_2010.pdf>.

¹⁸⁸ Klamper, Amy and Brian Berger. "Obama's 'Game Changing' NASA Plan Folds Constellation, Bets Commercial". Space News 8 Feb. 2010: 1.



change in NASA's orientation from a mission-focused organisation to a technology development one. According to this doctrine, NASA would be responsible for related research and development, bringing about ground braking innovations that would ultimately revolutionise human spaceflight. As far as specific missions were concerned, it would only maintain authority over ISS operations and it would continue to promote international cooperation in future manned space exploration projects. All other manned space flights to low Earth orbit short of the ISS would be outsourced to private companies. NASA would thus become the driving motor for the development of a flourishing commercial spaceflight industry in the U.S. The agency would support private sector endeavors in two ways. On the one hand, it would conduct the necessary R&D to develop future space transportation technologies that private companies would then be able to commercialise. On the other hand, NASA itself would be a client for commercial spaceflight services, for instance in order to secure independent access to the ISS. In this fashion, NASA would become the industry's partner and client, instead of its competitor¹⁸⁹.

It should be noted that the new paradigm for developing human spaceflight in the U.S. bares significant resemblance to the way the country's Department of Defence has handled its relations with the commercial satellite industry. U.S. armed forces have been increasingly relying on a balanced mixture of developing their own space assets while punctually procuring commercial space applications products on an ad hoc basis. This dual approach has allowed for the simultaneous development of dedicated high performance military satellites on the one hand, and for outsourcing demand for less sophisticated products to the commercial satellite communications and Earth observation industry. With the proposed NASA space budget, a similar approach seems to be adopted in regard to the U.S. civil space flight programme as well. As we saw above, according to this new scheme NASA would be conducting the advanced R&D required for manned space exploration missions outside the Earth's orbit, while commercial companies would take over the technologically less demanding task of launching people to Earth orbit.

The proposed Obama space policy seems to have been developed exclusively within the White House Office of Science and Technology, and it was admittedly loosely inspired by the Augustine Report on the future of the Constellation programme. However, although

it was endorsed by NASA's Administrator Charles Bolden, it met with considerable resistance from lawmakers and NASA officials alike, including some skepticism expressed from Bolden's predecessor Mike Griffin. Criticism on the proposed course of action focused mainly on three issues. First, the Constellation programme cancellation would nullify the \$9 billion investment already made in the project and it would jeopardise the thousands of jobs depending on it. Second, outsourcing human space flight even to LEO could prove a lot more complicated than expected and in the end NASA might not be able to disengage itself from LEO spaceflight completely (for example, it would have to certify that commercial spacecraft are safe for humans). Third, changing the nature of NASA's objectives in relation to human spaceflight (from missions to R&D) and passing some of its mission areas to the private sector could jeopardise U.S. national capabilities in this field during the transition period from one policy model to the other¹⁹⁰.

Finally, the announcement of the new policy was closely followed on 23 February by changes in NASA's administrative structure. More precisely, the agency's ten regional field centres and four mission directorates would be reporting directly to Administrator's C. Bolden office instead of the Associate Administrator's office, as it was the case previously. This decision clearly increased the grip of NASA's Administrator on the agency's day to day activities and made its decision-making process more top-heavy. Furthermore, the restructuring also put additional focus on the agency's R&D activities by reestablishing the offices of the agency's Chief Technologist and Chief Scientist. In fact one could argue that the changes clearly reflected NASA's new R&D oriented direction, while at the same time ensuring a pivotal role of the agency's head in managing these activities¹⁹¹.

Understandably, the principal contractors for the Constellation programme were the first to contest the President's new space policy. Representatives of Alliant Techsystems Inc. (ATK) of Minneapolis, the programme's principal rocket subcontractor, expressed their disappointment with the administration's decision and their hope that it would be overruled by Congress, which should have the final word in approving the project's termination. They also voiced concern over whether commercial spaceflight companies would be capable to develop man-rated spacecrafts within the foreseeable future. The company

¹⁸⁹ Ibid.

¹⁹⁰ Ibid.

¹⁹¹ Berger, Brian. "Bolden Overhauls NASA Organisation, Centralises Chain of Command". Space News 1 Mar. 2010: 12.

was expected to lose at least \$650 million in backlog orders related to the Constellation programme. At the same time, it was unclear how much of the NASA's \$2.5 billion budget slated for wrapping up Constellation-related work ATK would receive. The decision to terminate the project could weigh heavily on the company's future, as it was already trying to cope with the phase-out of the Space Shuttle, as well as the cancellation of USAF's Minuteman 3 ballistic missile programme. Maryland based Lockheed Martin, the contractor for the building of Constellation's Orion capsule, also questioned the wisdom of the administration's new policy¹⁹².

Another concern voiced by many opponents of the new NASA policy was that it could corrode the U.S. solid rocket motor industrial base. In an interview on 11 February, NASA Deputy Administrator Lori Garver revealed that long high level discussions were held between NASA and Defence Department officials prior to the new policy's announcement. The Pentagon's concern was that after cancelling the Constellation programme there would be no solid fuel rocket development project left in the U.S. This situation could jeopardise the very existence of the only two companies that currently make these motors, Alliant Techsystems Inc. of Minneapolis and Aerojet of Sacramento. If these two companies seized their production, their important know-how would be irreversibly lost. Since the same motor type is also used in ballistic missiles, the U.S. could lose the industrial capability to replenish their strategic missile reserves. In order to tackle this issue, the U.S. military has set up a joint working group, mandated by Congress to deliver by June 2010 a strategic plan to preserve the U.S. industrial base in this field. In the meantime, the U.S. Air Force, Navy and Missile Defence Agency have decided to pool their solid motor rocket demands so as to sustain a very low rate production of the motors for as long as possible¹⁹³.

Concern over losing skilled workforce and critical industrial know-how as a result of the new policy was even expressed by officials who endorsed it, such as the president of the Aerospace Industries Association Marion Blakey. Although the potential of the new policy to create jobs in the private sector is acknowledged by the industry, there are also worries that a part of the skilled workforce currently employed in government pro-

grammes might lose its job. In that case, manufacturing know-how on several critical technologies could be irreversibly lost. On the other hand, NASA officials argued that commercial space had the potential to create a lot more jobs than those lost. Consequently, there is consensus in the U.S. that the space industrial base would benefit from the new policy on the long term. Nevertheless, coherent strategic industrial planning on a nation wide scale would be necessary to preserve critical manufacturing capabilities during the transition period. In an attempt to increase awareness of this problem, the NASA Administrator himself urged private space firms to make better use of existing labour force and industrial infrastructure¹⁹⁴.

In an effort to prevent further reaction from industrial and policy officials, NASA Administrator Charles Bolden confirmed on 6 February that development work on heavy-lift rocket technology would not stop under the new U.S. space policy. In fact, he said that NASA would conduct an evaluation of all technologies related to Ares 5, the heavy-lift launcher of the Constellation programme, in order to choose the most promising ones for further development regardless of the programme's cancellation. The objective of this decision would be to maintain R&D relating to key heavy launcher technologies in order to start the manufacturing of such a rocket by 2020 at the latest. In this respect, the Obama administration space policy seemed to adhere to the Augustin Report's key policy recommendation known as the Flexible Path. Under this policy NASA was to perform only unmanned missions to the Moon and rather concentrate on Mars as the principal destination of future U.S. human exploration missions. Furthermore, NASA officials pointed out that the new policy would actually speed up the development of new space transportation technologies through its provisions for larger R&D budgets and increased international cooperation. As far as research was concerned, it was clear that the new policy called for an approximately \$500 million annual budget for R&D on new space exploration technologies through 2016, whereas the Bush administration planning only foresaw \$100 million¹⁹⁵.

Another argument in favour of the new policy was the importance it gave to international cooperation, not only in managing the ISS but also in developing future space exploration technologies. Supporters of the new policy line insisted on the advantages of achiev-

¹⁹² De Selding, Peter B. "Constellation's Demise Will Cost Ares-1 Builder ATK \$650 Million in Backlog". *Space News* 8 Feb. 2010: 5.

¹⁹³ Klamper, Amy. "Obama's Move to End Constellation Prompts Industrial Base Questions". *Space News* 15 Feb. 2010: 1.

¹⁹⁴ *Ibid.*

¹⁹⁵ Klamper, Amy. "Bolden: Heavy-lift Development To Persist Despite Ares 5 Demise". *Space News* 15 Feb. 2010: 16.



ing innovation synergies with other major space-faring nations. This of course might in some cases require for the U.S. to depend upon foreign-made components for their future heavy-lift launcher, a decision which would probably meet with considerable resistance in Congress. On the other hand, it would also allow NASA to focus on the development of radical, or “game-changing”, new space technologies that could potentially secure the future U.S. lead in this field¹⁹⁶. In this context, it would be interesting to observe the future interaction between this new U.S. approach to space technology cooperation and the current EU policy of achieving strategic independence in this area. If for example the U.S. were to apply the principles of reciprocity and complementarity in its technological cooperation with other space agencies, then it could demand that the number of U.S. made components onboard foreign spacecrafts increased proportionally to that of foreign ones installed on NASA spacecrafts. Such a development would have obvious consequences upon the EU strategy for autonomy in space activities.

Under these circumstances, it was not surprising that the new NASA policy came under scrutiny by the U.S. legislative authorities. In consecutive hearings held on Capitol Hill on 24 and 25 February 2010, NASA Administrator Charles Bolden and White House science advisor Charles Holdren tried to defend the administration’s plan in front of Senate and House subcommittees. During these hearings it became clear that the vast majority of Congressmen were opposed to the new policy, which was far from securing the legislative approval necessary for its adoption. Both NASA and the White House came under constant criticism for not consulting with Congress before publicly announcing the new policy. A great number of Congress members accused NASA for rushing into this new direction without planning it adequately or consulting with all its expert senior scientists in advance. Furthermore, lawmakers resented what they described as a lack of transparency on behalf of the White House in preparing the new policy. In fact, the general view on the subject on the Capitol was that the administration had more or less imposed the new policy without much discussion¹⁹⁷.

At the same time, Congressmen also questioned the viability of the plan itself. A num-

ber of them voiced concern over the possible loss of jobs in space industry. Others doubted about the ability of commercial spaceflight companies to develop their spacecrafts without significant NASA help. They also feared that in such a case NASA’s increased research and development budget would be diverted and wasted into assisting private companies to master already existing technologies on human spaceflight. On top of that, most lawmakers deemed the new policy poorly documented and lacking of a detailed long-term development plan. They also found the policy’s objective of developing deep space transportation means to accomplish manned missions to Mars very optimistic. Finally, its preference for international cooperation met with scepticism from Congressmen wary of compromising the leading U.S. role in space activities. In general, opposition to the new NASA direction was so widespread among the members of Congress that even the NASA administrator himself felt compelled to say that the final decision to adopt it belong to the U.S. President and not himself¹⁹⁸.

In conclusion, it appears that the new NASA policy came under criticism primarily for the priority it attributes to the commercial spaceflight industry at the expense of NASA’s own manned orbital missions. In fact, most congressional critics presented this policy as a simple and poorly explained transfer of funds from public to private space transportation activities. Furthermore, certain lawmakers questioned the private firms’ ability to see through such complex and long-term projects as human space flight missions, without government assistance. In other words, one could say Congress members raised the same arguments that were heard during the previous months against the government’s financial stimuli plans (or “bailouts”) for the country’s investment banks. In both cases lawmakers questioned the wisdom of using taxpayer’s money to help private companies secure or increase their growth; in both cases they criticized the President’s precipitated decision without previously consulting with the legislative authority; and in both cases they underlined the lack of transparency in taking decisions with such important consequences. In short, congressmen already irritated by the administration’s financial bailout policies resisted the idea of yet another policy of using public funds for the benefit of private firms. Especially since the administration itself admits it could result to increased unemployment, at least on the short term. Consequently, it seems that the new NASA policy could in the long run fall victim not of its own

¹⁹⁶ Ibid.

¹⁹⁷ Klamper, Amy and Debra Werner. “NASA’s New Direction Drawing Fire From House and Senate Lawmakers”. *Space News* 1 Mar. 2010: 1.

Klamper, Amy. “House Appropriators Grill Obama’s Science Adviser on NASA Plan”. *Space News* 1 Mar. 2010: 6.

¹⁹⁸ Ibid.

possible weaknesses, but of the very timing of its making.

Some of the criticism against the new NASA policy seemed to be vindicated on 22 February, when the agency announced it might spend a considerable part of its \$3.1 billion propulsion research budget on developing a new family of main and upper stage heavy-lift rocket engines. If this announcement materialised, NASA would be developing a new type of rocket engines without having any new rocket insight, since the Constellation programme has been canceled. The new propulsion system was expected to be a fairly conventional hydrocarbon main stage engine, coupled with a more advanced liquid oxygen/methane upper stage one. The development of the main engine was expected to take place in close cooperation with USAF, which also looked for a U.S.-made engine to replace the Russian RD-180 engines of its Atlas 5 rockets. Given that the Atlas 5 lifts almost half of the U.S. military satellites every year, there is a strong national security imperative that dictates the development of a U.S. engine to replace it. Nevertheless, private launch services companies such as SpaceX also expressed interest in a new propulsion system and asked for it to be modular enough for use on their own commercial launchers as well. SpaceX's own Taurus 2 rocket would be also relying on the Russian built AJ-26 engine for propulsion. Nevertheless, this development would mean that NASA would be spending a great part of its budget on developing propulsion systems not for its own missions, but for the benefit of the Pentagon and the commercial spaceflight industry. Hence, the critics of the new policy who argued that after terminating the Constellation programme NASA would be funding private companies' development projects with public money could very well be proven right¹⁹⁹.

Nevertheless, President Obama's decision to increase spending and commitment to the International Space Station met with wide approval in Europe. In a press conference in Paris on the following day of the announcement, ESA's Director General J.J. Dordain endorsed the new policy's rationale. He added that prolonging ISS operational life at least until 2020 should now become a common priority for all parties involved. In this context, he also proposed that the current ISS users should be joined by emerging space faring nations such as China, India and South Korea. Furthermore, ways of making the space station more cost efficient could

now also be contemplated. Apart from the increased utilisation of ISS, ESA's Director General also found common ground with the new NASA policy in the field of Earth science. ESA, he said, is expected to devote almost 61% of its budget through 2015 to such projects and cooperating with NASA on a regular and mutual basis would be a more than welcome development²⁰⁰.

In a parallel development, NASA announced on 11 February that it would increase funding to the commercial firms currently working on space transportation vehicles by an extra \$300 million in 2011. This project, known as the Commercial Orbital transportation Services (COTS) programme, began in 2006 and it is run by NASA's Exploration Systems Mission Directorate (ESMD). The programme's principal beneficiaries so far have been the Orbital Sciences Corp. and the Space Exploration Technologies Corp. (SpaceX) commercial spaceflight companies. Both firms have been receiving an annual total of \$500 million by NASA in order to develop commercial space vehicles to support ISS logistics operations. The additional \$300 million funding would definitely help the two companies to meet their development objectives according to schedule, by allowing for additional technology demonstration flights in 2011. Currently, both companies are proceeding with the integration of their first prototypes. SpaceX's Falcon 9 rocket was expected to make its maiden flight in the spring of 2010, whereas Orbital's Taurus 2 should follow a year later. Increased funding for the development of commercial space transportation systems seems to be the first concrete outcome of the new U.S. space policy²⁰¹.

One of the companies that are expected to take advantage of the new U.S. space policy is Orbital Sciences Corp. The firm is developing the Taurus 2 rocket and the Cygnus unmanned cargo spacecraft that will form part of U.S. contribution to the ISS logistics support. Therefore, it should be one of the principal beneficiaries of the increased funding foreseen in the new policy for commercial space transportation systems that would compensate for the terminated constellation programme by providing spaceflight services to Earth orbit. In addition to this, Orbital Sciences is also engaged in commercial and civil satellite programmes, including classified work done on behalf of the U.S. Department of Defence. These include manufacturing of the Star 2 Geostationary communications

¹⁹⁹ Berger, Brian and Amy Klamer. "NASA Propulsion Plans Resonate with Some in Rocket Industry". Space News 1 Mar. 2010: 12.

²⁰⁰ De Selding, Peter B. "ESA Chief Lauds Renewed U.S. Commitment to ISS, Earth Science". Space News 8 Feb. 2010: 6.

²⁰¹ Klamer, Amy. "NASA Raises Bet on Commercial Cargo". Space News 22 Feb. 2010: 1.



satellite platform, four of which were sold in 2009. In general, the company's space programmes division saw a 15.6% revenue increase in 2009 and its profit growth was expected to remain above 10% in 2010 as well²⁰².

The example of Orbital Sciences demonstrates one of the most interesting consequences of the new U.S. space policy. More precisely, this policy could lead to an increased level of direct funding from NASA to space industry companies that engage not only in commercial, but in military programmes as well. If this new policy is carried through to its full potential, commercial firms such as Orbital Sciences may soon find themselves in a position where government contracts, either civil or military, would represent the bulk of their business activities. Consequently, the question emerges whether U.S. commercial space companies may eventually become completely dependent upon public subsidies and limit themselves to government contracts, or if they will rather use the extraordinary level of their public funding to gain the advantage over their foreign commercial competitors. Either way, as the same companies would simultaneously develop both civil and military space programmes under the same roof, the budgetary and operational delineation between the two may eventually become thinner, with as yet undetermined consequences upon international civil space cooperation.

3.5.2 National Oceanic and Atmospheric Administration (NOAA)

On 23 November, NASA's meteorological and oceanographic QuikScat satellite's performance was seriously crippled when the spacecraft's scatterometer instrument ceased to function. Although this development was anticipated since the satellite had long passed its projected life-span, no successor had as yet been identified. As a result, NASA and the U.S. National Oceanic and Atmospheric Administration (NOAA) would have to rely on data provided by ESA's Metop-A and India's OceanSat-2 spacecrafts to monitor global ocean winds. NASA's officials suggested that they might launch a scatterometer as a payload aboard Japan's Global Change Observation Mission's (GCOM) W-2 satellite, scheduled for launch in 2016²⁰³.

Also on 1 February, the White House announced it was terminating the troubled joint

civilian-military satellite programme known as the National Polar-orbiting Operational Environmental Satellite System (NPOESS). The spacecraft was at the time under development by Northrop Grumman. The project was the fruit of a 1994 decision to merge the separate civil (run by the National Oceanic and Atmospheric Administration-NOAA) and military (run by USAF) meteorological satellites under a joint platform. However, the technological complexity of the project and the divergence in civil and military operational needs caused long delays and budget overruns of several billion dollars. Under the new scheme proposed by the Obama administration NOAA and USAF would build their own separate systems, using components developed for NPOESS. Complementarity between the two system's orbital paths should secure continued Earth coverage. NOAA's proposed new satellite programme, known as the Joint Polar Satellite System (JPSS) would be managed by NASA's Goddard Space Flight Centre. NOAA included \$1.06 billion for the project in its 2011 budget request, with an additional \$3.47 billion to follow through 2015, when the satellite is expected to be launched. On the contrary, USAF did not have any immediate plans to develop any future system, as the current generation of its defence meteorological satellites has several years of operational life left and two more are scheduled to be launched by 2014²⁰⁴.

The National Oceanic and Atmospheric Administration (NOAA) requested a total budget of \$5.6 billion for 2011. Of that, \$2.02 billion was attributed to the agency's National Environmental Satellite, Data and Information Service, which handles its space assets. Funding was increased by \$831 million from 2010, mainly because of the new satellite's development costs. Apart from the \$1.06 billion dedicated to developing the Joint Polar Satellite System (JPSS), NOAA's funded space systems included among other \$730 million for the Geostationary Operational Environmental satellite-R programme, \$50 million for NOAA's participation in Eumetsat's Jason-3 altimetry satellite and \$49.4 million to conclude development of several NPOESS instruments²⁰⁵.

²⁰² De Selding, Peter B. "Orbital Bullish on U.S. National Security Satellite Market". Space News 22 Feb. 2010: 10.

²⁰³ Werner, Debra. "Demise of QuikScat Deprives Scientists of Ocean Wind Data". Space News 30 Nov. 2009: 6.

²⁰⁴ Brinton, Turner. "White House Dissolves NPOESS Partnership in Blow to Northrop". Space News 8 Feb. 2010: 5.

²⁰⁵ Brinton, Turner. "White House Dissolves NPOESS Partnership in Blow to Northrop". Space News 8 Feb. 2010: 5.

3.6 Russia

In 2009 and 2010, Russia continued the modernisation of its space infrastructure according to the ten-year Federal Space Programme announced in 2005. This document provided the key objectives and guidelines for the Russian space programme through 2015 and is still in force²⁰⁶. One more space policy related paper was produced in 2008 by Russia's Security Council, updating the security related project priorities²⁰⁷. The implementation of this programme so far has demonstrated the country's commitment to developing full scale capabilities across all areas of space activities.

According to the goals set in 2005, Russian space activities should have three key objectives: stabilise the country's economy, develop space science for the benefit of society, and consolidate its defensive power. These objectives were in fact in hierarchical order. Space technologies were first to contribute to the country's economic recovery after the "lost decade" of the 1990's, increase the volume of external trade and exploit the Russian industry's competitive advantage in space in order to consolidate its market position. Secondly, further space technology development should be targeted on space applications in order to enhance domestic stability (for example by extending state television broadcasting throughout Russian territory) and facilitate government work. Furthermore, scientific research should be conducted in close concertation with the industry in public-private joint ventures and should aim at diffusing its benefits to the entire society. Finally, military space capabilities should be preserved and modernised as much as possible and with the widest feasible utilisation of dual use systems.

Overall, one could say that so far the Russian space programme has, to various degrees, attained most of its objectives. The main challenge that it had to face was marrying two inherently divergent objectives. On the one hand, there was the necessity to maintain a widely degraded and even obsolete space infrastructure inherited from the 1990's. On the other, major investments had to be made simultaneously for the development of new systems. Apparently Russia has

succeeded in this undertaking, mostly thanks to increased funding made available from the country's flourishing energy and armament sector. Indeed, the Russian space budget has manifested the largest growth in the world during the past 10 years. In 2009 alone the country's civil space budget rose to Rub 88.64 billion, representing a 100% increase from 2008.

In addition to this, the Russian space industry's output grew by 18% in 2009, in spite of the financial crisis. This positive development has been the result of the carefully planned financial support that the Russian government extended to the country's space industry. More specifically, in the last two years the latter have received over 21 billion Rubles (\$609 million) in public funds. When one considers that this stimulus package was carried out as planned in the midst of a major financial crisis, it becomes apparent that the country's space programme enjoys strong political support. In deed, the Russian Prime Minister Vladimir Putin himself has underscored the space industry's importance for the country's economy in several occasions. Finally, in the course of this financial stimulus programme the country's space industry has had the chance to improve its production facilities²⁰⁸.

In order to achieve the objectives mentioned above, the Russian space programme has focused during the past 12 months on three main activity areas: completing the deployment of the Glonass satellite navigation constellation, initiating the creation of a new space port in the Far East, and restructuring the country's space industrial base. The Glonass constellation is expected to be completed by the end of 2010, with the launch of 7 spacecraft, bringing their total number to 28 satellites, of which 23 fully operational²⁰⁹. Nevertheless, the constellation would have to include at least 24 spacecraft to provide global coverage²¹⁰. The development of a new generation of satellites (Glonass-K) has already matured and the first spacecraft are expected to fly by 2011. The programme's budget reached 2.5 billion Rubles in 2009 and it was expected to rise to 3.7 billion Rubles through 2011²¹¹. The first three of the Glon-

²⁰⁶ "Major Provisions of the Federal Space Programme of the Russian Federation for 2006-2015" of 22 Oct. 2005. Russian Federal Space Agency (Roscosmos). 30 Apr. 2010. <<http://www.federal-space.ru/main.php?id=85>>.

²⁰⁷ "The Outlines of the Russian Federation Policy in the Field of Space Activities for the Period Until 2020 and Further Perspective" Apr. 2008. Russian Federation Security Council. 30 Apr. 2010 (Available in Russian). <<http://www.scrf.gov.ru/documents/96.html>>.

²⁰⁸ "Russia's Space Industry Output to Grow 18% in 2009- Putin". 30 Nov. 2009. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20091130/157042100.html>>.

²⁰⁹ "Russia to Orbit 7 New Glonass Satellites in 2010". 6 Apr. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100406/158456450.html>>.

²¹⁰ "Russian Spacecraft Successfully Orbits 3 Glonass Satellites". 2 Mar. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/science/20100302/158060090.html>>.

²¹¹ "Russia to Orbit 7 New Glonass Satellites in 2010". 6 Apr. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100406/158456450.html>>.



ass satellites scheduled for 2010 were put into orbit on 2 March onboard a Proton-M rocket launched from the Baikonur Cosmodrome²¹².

Further steps for the programme include improving its performance and accuracy, as well as giving it an international dimension by providing services outside Russia. In this respect the Russian government has launched a high political level effort to convince neighbouring countries and emerging space powers to subscribe to the system's services. The issue was discussed during the Russian Prime Minister's visit to India in March. According to Russian officials, the two countries would establish a joint venture in India to produce Glonass-compatible navigation equipment. According to the same sources Indian authorities would use the system's civilian signal at first, but negotiations were underway to allow them to access its more accurate military signal as well. All navigation equipment made in India would also be GPS compatible²¹³. Finally, in order to improve the system's commercial prospects Russian authorities announced that the next generation satellites' civilian use signal would be compatible with the GPS and Galileo systems.

In a similar fashion, Russian officials discussed with their Ukrainian counterparts the possibility of creating a joint venture for the supply of Glonass services to that country as well. Although Ukraine has previously opted for using the GPS satellite positioning system, the recently elected government seemed to prefer the simultaneous use of both the U.S. and Russian systems, but no final decision had been made yet. Finally, broader negotiations between the two countries on possible cooperative ventures in the field of communications, including Satcom's, were expected to start in the second half of 2010²¹⁴.

Another major preoccupation of the Russian space programme has been securing an independent space launch capability. In this regard, the construction of the new space centre will enable launches from national territory, providing Russia with the desired unrestricted access to space. Furthermore, Roscosmos has resumed the development of the Angara, its first entirely new post-soviet era rocket, which is expected to make its

debut in 2011. The new rocket will use predominantly Russian made components and it should therefore decrease the country's dependence on foreign suppliers. At the same time, Soyuz launches from French Guiana are scheduled to begin in 2010 and its Russian manufacturers have already secured 14 orders from the system's operator Arianespace. This development should help Russian companies to expand their global market share and provide them with the necessary starting funds to develop their next generation of rockets.

In the framework of this dual strategy to reduce its dependence on third countries, Russia moved to secure the future use of the Baikonur Cosmodrome in Kazakhstan and to consolidate its plans to build a new spaceport in Vostochny, in the Russian Far East. Indeed, after years of disputes the Kazakh Parliament officially ratified on 9 April 2010 a 2004 agreement between the two countries, granting Russia access to the site until 2050. The agreement followed the general terms of the lease contract currently applied, under which Russia pays an annual fee of \$165 million for the use of the Cosmodrome. After this development, the road opened for the joint construction by the two countries of a new space launch facility in Baikonur, known as the Baiterek, in order to accommodate the new Angara heavy rocket currently under development²¹⁵.

At the same time, Russian officials confirmed that preliminary work for the creation of a new spaceport in Vostochny were proceeding according to plans and that its construction would begin in 2011. The new launching site would be operational by 2015 and certified for manned spacecraft missions by 2018. The project's total budget was expected to exceed 400 billion Rubles (\$13.5 billion). Government officials accorded great importance to the new spaceport, which is hoped to boost the Russian space launch industry's overall competitiveness. In fact, the site is expected to become a space industry hub, generating more than 20,000 jobs on a long term basis²¹⁶.

²¹² "Russian Spacecraft Successfully Orbits 3 Glonass Satellites". 2 Mar. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/science/20100302/158060090.html>>.

²¹³ "Russia, India May Jointly Make Glonass, GPS Navigation Devices". 9 Mar. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100309/158137947.html>>.

²¹⁴ "Kiev Says Russian Rival to GPS Good for Ukraine's Security". 19 May 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/world/20100519/159078178.html>>.

²¹⁵ "Kazakhstan Finally Ratifies Baikonur Rental Deal With Russia". 9 Apr. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/world/20100409/158494207.html>>.

²¹⁶ "Russia to Spend \$13.5 Bln on New Space Centre in Far East". 15 Oct. 2009. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20091015/156475196.html>>. "Russia to Boost Share in Global Space Market". 26 Mar. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100326/158322158.html>>.

3.7 Japan

In 2009 and 2010, Japanese space policy saw important developments and changes. A long transitional period ended with the creation of a coherent new space strategy for the country. This is forged by two key documents, the Basic Space Law (BSL) of 2008 and the Basic Plan for Space Policy (or Basic Space Plan – BSP) adopted on 2 June 2009. The first was Japan's first comprehensive national space law, aimed at regulating all space activities, public and corporate, and setting the strategic scope of the Japanese space programme. The second was mandated by the BSL as the country's fundamental space policy document, in order to define and materialise BSL into a coherent Japanese space activities roadmap. The BSP was issued by the Strategic Headquarters for Space Policy, the inter-ministerial governing body for Japan's space activities, also set up by the BSL²¹⁷. At the same time, the Japanese government has continued the administrative reorganisation of space activities, with the explicit aim of simplifying governance by concentrating authority under the single roof of the Japanese Cabinet Office. The Japanese Space Exploration Agency (JAXA) will coordinate and finance all government space activities, following the example of NASA.

The BSP established a five year roadmap for 2009–2013, along six basic pillars. 1) The realisation of a "secure, pleasant and affluent society" utilising space. 2) The enhancement of Japan's national security. 3) The promotion of "space diplomacy". 4) The creation of a "vigorous future" by promoting space related research and development. 5) Fostering of strategic space industries for the 21st century. 6) Considering the environment²¹⁸.

The Basic Plan clearly demonstrates the strategic importance given to space for the future prosperity and security of the entire country. Furthermore, it identifies the future areas of interest for the country's space policy. These are space applications, security, international cooperation, scientific development, industrial development and environment protection. It should be noted that security in its broader sense (military, diplomatic and economic) becomes the cornerstone of the new policy, as it is depicted in three of the six pillars. Other key policy objectives include achieving full autonomy in space technologies and increasing public-corporate synergies in space activities. Finally, space exploration (includ-

ing independent manned flights) also receives special attention in the document²¹⁹.

Japan's ambitious new space policy has also secured adequate funding, a fact that in the face of the current financial crisis underscores its importance in the eyes of the country's government. The proposed 2010 space budget foresees a 25% increase that will bring its total sum to ¥436 billion (\$4.7 billion). This is the total inter-ministerial funding according to the Basic Plan for Space Policy. However, even this sum falls short of the ¥2.5 trillion budget through 2013, recommended by the BSP. This is due to the Finance Ministry's intervention, which usually curtails space funding in its cost revisions in December²²⁰.

The principal civilian space activities funded in 2010 include the Daichi Earth observation satellite, a satellite for the Quasi Zenith GPS augmentation system and the new Advanced Solid Rocket for launching small payloads. Funding for defence space capabilities includes space situational awareness development, a dedicated military communications satellite, research in infra-red missile warning sensor technology and microsatellites. In spite of an expected change in the Japanese government in September, space programmes seemed to have secured the necessary political consensus to continue²²¹.

A report, requested by Japan's cabinet official for space policy, Seiji Maehara, and delivered on 20 April 2010, urges Japan's government to form a new space agency and close the existing JAXA. The aim is a better, quicker and more efficient response to Japan's national needs concerning space activities. Nowadays, JAXA's policy and planning is in the responsibility of the Ministry of Land, Infrastructure, Transport and Tourism, while the budget is part of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) causing unnecessary complications according to this report. It proposes a new space agency controlled by a small executive committee under the direct authority of the Prime Minister and Maehara. As 2011's space budget has to be requested in August 2010, the report recommends the establishment before this date²²².

²¹⁹ Ibid.

²²⁰ Kallender-Umezu, Paul. "Amid Shift in Power, Japan Seeks Space Budget Hike". *Space News* 7 Sept. 2009: 14.

²²¹ Ibid.

²²² Kallender-Umezu, Paul. "Japan Urged To Break up JAXA and Establish New Space Agency." *Space News* 3 May 2010: 10.

²¹⁷ "Basic Plan for Space Policy" of 2 June 2009. Strategic Headquarters for Space Policy. 30 Apr. 2010.

<http://www.kantei.go.jp/jp/singi/utyuu/basic_plan.pdf>

²¹⁸ Ibid: 6–15.



3.8 China

China's space policy evolves around the country's five years' economic development plans, the current plan having been decided in 2006. China's space programme is therefore meant to support the country's overall development objectives, while maintaining a comprehensive set of objectives for space activities. The main challenge for the Chinese programme is to mix the desire to develop independent capabilities to the maximum with the need to participate as much as possible in international space cooperation. No key strategic document was published in the field of Chinese space policy in the past 12 months, as the current ones were published at the beginning of the five-year plan and are valid until the end of 2010. New documents may be expected at the beginning of the new planning cycle.

China has a long-standing, full fledged space programme which spreads over a variety of activities. However, its main focus lays on manned space flight, space applications and the further development of its Long March family rockets. It is difficult to distinguish Chinese civilian and military space activities, as several systems have dual use and some key civilian projects (such as the Shenzhou spacecraft) are in fact under military control. Another cause of confusion is that Chinese authorities have a strict confidentiality policy regarding their space systems and they withhold information on the costs and annual budgets of most of their programmes. Although no accurate data is publicly available, the Chinese space budget is thought by most experts to increase constantly over the past few years.

China has also been increasing its involvement in international space cooperation, albeit through bilateral rather than multilateral agreements. On 17 November 2009 for example, the U.S. and China announced that the heads of their respective space agencies would exchange visits in 2010, in an effort to step up cooperation in space exploration, including human space flight. This joint statement was issued during the official visit of U.S. President Barack Obama in Beijing on 15–18 November. An agreement between the two agencies to talk at least once a year was reached during NASA Administrator M. Griffin's first historical visit to China, but the Chinese ASAT test in January 2007 postponed its implementation. In spite of this, NASA and the China National Space Administration (CNSA) have formed joint working

groups for space science and space-based climate research since 2008²²³.

On 14 April 2010, Wang Wenbao, head of the China Manned Space Engineering Office, gave an overview of China's plans to build a 30-ton space station until 2022. The first steps would contain the launch of Tiangong 1 target and Shenzhou 8 doing docking and rendezvous experiments in 2011. This is meant to be the beginning of further docking, rendezvous and refuelling experiments including manned spacecrafts like the Tiangong 3 spacelab which was to be launched between 2014 and 2016. While these launches were to be conducted by Long March 2F rockets, the three modules in order to construct the space station between 2016 and 2022 were to be launched by China's new heavy-lift rockets yet in development. China's space station should be able to host three astronauts and it is planned to last 10 years²²⁴.

3.9 India

Indian policy traditionally aims at achieving social and economic development through space activities. The Indian space programme currently operates under the guidelines of the current 11th five year plan (2007–2012) which focuses on creating space applications capable of providing tangible products that improve life conditions in the country. Self reliance and space services oriented projects are the corner stones of India's space policy. These include two operational space systems, one for satellite communications and television broadcasting services and one for Earth observation.

As the five year plan develops, Indian space budgets have been increasing accordingly. In July 2009, the Indian Space Research Organisation (ISRO) announced that its 2010 budget would stand at Rp 49.79 billion (\$1.04 billion), an increase of 40% from the previous year. This is the largest increase ever recorded in ISRO's history. The largest share of funding was set for launch vehicle development, followed by satellite technology and space applications. Rocket development plans include the Mk 3 version of the Geosynchronous Satellite Launch Vehicle (GSLV), with a lift capability of four tons. Its first flight is expected in 2010 or 2011, soon after a new indigenous cryogenic upper stage engine has

²²³ Ferster, Warren and Amy Klamper. "China, U.S. Put Spaceflight Cooperation Talks on Agenda". Space News 23 Nov. 2009: 12.

²²⁴ Klamper, Amy. "Official Details 11-year Path to Developing China's Own Space Station." Space News 19 Apr. 2010: 6.

been tested. The Indian human space flight program also acquired additional funding for the development of a two person capsule capable of attaining a 400 km orbit. In fact, ISRO reaffirmed its intention to proceed to its first manned flight by 2015.

Satellite technology research also secured funding, driven mainly by the Regional Navigational Satellite System. This is a proposed seven satellite navigation and positioning constellation to cover Indian national territory and neighbouring states. Other space applications projects include the environment monitoring missions Oceansat-3 and Resourcesat-3, as well as the new cartography satellite Cartosat-3²²⁵.

India's launch of its first self-built cryogenic stage satellite launcher failed containing the GSAT-4 communications satellite on 15 April 2010. According to ISRO's first statements, the failure was due to two vernier control motors igniting. However, it is not certain whether the cryogenic stage started to fire. While the cryogenic engine had been tested by ISRO and other experts, it was not tested in conditions that simulate high altitude, according to Nambi Narayanan. The failure will probably affect and postpone the Chandrayaan-2 lunar orbiter mission in 2012 and launches of communication satellites²²⁶.

3.10 Emerging Space Actors

3.10.1 Africa

From 7 to 9 December 2009, the Third African Leadership Conference on Space Science and Technology for Sustainable Development took place in Algeria and as a result, Algeria, Kenya, Nigeria, and South Africa signed an agreement to build up the African Resources Management Satellite Constellation. The purpose of this constellation is to help with environmental monitoring, public health, and water as well as land usage²²⁷.

The Nigerian space programme is one of the most advanced of Africa. On 17 July 2009, the director of the Nigerian Space Agency signed a Memorandum of Understanding defining a roadmap of cooperation with the

German based Infoterra in order to prepare a radar mission that Nigeria is considering²²⁸.

Nigeria is also planning to launch its second satellite, the NigeriaSat-2, in the fourth quarter of 2010 on a Dnepr rocket. The last milestone of this mission was reached in October 2009, when the spacecraft passed its flight readiness reviews²²⁹.

When it comes to South Africa, although a bill was signed in January 2010 by South African President to establish the South African National Space Agency (SANSA) in 2009, it is not done yet. However, in autumn 2009 the nominations for a board were approved. Once the space agency is established, it seems likely that one of its core programmes will be dedicated to Earth observation²³⁰.

Good news can be reported from the Sumbandila project – the first South African government-owned satellite that was launched on 17 September 2009 with delay. It was developed by SunSpace, the company that launched also the satellite-project of the University of Stellenbosch called SunSat in 1999. Sumbandila passes four times a day over South Africa and will collect images for governmental use for instance in water management, agriculture, and urban planning²³¹.

3.10.2 Southeast Asia

The second half of 2009 and the first half of 2010 was a challenging and somewhat frustrating year for South Korea and its attempts to launch a satellite onboard the country's first national space launching vehicle. The first attempt, which was made on 25 August 2009, failed when the Korea Space Launch Vehicle (KSLV-1) did not put its payload (the meteorological satellite STSAT-2) into orbit. The vehicle, built with considerable help from the Russian rocket engine manufacturing

²²⁵ Jayaraman, K.S. "ISRO Budget Receives 40 Percent Increase from 2008". Space News 13 July 2009: 12.

²²⁶ "ISRO's Cryogenic Stage Fails in Maiden Flight." Space News 19 Apr. 2010: 3.

²²⁷ "Space Activities in Africa." 27 Dec. 2009. Space Issues. 25 May 2010. <<http://www.space-issues.com/blog/?p=316>>.

²²⁸ "Nigerian Space Agency signs MoU with Infoterra." 17 July 2009. Infoterra. 25 May 2010. <<http://www.infoterra.de/detailview/date/2009/07/17/nigeria-n-space-agency-signs-mou-with-infoterra-gmbh.html>>.

²²⁹ Wolstenholme, Robin. "Nigeria completes milestone in space." 07 Oct. 2010. Surrey. 25 May 2010. <<http://blog.sstl.co.uk/archives/254-Nigeria-completes-milestone-in-space.html>>.

²³⁰ Fairly, Peter. "South Africa's Polar-Orbiting Ploughshares – A National Space Agency could help it become a regional powerhouse in Earth observation." 18 Jan 2010. earthzine. 25 May 2010.

<<http://www.earthzine.org/2010/01/18/south-africas-polar-orbiting-ploughshares-a-national-space-agency-could-help-it-become-a-regional-powerhouse-in-earth-observation>>.

²³¹ "SA satellite finally lifts off." 18 Sep. 2009. News24. 25 May 2010. <<http://www.news24.com/SciTech/News/SA-satellite-finally-lifts-off-20090918>>.



company Khrunitsev, was presumed to have suffered an upper stage malfunction²³².

In spite of this unhappy moment, South Korea did not back down from its ambition to successfully lift the vehicle and become the 10th country to independently launch its own satellite. Its next attempt was scheduled for May 2010, despite of North Korean protests against the launch, qualifying it as a ballistic missile test²³³. At the same time, Korea proceeded with its plans to acquire a completely independent launching capability by 2018.

On 22 February the Thaicom satellite fleet operator of Thailand announced a small 1.7% drop in its 2009 revenues. This result was mainly attributed to a 28% fall in broadband satellite terminals sales. Thaicom provides satellite broadband services through its dedicated Thaicom 4 (also named Ipstar) spacecraft. The firm expected this downward trend to reverse in 2010, as it planned to expand its operations to India and Taiwan. On the contrary, Thaicom's conventional satellite communications services' revenue increased by 1.6%, in spite the retirement of its Thaicom 1A spacecraft at the end of 2009. The company currently uses one more satellite, the Thaicom 2, which is also approaching the end of its expected operational life span. In 2009 Thaicom reported \$134.7 million in total revenues²³⁴.

The conflict in Thailand had impacts on Thaicom as the government forced Thaicom to shut down broadcasting of the People Channel Television (PCT), although PCT was not a direct Thaicom customer. After demands to its customer were not accomplished, Thaicom started to jam PCT on 7 April, but the channel moved to another Thaicom customer based outside Thailand. After threats of Thaicom to shut down the whole C- and Ku-band capacity of its customer, the latter stopped broadcasting on 23 April. Thaicom found itself between government's instructions, "company's employees and assets" and decided in favour of the government²³⁵.

²³² Parks, Clinton. "S. Korean Officials Investigate Launch Failure". Space News 26 Aug. 2009.

<<http://www.spacenews.com/launch/korean-officials-investigate-launch-failure.html>>.

²³³ Kim, Christine. "South Korea Plans Domestic Rocket Launch in Weeks" 13 Apr. 2010. The Star Online. 30 Apr. 2010.

<http://thestar.com.my/news/story.asp?file=/2010/4/13/worldupdates/2010-04-13T092511Z_01_NOOTR_RTRMDNC_0_-476451-1&sec=Worldupdates>.

²³⁴ "Declining Terminal Sales Harm Thaicom Revenue". Space News 1 Mar. 2010: 9.

²³⁵ De Selding, Peter B. "Thailand's Political Unrest has Thaicom Caught in the Middle." Space News 3 May 2010: 6.

3.10.3 Middle East

In January 2010, the question of satellite broadcasting interference came under the spotlight in the Middle East. In particular, France's National Frequencies Agency (ANF) asked the Geneva based International Telecommunication Union (ITU) to intervene with Iranian authorities in order to persuade them to cease jamming of BBC World Service's Farsi speaking programme over Iranian territory. French authorities were involved as the programme was transmitted through the Eutelsat Hot Bird 6 satellite. According to French sources, jamming had started during the Iranian election campaign in the spring of 2009 and had not stopped since. After repeated failed attempts to address this issue directly with Iranian authorities, ANF appealed to the ITU. However, since the latter is a purely regulatory organisation with no means to enforce its decisions on its Member States, it was unclear whether its involvement would bring about any results. In the meantime, the BBC had decided to move its broadcasting to another Hot Bird 6 beam and ultimately to another Eutelsat satellite over the region, in an attempt to overcome the interference²³⁶.

In a separate development, on 3 February Iran unveiled the country's latest rocket, Simorgh. A full-scale mock-up of the vehicle was demonstrated to the public during the Iranian national Space Day ceremonies, which also included the launch of the Kavoshgar-3 rocket that carried small animals to space. According to the published pictures of the Simorgh, the vehicle seems to be 27 m long with a maximum diameter of at least two metres. It has two stages, with four engines for the first and one for the second one. Iranian officials claimed that it had the capacity to lift 100 kg into orbit, but western analysts claimed this could be upgraded in the medium term. The same analysts noted that if it was used as a ballistic missile, Simorgh could propel a one ton warhead to a range of 4,000 km. U.S. and Israeli experts were surprised to see an entirely new launcher developed by Iran, as they predicted Iran would focus on evolving its existing rockets, namely the liquid-fuelled Safir-2 and the solid-fuelled Sejil-2. It appears that Shehab 3B engines were used in the rocket's clustered first stage. Some observers also noticed similarities with the first stage of North Korea's Taepodong-2 three-stage launcher. In spite of its size, Simorgh apparently lacked a thrust-to-weight ratio capable of an intercontinental range. Its radically new

²³⁶ De Selding, Peter B. "France Seeks ITU Help To Halt Satellite Signal Jamming by Iran". Space News 11 Jan. 2010:4.

first stage design however, could eventually be used in a future Iranian ICBM²³⁷.

3.10.4 Latin America

In the past 12 months, Brazil has continued to expand its scope of bilateral cooperation agreements on space activities in an effort to develop necessary technologies for its ambitious space programme. On 8 October for example, the country's space agency AEB signed a technology exchange agreement with Belgium's Liege space centre. This four year agreement includes a wide area of technologically advanced fields of activity, from nanosatellites to space instruments validation²³⁸.

The key Brazilian objective in recent years has been the development of the national space rocket VLS-1, capable of carrying satellites to LEO. This project has been managed in close cooperation with Ukrainian and Russian companies. In April 2010, Brazil's space agency AEB announced a schedule for the programme, which foresaw the first launch of a version of the VLS-1 capable of lifting small satellites into LEO by 2014 at the latest. This mission would be the first since 2003, when an explosion of the rocket on its launching pad cost the lives of 21 people and put a halt to its further operational testing. Reportedly, this improved version has been developed with the assistance of Russian companies²³⁹.

Finally, joint Brazilian-Chinese cooperation in building the next generation of Earth observation CBERS satellites for the country suffered a set back in February 2010, when AEB announced the postponement of the CBRS-3 spacecraft launching to 2011. The delay was attributed to technical problems identified during the system's design review²⁴⁰.

3.11 International Sectoral Comparison

In order to assess the scope and dynamism of activities, strategies and plans of the main space-faring nations, key space activities, such as the ability to launch missions and the number and type of missions launched, must be considered.

3.11.1 Launch Sector

The possession of launch vehicles and spaceports is a central element enabling independence in space activities. Moreover, the number of launches and the level of activity on the space bases give an indication on the dynamism of a country in the space sector.

In 2009, there was a total number of 78 orbital launches conducted by eight countries, Europe and the now bankrupt multinational consortium Sea Launch including Land Launch (Figure 3.2)²⁴¹.

Despite the reduction of Sea Launch's activities during 2009, the Sea Launch subsidy Land Launch was responsible for three launches conducted from Baikonur with Ukrainian rockets.

Whereas China nearly cut in half its launches from 11 to six and lost its third position to Europe, the U.S. increased its launches significantly (from 15 to 24) as well as Japan (from one to three). Iran conducted its first successful and indigenous orbital launch. Other new members in the field of launching countries are North Korea and South Korea with one launch each, however, their attempts both failed.

As mentioned above, the hierarchy changed in 2009. Russia (with 29 launches) and the USA (24 launches) still hold the first and second positions and represent 68% of total launches. Europe now occupies the next position with six launches (also in 2008) whereas

²³⁷ Opall, Barbara. "Israeli Missile Experts: Simorgh Sets Iran on Path to ICBM". Space News 15 Feb. 2010: 14.

²³⁸ "Brazil, Belgium Sign Space Cooperation Agreement." 08 Oct. 2009. Space Mart. 28 May 2010. <http://www.spacemart.com/reports/Brazil_Belgium_Sign_Space_Cooperation_Agreement_999.html>.

²³⁹ "Brazil To Develop Carrier Rocket By 2014." 06 Apr. 2010. Space Travel. 28 May 2010. <http://www.space-travel.com/reports/Brazil_To_Develop_Carrier_Rocket_By_2014_999.html>.

²⁴⁰ "Brazil, China To Postpone Joint Satellite Launching To 2011." 16 Feb. 2010. Space Travel. 28 May 2010. <http://www.space-travel.com/reports/Brazil_China_To_Postpone_Joint_Satellite_Launching_To_2011_999.html>.

²⁴¹ This figure includes 70 successful ELV launches, three ELV failures and five Shuttle flights.

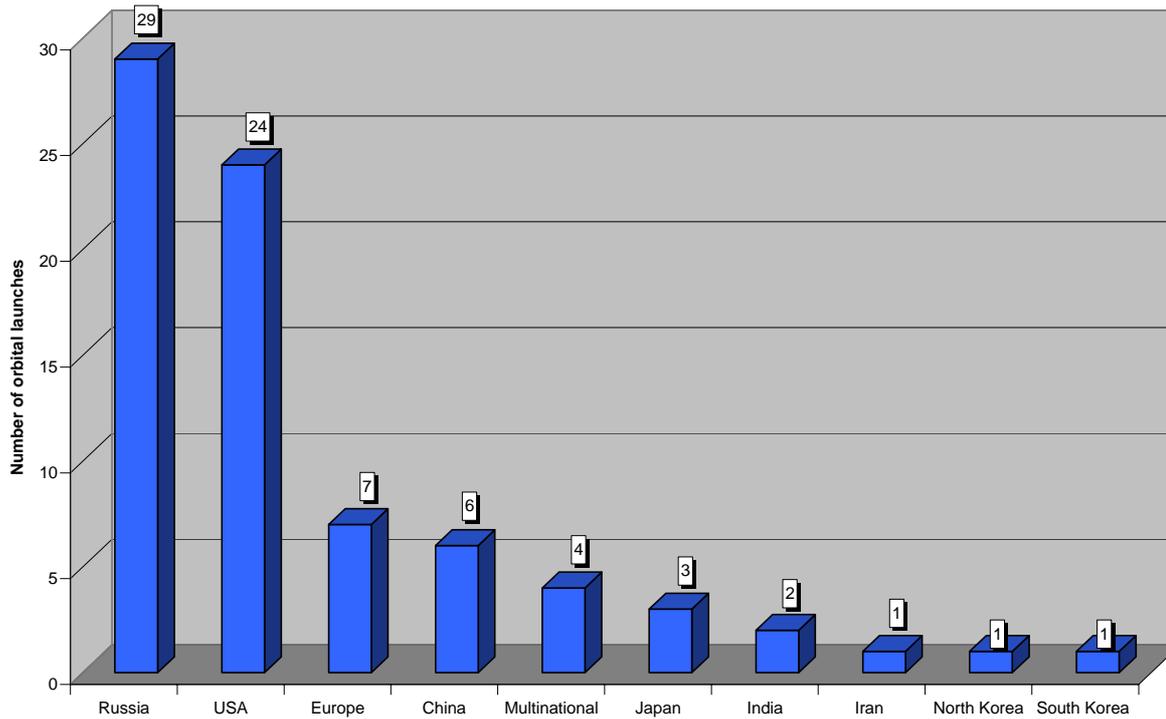


Figure 3.2: Total worldwide orbital launches per entity in 2009 (Source: FAA²⁴²)

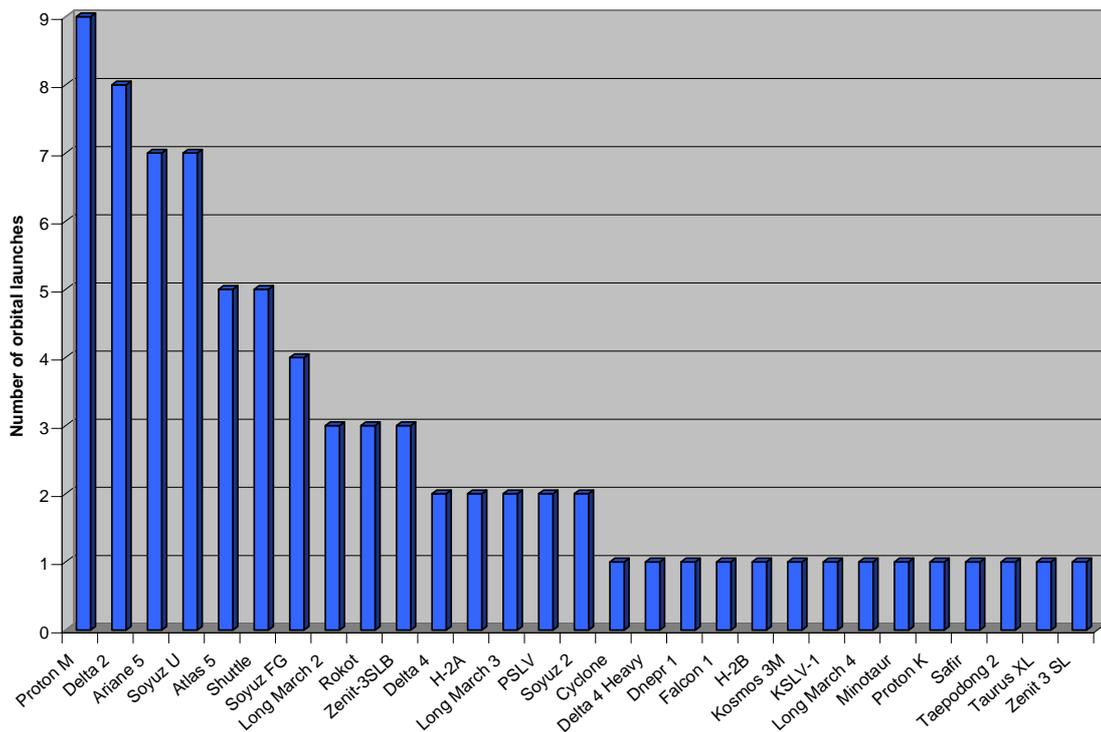


Figure 3.3: Worldwide orbital launches per launch system in 2009 (Source: FAA²⁴³)

²⁴² Federal Aviation Administration. "Commercial Space Transportation ..."

²⁴³ Federal Aviation Administration. "Commercial Space Transportation: 2009 Year in Review." Jan. 2010. Washington DC: FAA. 30 April 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

one can observe a bigger gap between the main launching countries and the rest due to China's reduction of launches. The launches were distributed over 29 launch systems, with Russia and the U.S. each having used eight different ones, China having used three different launch systems and Japan having used two launch systems. Europe, Sea Launch, India, Iran, North Korea, and South Korea each used only one single launch system (Figure 3.3). The total amount of different launch systems increased by nearly 40% compared to 2008. Proton M was again the mostly used launch system, with nine launches, followed by Delta 2 with eight launches, Ariane 5 and Soyuz U complete the podium with seven launches each. The distribution is more uneven than in the previous year, with 14 launch systems having served just once compared to only four in 2008.

The use of space transportation infrastructure is another indicator that helps assess the "space hierarchy", as space bases are core assets for independent access to space. The number of space bases used by a country, as

well as the frequency of launches conducted from its different spaceports, are important indicators of the dynamism of a country's space activities. In 2009, 16 launch sites were used, including one mobile platform (Sea Launch Odyssey Platform). This is two more than in 2008 (Figure 3.4)²⁴⁵. The United States used four launch sites (Cape Canaveral/Kennedy Space Center, Vandenberg, Kwajalein and Wallops) and therefore displaced Russia as the leading country in diversity in 2009. Russia indeed increased the number of launches but it downsized the number of its launch sites and concentrated all launches on Baikonur and Plesetsk. As in 2008, China used three launch sites, namely Taiyuan, Xichang and Jiuquan. Europe, Japan, India, Iran, North Korea and South Korea each used one launch site.

In 2009, Baikonur was even more the busiest space base, with 24 launches, five more than in 2008 and representing one third of the total launches in the year. Also Cape Canaveral experienced an increase and was the base for 16 launches (seven launches in

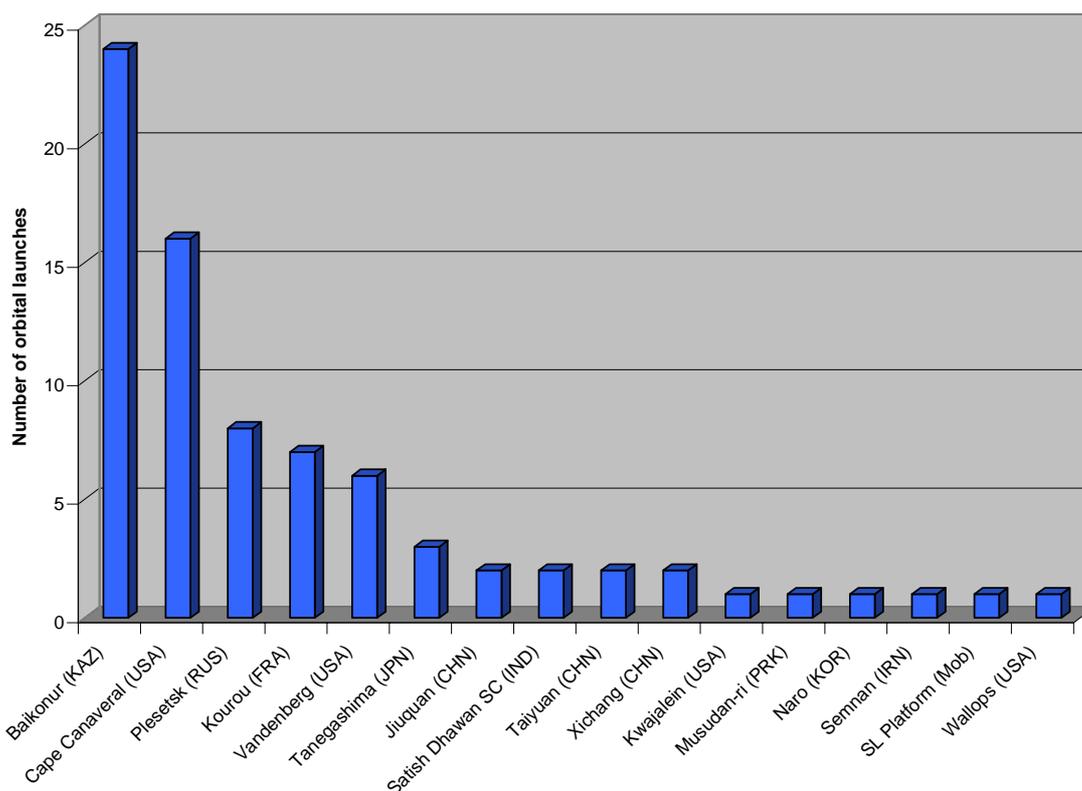


Figure 3.4: Worldwide orbital launches per launch sites in 2009 (Source: FAA²⁴⁴)

²⁴⁴ Federal Aviation Administration. "Commercial Space Transportation: 2009 Year in Review." Jan. 2010. Washington DC: FAA. 30 April 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

²⁴⁵ The item 'Cape Canaveral (USA)' includes both the Cape Canaveral AFS and the Kennedy Space Center. The Satish Dhawan Space Center in India was formerly known as Sriharikota.

the missions decreased from nine missions to five in 2009.

It is also important to look at the type of missions launched, as only few countries could display a broad variety of missions (Figure 3.6). The inequality in this field is striking, as 17 countries launched only one type of mission. The USA had again the most diverse set of missions, as they launched 13 different kinds of missions. They were followed by Russia (eight types) and China²⁴⁹ (four types). It is however noteworthy that when considered as a whole, Europe launched seven different kinds of missions.

3.11.3 Overall Assessment

The overall picture of a hierarchy in space activities was confirmed in 2009; however, a smaller shift can be noticed. The United States and Russia remained the two dominant actors in space. Whereas Russia was still the world leader in the launch sector in 2009, the U.S. occupied first place in terms of missions launched. Europe had a solid year in

2009 with seven launches, but 25 missions, again as many as Russia. China comparably lost some ground with respect to the number of launches as well as the number of missions, but still remains a strong space nation.

Japan made up lost ground and regained the position it lost last year as the fifth most important space-power, thereby stopping the negative trend of the last three years. India, which occupied the fifth place in 2008, remained solid in 2009 in terms of launch and mission numbers (Figure 3.7).

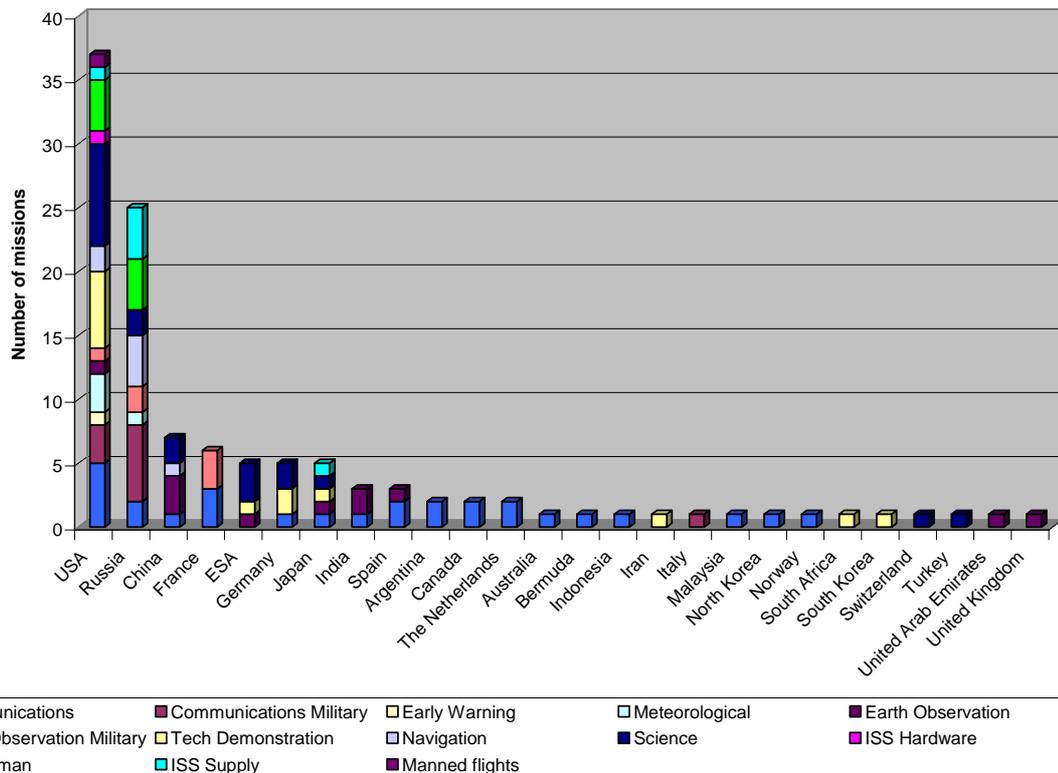


Figure 3.6: Types of missions launched into orbit in 2009 (Source: FAA²⁵⁰)

²⁴⁹ In some cases, it is difficult to assess the exact nature of the Chinese missions, as there are suspicions about the dual-use character of certain payloads.

²⁵⁰ Federal Aviation Administration. "Commercial Space Transportation: 2009 Year in Review." Jan. 2010. Washington DC: FAA. 30 April 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

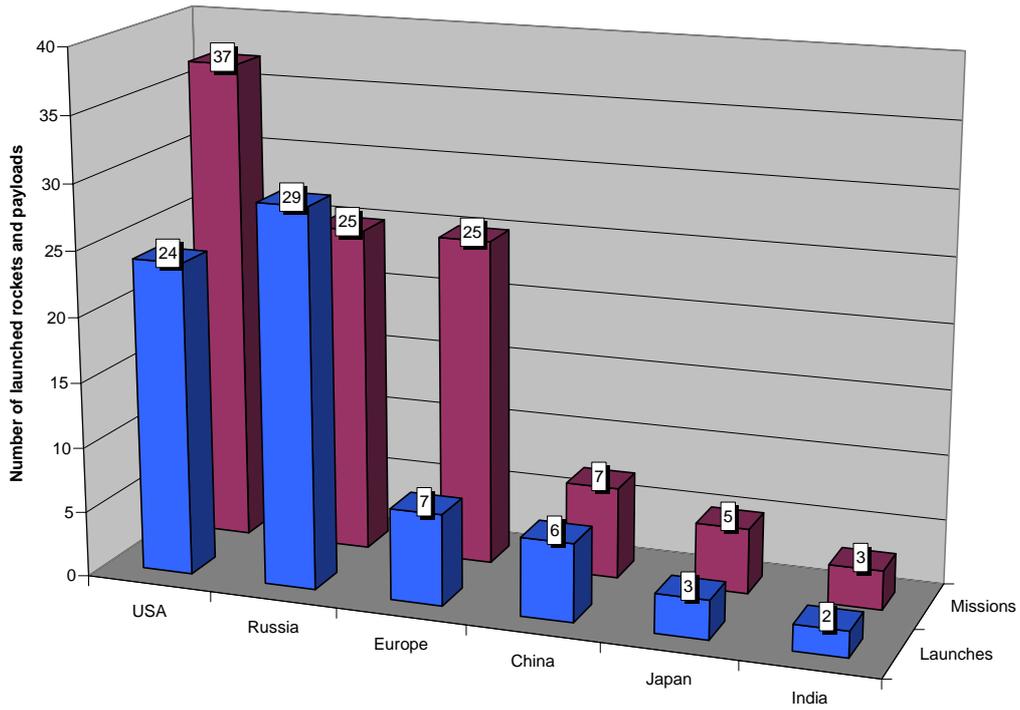


Figure 3.7: Assessment of major space powers' activities in 2009 (Source: FAA²⁵¹)

²⁵¹ Federal Aviation Administration. "Commercial Space Transportation: 2009 Year in Review." Jan. 2010. Washington DC: FAA. 30 April 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

4. European Institutional Market

In this chapter, institutional space spending in Europe is described along distinct categories that are explained accordingly. The amounts are put into perspective and compared with each other. This enables the understanding of important ratios and proportions within European space activities. It also sets a basis for comparison with space actors outside Europe.

4.1 European Institutional Features

European space programmes develop simultaneously on three distinct levels: national, intergovernmental (e.g. ESA, EUMETSAT) and supranational (European Union). This structure results in overlapping complementary budgetary lines, which are evident in the diagram shown in Figure 4.1.

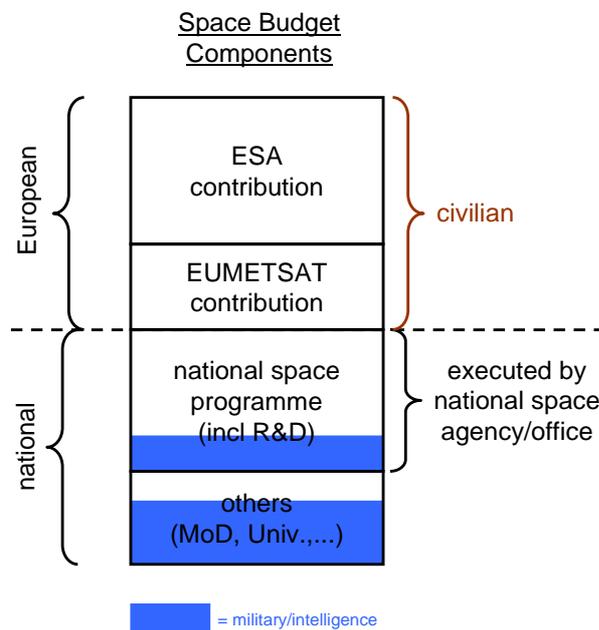


Figure 4.1: General structure of space budgets

As a result of the abovementioned structure, national space budgets in Europe usually have both a European and a national component. The first consists of contributions to ESA and EUMETSAT and is considered as civilian for the purposes of this report, as both organisations are broadly labelled as civilian in spite of the fact that their products

and services are also of military usefulness. Direct Member States' contributions to the European Union do not officially have a space related designation and shall not be taken into account. Nevertheless, in recent years EU funds have been increasingly used to finance space activities.

National space budgets usually have three tiers: civilian, military and space related academic research. In the case of countries that have instituted national space agencies, these generally centrally fund the first and the third tiers, whereas the second remains under defence ministries' management. In countries that prefer less centralised approaches, as for example was the case in the United Kingdom until recently, budgetary lines are dispersed throughout government agencies, which makes them more difficult to account for.

Apart from this vertical delineation, space related budgets are also dispersed horizontally among national, bilateral and multilateral space cooperation agreements. For example, some European countries that are engaged in multinational cooperation through their participation in the European Space Agency (ESA) also have bilateral agreements on military space activities between them. In this way, the same or similar military space projects are simultaneously funded within European institutions (notably the EU Commission and the European Defence Agency) and outside them. These are represented in the blue area of Figure 4.1. The same applies to academic research and development projects that are channelled both through ESA and bilateral scientific cooperation agreements.

Not all European countries invest in military or intelligence space activities, and the lion's share of European institutional spending is dedicated to civilian activities. The total sum of European institutional spending on space in 2009 was around €6.5 billion which is around half a billion less than in 2008. That will be detailed in the following sections. The sum is split into 91% for the civilian sector and 9% for the military one, and indicates a drop of the military share from 18%. Not only in relative numbers – the U.S. spends an estimated share of 58% on security-related space activities – but also in absolute num-



bers, these militarily used funds are significantly lower than those spent in the United States.

4.2 Civilian Space Expenditure

Around €5.9 billion of public European funds were spent for the civilian space sector. The ESA budget rose and remained the largest at €3.59 billion (now about 61% of the total European civilian space expenditures), while national programmes decreased and accounted for approximately €1.8 billion (around 31%). The EU again appeared as a significant spender with an estimated annual budget of about €750 million (13%), whereas the EUMETSAT budget increased to €229 million (4%). Figure 4.2 shows the budgets of these four constituents in comparison to 2008.

4.3. European Space Agency (ESA)

The European Space Agency budget represents the largest share of civilian space funding in Europe. In 2009 the ESA budget reached €3.59 billion, up from €3.04 billion in 2008. ESA funding derives principally from Member States' contributions, but it also includes Canadian participation as an associated Member State and third-party funding for specific programmes. Member States' contributions to the mandatory ESA programmes are calculated as a fixed percentage of their Gross Domestic Product (GDP). In the case of additional optional programmes, the level of involvement is freely decided by participating Member States themselves.

Major areas of ESA funded activities in 2009 included Telecommunications and Navigation (19.7%, down from 20.1% in 2008), Launcher Operations (18.4%), Earth Observation (16.3%), Science (12.1%) and Human Spaceflight (10.8%, up from 8.71% in 2008). ESA budget allocations are depicted in Figure 4.3.

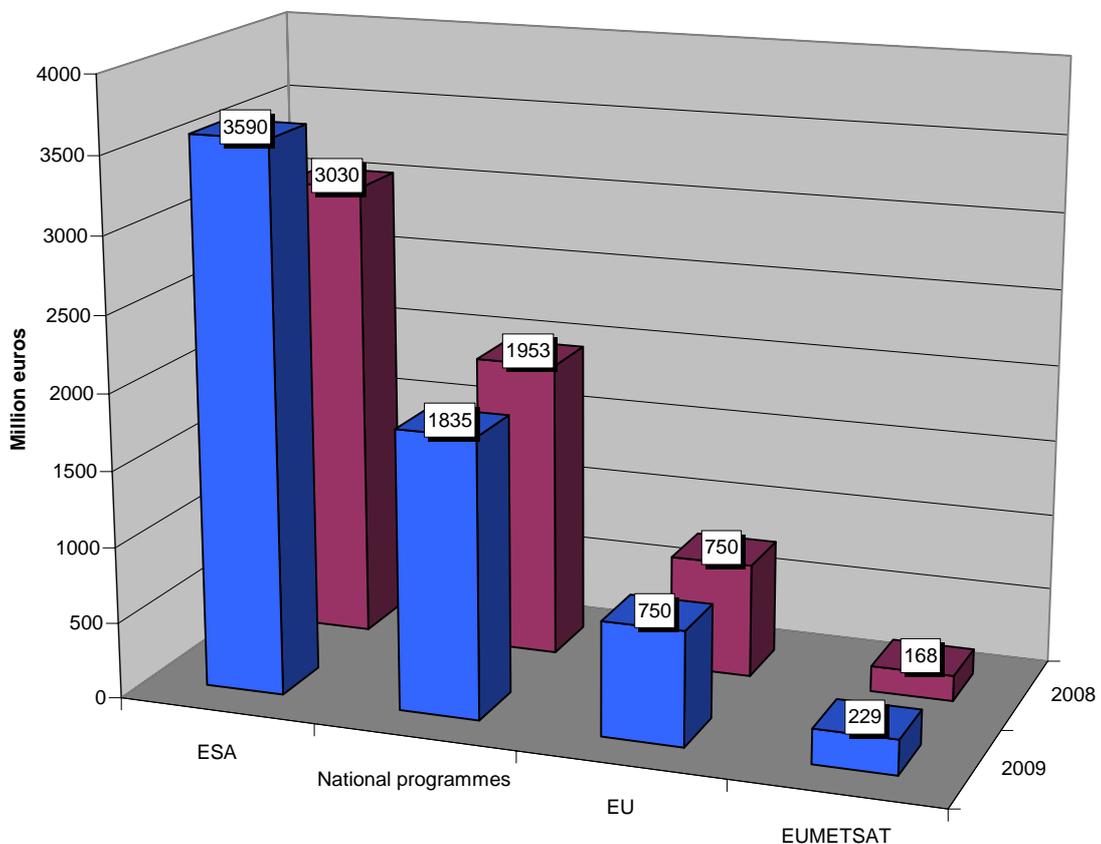


Figure 4.2: Estimated European civil public expenditures in 2009

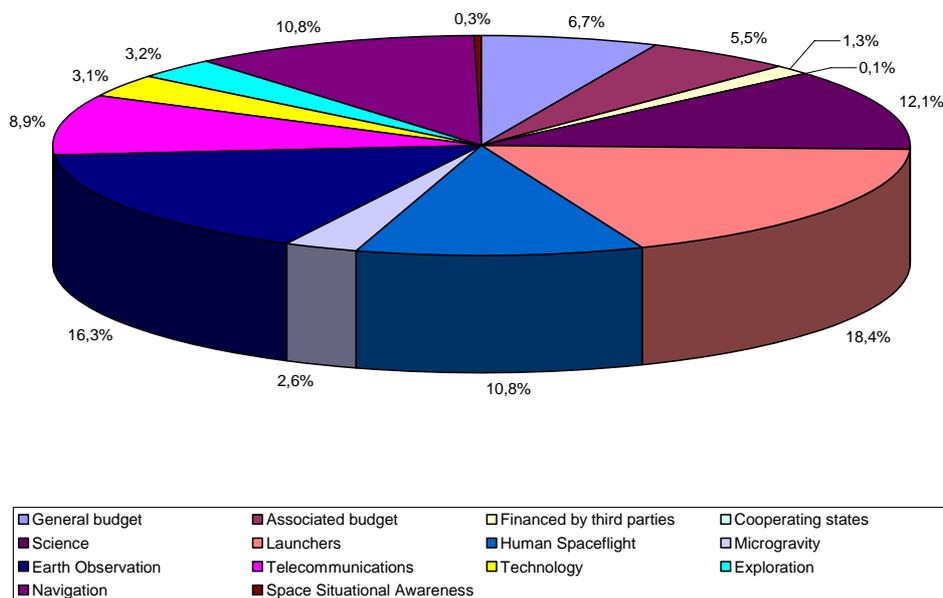


Figure 4.3: ESA programmatic budget allocations for 2009 (Source: ESA²⁵²)

Member States' contributions to ESA in 2009 increased to €2.82 billion from €2.42 billion in 2008. France remained the biggest con-

tributor and even extended its share to €716 million in 2009, representing 25.4% of the total. It was followed by Germany (23.0%),

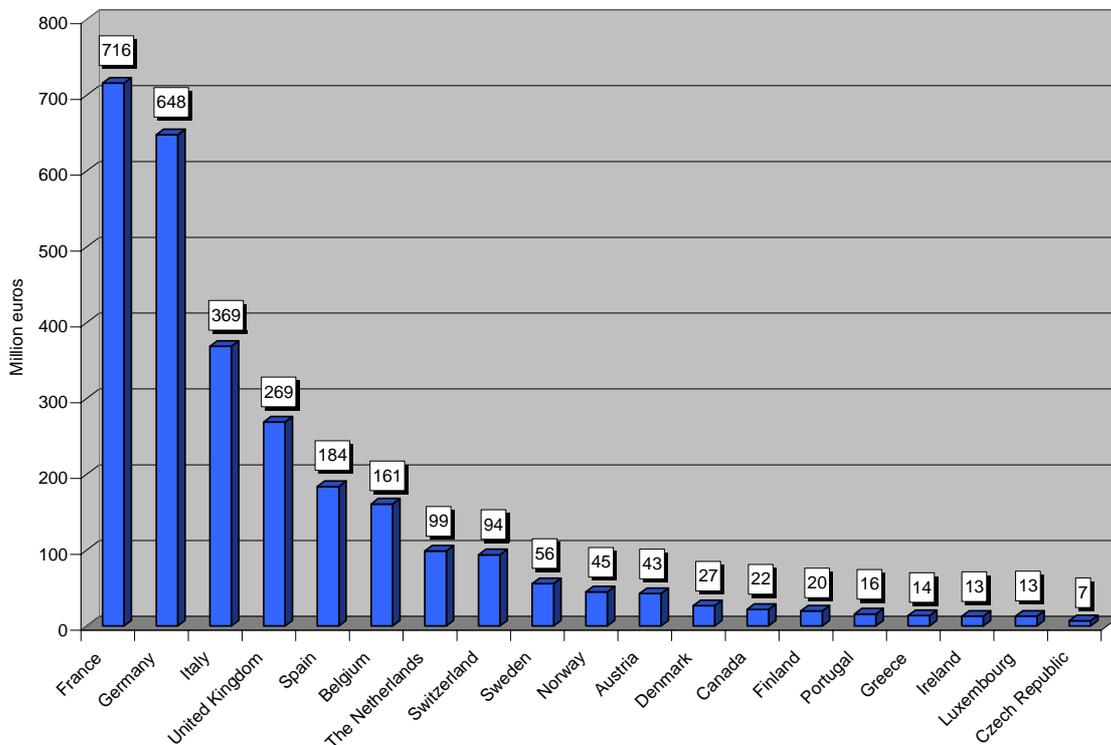


Figure 4.4: Member States contributions to ESA budget for 2009 (Source: ESA²⁵³)

²⁵² European Space Agency. The European Space Agency. Paris: ESA, Sept. 2009. <http://esamultimedia.esa.int/docs/corporate/ESA_Presentation_Sept_2009.pdf>.

²⁵³ Ibid.



Italy (13.1%), UK (9.6%) and Spain (6.5%). These five countries accounted for 77.6% of ESA Member States' contributions (Figure 4.4). An additional €420 million came from sources other than direct Member States contributions²⁵⁴.

4.4 EUMETSAT

The vast majority of EUMETSAT's budget comes from contributing member and cooperating states. Members' contributions are calculated on the basis of their Gross National Income (GNI), rather than GDP. In 2009 Germany was the largest contributor with 19.9% (down from 21.4% in 2008), followed by the UK with 16.2% (down from 16.6%), France with 15.2% (down from 15.7%), and Italy with 12.5% (down from 12.6%). These four countries accounted for

63.8% of the total (Figure 4.5). Hungary became a Member State in October 2008. It contributed 0.71% of the total budget to the mandatory programmes of EUMETSAT in 2009. Cooperating states contribute 50% of a full membership fee. In this way, for example, Bulgaria accounted for 0.18% of EUMETSAT's budget in 2009²⁵⁶.

In 2009 the EUMETSAT budget rose significantly to €229.1 million, from €168 million in the preceding year and €205 million in 2007. Major funded programmes in 2009 included Meteosat Second Generation (MSG) satellites with €92.4 million, the EUMETSAT Polar System (EPS) with €85.3 million (up from €73.1 million in 2008), and preparation for the Meteosat Third Generation (MTG) satellites with €11.7 million. An additional €11.7 million was devoted to the general budget. The MSG project replaced EPS as the organisation's biggest cost factor in 2009²⁵⁷.

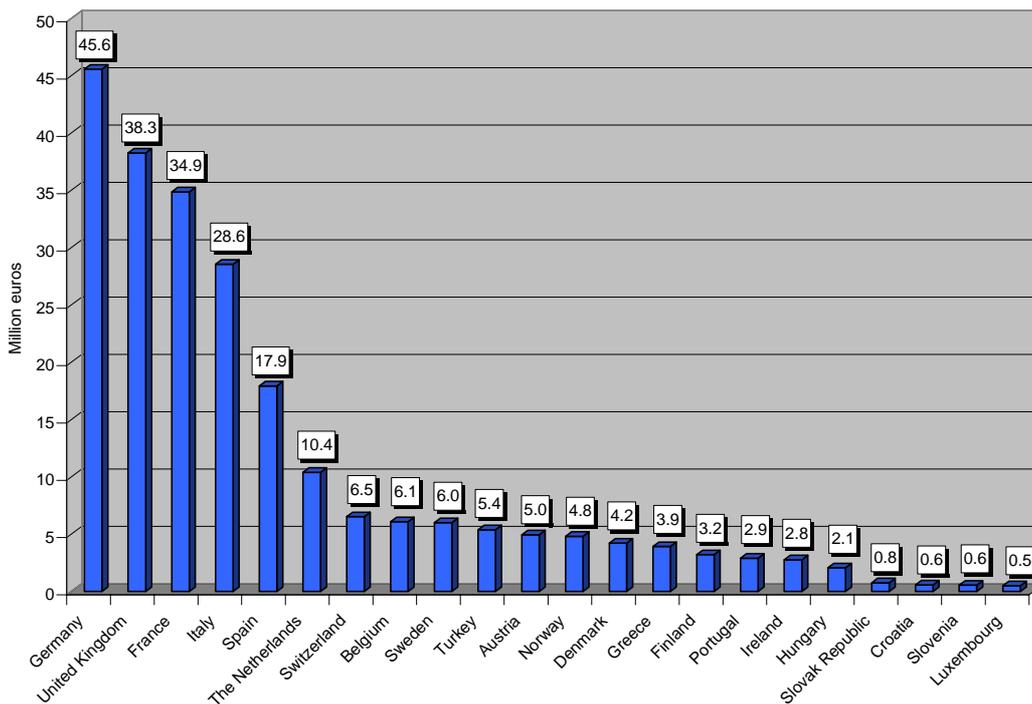


Figure 4.5: Member States contributions to EUMETSAT for 2009 (Source: EUMETSAT²⁵⁵)

²⁵⁴ Ibid.

²⁵⁵ "Funding" 3 Mar. 2009. EUMETSAT. 19 Mar. 2010. <<http://www.eumetsat.int/Home/Main/AboutEUMETSAT/WhoWeAre/Funding/index.htm?l=en>>.Ibid.

²⁵⁶ Ibid.

²⁵⁷ Ibid.

EUMETSAT. Annual Report 2008. Darmstadt: EUMETSAT, June 2009. <http://www.eumetsat.int/Home/Main/AboutEUMETSAT/Publications/AnnualReport/groups/cps/documents/document/pdf_ar_2008.pdf>.

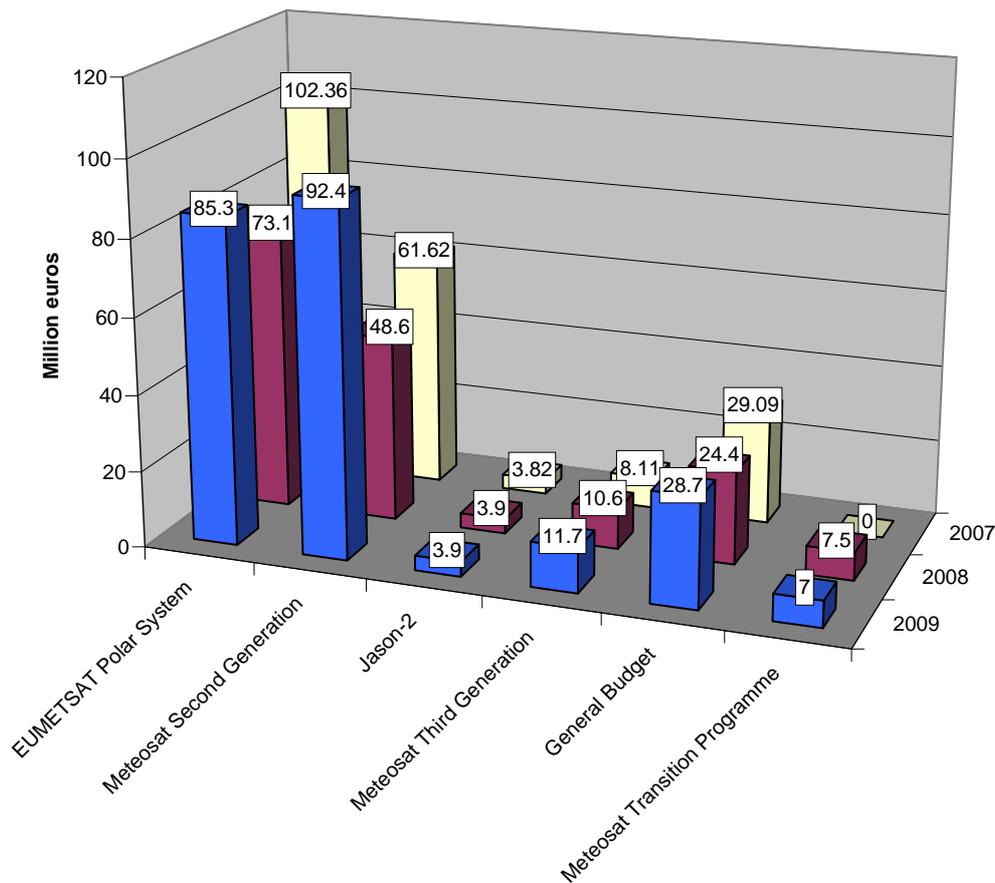


Figure 4.6 Major programmatic allocations of EUMETSAT in 2009, 2008, and 2007

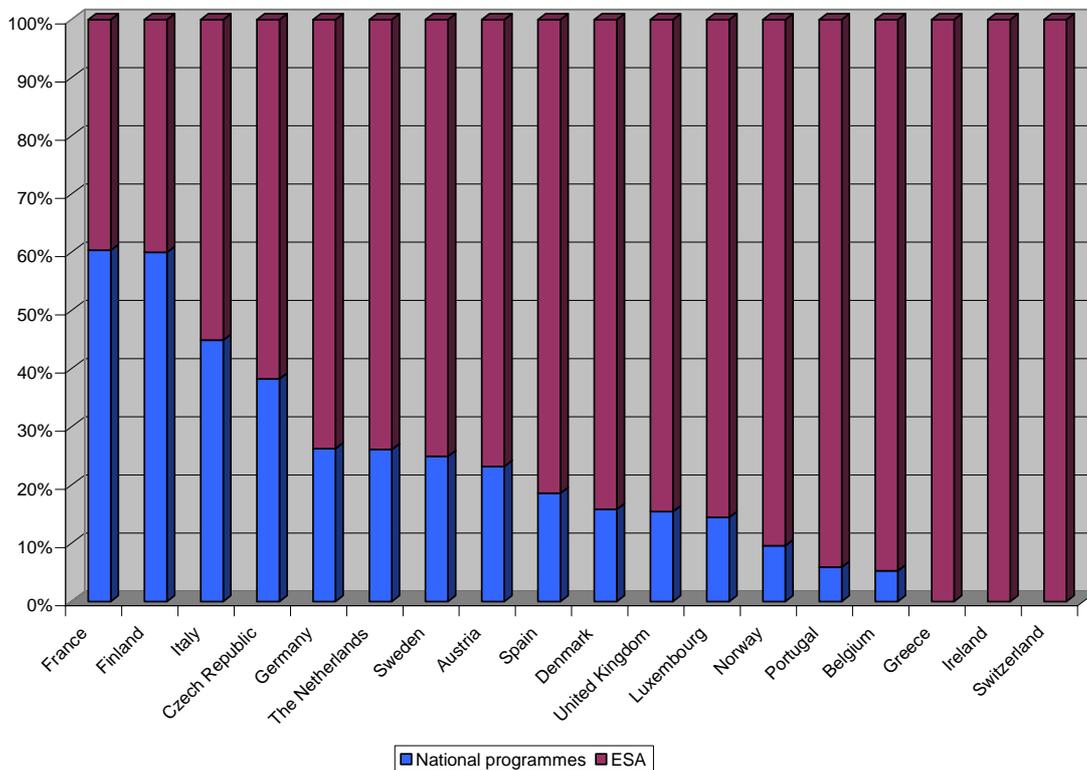


Figure 4.7 Estimated shares of European national institutional investment in civilian space of ESA members in 2009 (Based on Euroconsult data)

4.5 National Agencies

Most of the 18 ESA Member States implement their own national space programmes through a dedicated space agency, or some kind of space activities' administrative body. Understandably, this situation leads to a great variety of policy priorities, and operational needs across Europe. However, the bulk of respective countries' national space investment is predominantly channelled through ESA programmes (Figure 4.7)

Public spending for space activities remains quite diversified within Europe. In 2009, the three biggest spenders, France, Germany, and Italy, again accounted for the vast majority of European civilian space expenditure, constituting around 88% together (Figure 4.8) compared to 83.5% in 2008. These countries and their space agencies, the Centre National d'Etudes Spatiales (CNES), the Deutsches Zentrum für Luft und Raumfahrt (DLR) and the Agenzia Spaziale Italiana (ASI) are briefly described below in terms of budgetary figures.

4.5.1 France

As was the case last year France, with €1.8 billion in 2009, was the country with the largest national civilian spending in Europe. Funding for the national space agency CNES accounted for approximately €1.1 billion, while the French contribution to ESA was again €685 million. EUMETSAT received €36 million out of the French civilian space spending²⁵⁸.

On 28 January 2010 officials from the French space agency CNES announced that the agency's R&D budget for 2010 would be reduced to €21.3 billion. This figure was approximately 5% lower compared to 2009 and 17% compared to 2008. The overall CNES budget for 2010 was expected to reach €749 million. Negotiations between CNES and the French government were also under way for the establishment of the agency's next five-year plan through 2015. CNES officials did not foresee any increase in the budget's non-ESA segment. As a result, the French space agency was expected to focus on prioritising among future technologies to be developed. It would also work on improving quality management, so as to ensure that only technologically mature and asserted systems would be integrated into specific programmes.

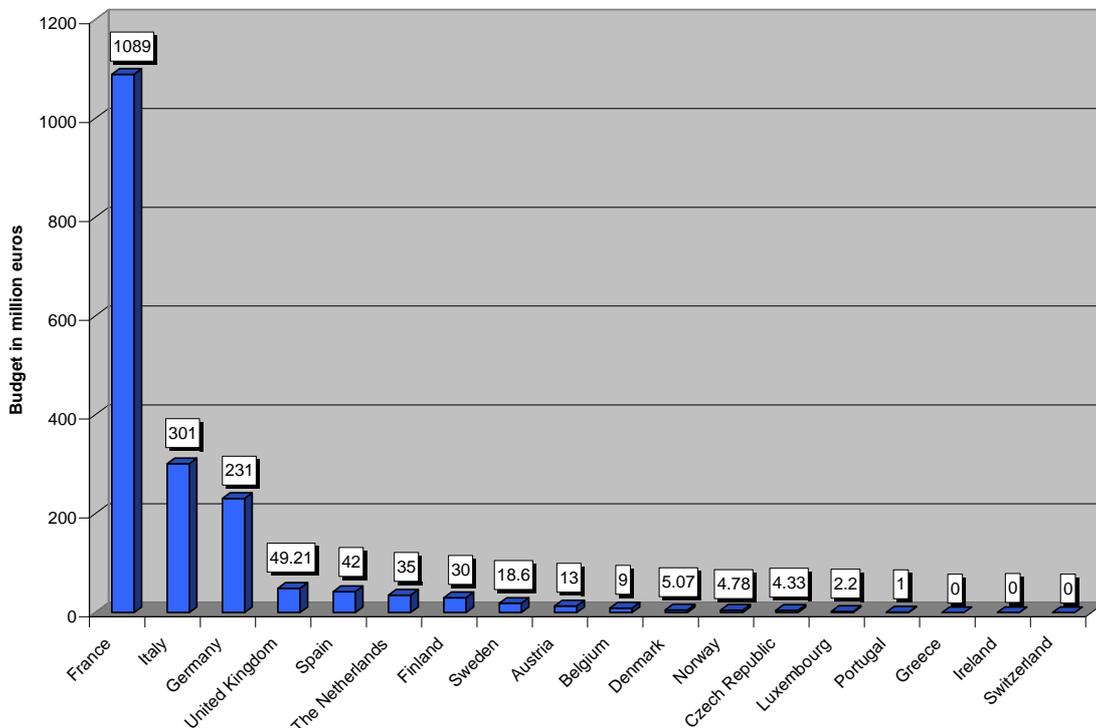


Figure 4.8: Estimation of European national space budgets of ESA members in 2009 (Based on Euroconsult data)

²⁵⁸ EUMETSAT. Annual Report 2008. Darmstadt: EUMETSAT, June 2009. <http://www.eumetsat.int/Home/Main/AboutEUMETSAT/Publications/AnnualReport/groups/cps/documents/document/pdf_ar_2008.pdf>.

Among the key technologies funded in 2010 were the development of small satellite bus platforms, new Earth observation sensors and radiation-hardened components²⁵⁹.

In February 2010 the French space agency CNES announced it could receive up to €750 million from the government's economic stimulus package, expected to be voted by the country's parliament in March. Two thirds of these funds would be channelled directly to space programmes, including preliminary work on the future Ariane 6 launcher. Furthermore, an additional €250 million could be secured for funding broadband services communications satellites built by CNES, in the framework of a government programme to increase rural broadband internet connectivity in the country. This additional funding was timely for CNES, as the agency's budget had not increased in 2010. More precisely, CNES' participation to ESA projects in 2010 amounted to €685 million, not adjusted for inflation, while the French national space programme rose by merely 1.5%, to €749 million. However, CNES officials expected a considerable budget increase in 2011, within the framework of the agency's revised medium-term planning for 2011–2015. Under this plan, French contribution to ESA in 2011 would rise to €770 million, or 12.4%, and it will also be adjusted for inflation throughout the five year period. This increased rate of spending would allow CNES to repay its €325 million debt to ESA by 2015²⁶⁰.

4.5.2 Germany

In 2009, Germany spent the second largest amount on civilian space activities. In total, the budget was about €926 million, €231 million of which was allocated to its national programme managed by DLR and €646 million was the German contribution to ESA. The German share of the EUMETSAT budget accounted for €49 million.

4.5.3 Italy

The third biggest civilian space budget in 2009 was the Italian one, which amounted to approximately €699 million. €301 million was the budget of ASI, the national space agency. The Italian contribution to ESA was an estimated €370 million and Italy spent around €29 million in contributing to EUMETSAT.

²⁵⁹ De Selding, Peter B. "CNES Outlines Plans for Smaller Research and Technology Budget". Space News 1 Feb. 2010: 5.

²⁶⁰ De Selding, Peter B. "French Stimulus Package Includes up to \$1 Billion for CNES". Space News 15 Feb. 2010: 6.

4.6 European Union

The increasing involvement of the European Union authorities in space activities has been a key plank in the continent's space programmes during the last few years. According to its five year 2007–2013 plan, common EU funding for space projects amounts to €5.25 billion or approximately €750 million on an annual basis. Major EU funded initiatives include the Galileo satellite positioning constellation and the Global Monitoring for Environment and Security (GMES) satellite programmes²⁶¹.

European Commission funding for space activities is also provided from its €50.5 billion 7th Framework Programme for Research and Technological Development (FP7) from 2007 to 2013. The plan is divided into four action areas: cooperation, ideas, people and capabilities, with the first receiving most of the funding. Space activities are included in this framework, with a projected €1.43 billion (or €204 million on an annual basis) budget. However, funding is not equally divided from year to year but it depends on the quantity and quality of projects proposed each time.

The bulk of this budget is consumed by the European Commission's flagship programmes GMES and Galileo. GMES accounts for almost 85%, or €1.2 billion of the total funding. However, space systems are not yet considered on their own merit by European authorities. Instead, space assets are seen as enablers for promoting other common EU policies, such as security, technological innovation and industrial competitiveness. In all, EU space policy is principally focused on space applications and their broader benefits for other EU policy objectives. In this sense, the EU Commission expects space technology investment to diffuse its benefits to fuel the wider economy and especially small and medium size enterprises activity. The FP7 is thus considered complementary to ESA research projects, which are more scientific-oriented and space exploration related²⁶².

The third space call in the framework of FP7 (FP7-SPACE-2010-1) was published on 30 July 2009. Its volume reached €114 million, more than double than the previous call's €51.5 million. The call had three main activity lines: space-based applications at the service

²⁶¹ European Parliament. Report on Space and Security. 2008/2030 (INI) of 10 June 2008.

<<http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+REPORT+A6-2008-0250+0+DOC+PDF+V0//EN>>.

²⁶² European Commission. FP7 – tomorrow's answers start today. Brussels: European Communities, 2006. <http://ec.europa.eu/research/fp7/pdf/fp7-factsheets_en.pdf>.



of European society, strengthening space activities foundations, and cross-cutting issues²⁶³. Funding also included some work on Galileo, principally with two calls for tender (2009/S 96-137211 and 2009/S 136-198082) on 20 May and 18 July 2009 with a budget of €1 million each. The calls addressed Galileo Frequency Regulatory and Standardisation Support²⁶⁴.

The European Parliament and the European Council have allocated €3.4 billion through 2013 for the Galileo satellite positioning system and the European Geostationary Navigation Overlay Service (EGNOS), in which €400 million from FP7 was also included. Other funding sources for space activities include the Trans-European Transport Networks (TEN-T), part of Trans-European Networks (TEN) and the Entrepreneurship and Innovation Programme (EIP), which is part of the Competitiveness and Innovation Framework Programme (CIP) of the European Commission. The resulting total volume of €3.4 billion for European satellite navigation over a period of seven years equals an average budget of €485 million per year. In 2010 the Commission should present its funding proposals beyond 2014²⁶⁵.

Procurement of the Galileo system began in July 2008 with six work packages: system support, ground mission segment, ground control segment, space segment, launch services and operations. Given the complexity of the procurement process, the European Commission and ESA have opted for a procurement scheme called "Competitive Dialogue", described in the EC Financial Regulation Implementing Rules. In September 2008, 11 candidates were short listed. In January 2010, the European Commission awarded three of the six contracts for the procurement of Galileo. A contract for the system support services was given to Thales Alenia Space to cover both industrial services and the validation of the Galileo system. A contract for building the first 14 satellites was awarded to OHB System AG. The remaining

satellites needed to build the 22 spacecraft initial operational capability constellation would be ordered either from OHB or EADS Astrium Satellites. Arianespace secured the launch services contract to provide Soyuz rockets carrying two satellites each. The contracts were handled by ESA, on behalf of the European Commission. The remaining three procurement contracts should be awarded by mid-2010²⁶⁶.

GMES will deliver services of public interest, and it is foreseen to fund those publicly as well. As stated above, the GMES budget within FP7 is around €1.2 billion. This, however, is not sufficient, and in general the EU budget is not enough to drive GMES to its full potential. GMES will accordingly be financed through a multi-layer approach involving European, intergovernmental and national levels. The details are not settled yet, but the ESA worked out a long-term scenario document for the estimations of the costs. According to this analysis, the financial effort would represent €4 billion for the period from 2014 to 2020. This sum includes annual costs of €430 million for operational activities and €170 million for research and development²⁶⁷.

²⁶³ "Space Call 3" 30 July 2009. European Commission 19 Mar. 2010. <http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.CooperationDetailsCallPage&call_id=239>.

²⁶⁴ "Support to Galileo Standardisation" 20 May 2009. European Commission 19 Mar. 2010. <http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.CooperationDetailsCallPage&call_id=212>.

"GALIFREGS" 18 July 2009. European Commission 19 Mar. 2010. <http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.cooperationDetailsCallPage&call_id=288>

²⁶⁵ Commission of the European Communities. Report from the Commission to the European Parliament and the Council on the Implementation of the GNSS Programmes and on Future Challenges. COM (2009) 302 final of 26 June 2009. Brussels: European Union.

²⁶⁶ "Commission awards major contracts to make Galileo operational early 2014" 7 Jan 2010. European Commission 19 Mar. 2010.

<<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/7&format=HTML&aged=0&language=EN&guiLanguage=en>>.

"GALILEO: the procurement for the first constellation of the European navigation satellites will now start" 7 Jan 2008. European Commission 19 Mar. 2010.

<<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1068&format=HTML&aged=0&language=EN&guiLanguage=en>>.

²⁶⁷ Commission of the European Communities.

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Global Monitoring for Environment and Security (GMES): Challenges and Next Steps for the Space Component. COM (2009) 589 final of 28 Oct. 2009. Brussels: European Union.

Commission of the European Communities. Commission Staff Working Document: Global Monitoring for Environment and Security (GMES): Progress Report on the GMES Space Component. SEC (2009) 1439 of 28 Oct. 2009. Brussels: European Union.

Commission of the European Communities. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Global Monitoring for Environment and Security (GMES): we care for a safer planet. COM (2008) 748 final of 12 Nov. 2008. Brussels: European Union.

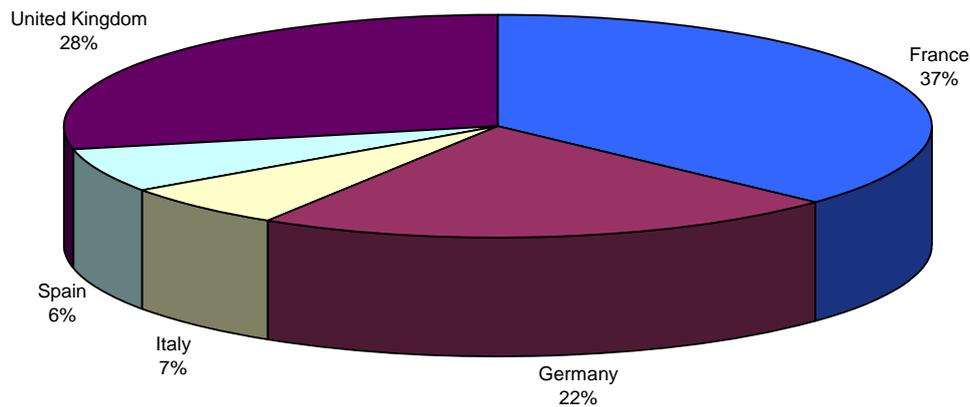


Figure 4.9: Estimated share of military space spending in Europe in 2009 (Based on Euroconsult data)

4.7 Security-Related Space Expenditures

Security-related space expenditures in Europe are difficult to assess on a national level. Only few countries are directly involved in such endeavours, with some smaller countries trying to gain access to relevant capabilities via cooperation agreements. Furthermore, the figures are to be taken only as estimations, due to the incertitude surrounding classified spending. It also has to be stated that money spent on dual-use programmes or research is not included in this overview. For instance, this is the case concerning the French CNES expenditures.

In total, European institutional spending for security-related space activities is estimated at approximately €558 million, which indicates a decrease of 32% compared 2008.

France has historically been the largest spender in this domain and it continued to be so with a corresponding budget of about €205 million in 2009, which nevertheless represents a 48% decrease as well.

Typically, the procurement of satellite systems for Earth observation and communications purposes makes up the lion's share of military spending. The United Kingdom's security-related space budget in 2009 was estimated at €157 million, Germany's at about €120 million, Italy's at approximately €36 million (a drop of 69%) and Spain's at €35 million (Figure 4.9)²⁶⁸. Besides the expenditures of France and Italy, European countries'

security-related space spending remained stable.

The European Union Satellite Centre (EUSC) in Torrejón, Spain, remains the only operational European Union agency in the field of Earth observation utilisation. The EUSC operated in 2009 on a €12.2 million budget. Funding was increased by 4.5% by comparison to the 2008 budget (€11.6 million). The EUSC's operations build upon data from Member States' military satellites and even more so on commercially acquired imagery²⁶⁹.

In 2009, the European Defence Agency (EDA) developed a growing interest in space. Its policy had been to promote the consolidation and pooling of European needs in security-related space programmes and to coordinate the development of critical space technologies on a European level. The total EDA budget for 2009 can be estimated to amount to €30 million, slightly below the €32 million spent in 2008. However, funding dedicated to space activities remains marginal and hard to determine accurately²⁷⁰.

²⁶⁹ European Union Satellite Center. EUSC Annual Report 2008. Madrid: EUSC, 2009. <<http://www.eusc.europa.eu/images/stories/eusc%20annual%20report%202008%20publication.pdf>>

"Europas Augen" 13 Dec. 2008. Spiegel Online 19 Mar. 2010 <<http://www.spiegel.de/wissenschaft/mensch/0,1518,596139,00.html>>.

²⁷⁰ European Defence Agency. 2008 Financial Report. Brussels: EDA, June 2009. <<http://www.eda.europa.eu/WebUtils/downloadfile.aspx?fileid=736>>. European Defence Agency. "The EDA Approach to development of SDR technology" Presentation. SDR Forum Annual Conference 2009. Washington DC, U.S. 1–4 Dec. 2009. <http://data.memberclicks.com/site/sdf/sdr09-Magrassi_EDA.pdf>.

²⁶⁸ Ibid.



On 3 November for example, European Defence Agency (EDA) representatives announced that the Agency was finalising a €130.000 contract with London Satellite Exchange, an Astrium Services subsidiary, to establish a central European Union database for purchasing commercial communication satellite services. This would be the first step in an effort to pool services demands from all European Defence authorities into a single contracting vehicle. According to the EDA, EU Member States currently spend more than €50 million on commercial satellite services, paying higher spot prices for them as they cannot accurately estimate future capacity

requirements. In contrast, the central purchasing agent favoured by EDA would be able to pool together demand by region, frequency and bandwidth requirements, thus achieving a 30% to 50% cost reduction by negotiating longer term lease agreements with commercial operators²⁷¹.

Finally, one of the key planks in the EDA's policy in the past 12 months has been its increased cooperation with other European institutions and especially its trilateral dialogue with the European Commission and the European Space Agency.

²⁷¹ "Pending Deal Would Pool Europe's Satcom Demand". Space News 9 Nov. 2009: 13.

5. Space Industry Evolutions

5.1 Europe

On 10 June, the French commercial image satellite operator Spot Image assured its customers that it would be willing to field two new medium resolution satellites, Spot 6 and Spot 7, starting in 2012. The two new satellites should complement the highly successful Spot 5 that currently accounts for the majority of the company's revenues and is expected to operate until 2014. However, Spot Image declined to give more specific details on the project, as the financing decision had not yet been made by its principal shareholder, Astrium Services, which was still negotiating on this issue with the French government²⁷².

A few days later, on 18 June, Astrium Services announced that financing issues had been resolved and that the company would cover the approximately \$500 million cost of the two satellites, without asking for any financial support from the French government. However, Spot Image officials asked for some kind of commitment from the French government to buy images from the future satellites. Companies in the United States (such as GeoEye and DigitalGlobe) already operate in this fashion. In general, it appears that the commercial image industry is in the middle of a transition from a fully government financed business model to a mixed private-public financing, based on guarantees of future government contracts²⁷³.

On 1 July, satellite services provider Telespazio and the Italian Space Agency ASI agreed on the creation of a joint commercial platform for selling data from the Cosmo-SkyMed radar imaging satellite constellation. A new company called e-Geos has been set up for this purpose in Rome, with Telespazio holding 80% of its shares and ASI 20%. Under the agreement, the former transferred its Earth observation division to the new company and the latter its rights to commercial-

ise Cosmo-SkyMed images. According to company officials, e-Geos was close to striking a deal to supply images to clients in the Middle East²⁷⁴.

In a related development, e-Geos announced on 19 November that it had secured a contract from the European Space Agency (ESA) to provide radar and optical images to the EU Global Monitoring for Environment and Security project (GMES). The €3.5 million deal included providing radar data from Italy's Cosmo-SkyMed constellation and optical data from U.S. commercial operators GeoEye and DigitalGlobe²⁷⁵.

On 20 July, Thales Alenia Space secured a €17.9 million contract from ESA to build the Experimental Re-Entry Test Bed (EXPERT). This will be a 440 kg bullet-shaped re-entry capsule that will be launched for a sub-orbital flight onboard a Russian submarine launched Volna rocket, as early as October 2010. The capsule is expected to offer valuable data for the development of ESA's Advanced Re-entry Vehicle (ARV). ARV will be an enhanced, atmosphere re-entry capable design of ESA's Automated Transfer Vehicle (ATV) that carries supplies to the International Space Station (ISS). ARV first flight is scheduled for 2016²⁷⁶.

In October, NATO announced it would be conducting an open competition to acquire additional satellite communication services for its troops in Afghanistan. Since 2004, NATO's Consultation, Command and Control Agency (NC3A) has had a \$659 million agreement with a consortium using bandwidth on Skynet, Syracuse-3 and Sicral satellites to provide SHF and Ultra-high frequency communications. Extra bandwidth is indispensable, however, as Afghanistan communication infrastructures are very limited. Due to security reasons, the competition would be limited to NATO Member States only. In addition to current providers, Germany, Greece,

²⁷² De Selding, Peter B. "Spot Commits to New Satellites, But Funding Questions Remain". Space News 15 June 2009: 1.

²⁷³ De Selding, Peter B. "Astrium Services Cleared To Buy New Spot Satellite". Space News 22 June 2009: 13.

²⁷⁴ De Selding, Peter B. "Italian Company Formed To Market Cosmo-SkyMed Imagery". Space News 13 July 2009: 6.

²⁷⁵ "Italy's e-Geos Lands GMES Radar, Optical Imagery Deal". Space News 23 Nov. 2009: 8.

²⁷⁶ De Selding, Peter B. "Thales Alenia To Build ESA's Expert Test Vehicle". Space News 27 July 2009: 11.



Spain, Turkey and the United States all have satellites that could be used to fill the gap²⁷⁷.

On 27–29 October the Satellite Users Interference Reduction Group (SUIRG) met in Cannes, France. The Group has been trying for years to raise industry awareness of the importance of interference for commercial communication satellites operators. During the meeting, Intelsat, SES and Inmarsat decided to create a voluntary satellite database named Space Data Association (SDA) and based on the Isle of Man. Its mission will be to collect voluntary data contributions from commercial operators on their respective satellites, such as satellite location, broadcast frequencies and power, signal polarisation and coverage areas. Using this database should shorten the time needed to localise interference sources. Other commercial operators were expected to join in the effort, but questions remained on whether they would be willing to distribute such sensitive information. Furthermore, although this initiative is expected to contribute to limiting unintentional interference, it will still have to overcome the absence of a legal framework that would oblige operators to cease activities that create interference²⁷⁸.

In November, SDA begun to take form as its three founding companies issued a Request for Proposals (RfP) for a contract to design and build the database. The RfP called for the creation of a central Space Data Centre on the Isle of Man, as well as two more backup data storage servers on different continents. These would probably operate from within SDA member companies. The centre would provide accurate and timely information on commercial satellites and would also act as a registry of interference incidents and sources. SDA's members also signalled their future intention to link the database to the U.S. Space Surveillance Network and to invite operators from Russia, China and India to participate as well²⁷⁹.

On 30 November, satellite fleet operator SES Astra announced its intention to order four direct broadcast television spacecrafts from EADS Astrium Satellites, at a total cost of approximately €500 million. This contract would constitute the biggest single satellite order ever made by SES and it would account

for more than 15% of 2009's commercial satellite sales worldwide. The spacecrafts would be delivered at 6 month intervals starting in 2012. Apart from featuring more than 60 Ku-band transponders for direct broadcast services each, the spacecrafts would also have 2 to 4 Ka-band payloads. This would be a step forward in the company's effort to develop next-generation broadband communication services in Europe. Furthermore, the series' fourth satellite was expected to carry a navigation payload for the EU Commission's Egnos programme, designed to enhance GPS signal reliability²⁸⁰.

In a parallel development, SES announced that it was also negotiating with Astrium Services the sale of its German-based ND Sat-Com subsidiary. The company held a 25% participation in MilSat Services, the satellite communication provider contracted by the German military to operate its two Sat-ComBw communication satellites. EADS Astrium Services, an Astrium Satellites sister company, held the remaining 75%²⁸¹.

On 21 December 2009, Avanti Communications of London announced it had secured a \$309 million in loans from U.S. and French export credit agencies (the Export-Import Bank and Coface respectively) to build its next generation Hylas 2 Ka-band broadband services satellite. The spacecraft, which was scheduled for launch in 2012, would weight 3.1 tons and provide an 8.28 gigahertz capacity to up to 1 million subscribers, representing a significant capabilities increase from its predecessor Hylas 1. According to the package's terms, Avanti would sell 21.5 million shares in order to raise £86 million on its own to finance the project²⁸².

In a related development, commercial satellite fleet operator SES also announced on 21 December 2009 that it had secured a €522.89 million loan, backed by the French export-credit agency Coface, to pay for the construction of 4 new satellites by EADS Astrium. The spacecrafts, named Astra 2E, 2F, 2G and 5B were scheduled for launch between 2012 and 2014. SES officials claimed that the company, which had a €4 billion accumulated debt, could find credit in the open market and did not necessarily need Coface's backing. However, they added that its support was welcome as it allowed them to borrow on lower interest rates and to

²⁷⁷ Singer, Jeremy. "NATO Readies Competition for Satcom Services". Space News 2 Nov. 2009: 12.

²⁷⁸ De Selding, Peter B. "Satellite Operators To Create Database To Combat Interference". Space News 2 Nov. 2009: 20.

De Selding, Peter B. "Execs Say Interference is Mostly Unintentional, but Often Hard to Resolve". Space News 2 Nov. 2009: 20.

²⁷⁹ De Selding, Peter B. "Satellite Operators Solicit Bids To Create Orbital Database". Space News 23 Nov. 2009: 6.

²⁸⁰ De Selding, Peter B. "SES Selects Astrium to Build Four Direct Broadcast Satellites". Space News 30 Nov. 2009: 4.

De Selding, Peter B. "Four Satellite Order Bolsters SES's Direct Broadcast Presence". Space News 7 Dec. 2009: 6.

²⁸¹ Ibid.

²⁸² "Avanti Gets Export-Credit Backing for Ka-band Satellite". Space News 4 Jan. 2010: 8.

spread the repayment period onto a longer time period throughout 2022²⁸³.

On 26 January 2010, OHB Technologies chief executive Berry Smutny confirmed that although EADS Astrium did not obtain the prime contract for building the first phase of the Galileo NPT constellation, it would still secure up to 50% of the contract's work as a sub contractor of OHB. In fact, the official clarified that EADS subsidiary SSTL of Britain would build most of the satellites' electronics payload, which would account for up to 40% of the spacecraft's total value. He also said that OHB would be using for the Galileo project a derivative of the satellite bus developed for the German SAR-Lupe constellation²⁸⁴.

On 9 February the French space agency CNES signed a €280 million contract with Thales Alenia Space for the construction and launch of the Athena-Fidus satellite. Athena-Fidus will be a three ton Geosynchronous Earth Orbit (GEO) telecommunications satellite based on Thales' Spacebus 4000 B2 platform and using EHF and Ka-band frequencies. It is a joint project evenly funded by the French and Italian space agencies. Its mission will be to offer high speed (up to three GB) communications to military and civil-protection agencies. Its technical specifications would allow it to transmit real time video data from unmanned aerial vehicles (UAV). The satellite will be operated by France and it is expected to be launched onboard an Arianespace rocket by 2014 at the latest²⁸⁵.

In February 2010, Surrey Satellite Technology U.S. (SST-US), a subsidiary of the British Surrey Satellite Technology Ltd (SSTL), proposed the replacement of the older commercial imaging spacecrafts Ikonos and Quick-Bird by a constellation of small satellites. Ikonos was launched in 1999 and it is operated by GeoEye of Dulles, whereas Quick-Bird flew in 2001 for DigitalGlobe of Colorado. Both companies have been the principal commercial image providers for the U.S. Department of Defence. SSTL officials have been promoting the use of a constellation of 5 SSTL 150 kg imaging spacecraft instead, for a total price of less than \$150 million. SSTL had already built a similar constellation for the German commercial imaging provider RapidEye AG. The ground resolution offered by these small satellites would be approximately one metre in black and white and four

metres in colour images, which is comparable to Ikonos' and slightly inferior to Quick-Bird's performance. A constellation of small satellites also has the advantage of shorter revisiting times, but on the other hand it offers a much narrower swath path due to its fixed camera. From a military point of view, a constellation of small satellites also shows greater survivability and redundancy to interference than a single spacecraft. Given that the U.S. Pentagon is already developing such formation flying satellite systems for military use, one could argue that private satellite services providers that work with the U.S. military would soon follow suit, offering commercial spacecraft comparable to the dedicated military ones. In other words, private companies seem to incorporate to their new satellite systems technical characteristics that imitate the standards set by government spacecraft, in an attempt to secure contracts²⁸⁶.

Eutelsat, the world's third largest satellite fleet operator, reported on 18 February that its 2009 financial results were good beyond all expectation. More specifically, the company's officials announced a 9.6% revenue increase for the second half of 2009, which brought total revenues in the aforementioned period to €508 million. This figure represented a gross revenue margin of 81% (EBIT-DA), which was well above the firm's objective of a 77% annual average for the period from 2009 to 2012. Thanks to this performance, Eutelsat foresaw to exceed for the first time in its history the €1 billion revenue mark during the 2010 fiscal year. Furthermore, the firm's officials now expected its average growth to surpass the 7% benchmark on an annual basis through 2012. Eutelsat's backlog also exceeded expectations, marking a 19% increase from the previous year and standing at €4.2 billion at the end of 2009. The firm's positive financial performance was attributed to several factors, including an increase to its available satellite transporters from 489 to 532, a raise in satellite lease prices in Europe and, most importantly, Eutelsat's bullish presence in the emerging Russian, Middle East and African markets²⁸⁷.

On 23 February, Dutch Space of Leiden, Netherlands, announced it was selected to provide solar arrays for the first four GMES Earth observation satellites, of the Sentinel 1 and 2 series. The company was chosen by Thales Alenia Space under a € 13.4 million

²⁸³ "SES Taps Coface Financing For Four Astra Satellites". Space News 4 Jan. 2010: 9.

²⁸⁴ "Astrium Positioned for Substantial Galileo Work". Space News 1 Feb. 2010: 8.

²⁸⁵ De Selding, Peter B. "Thales Alenia Gets \$384 Million CNES Contract for Athena-Fidus". Space News 15 Feb. 2010: 12.

²⁸⁶ Brinton, Turner. "Firm Pitches Low-cost Replacements for Ikonos, QuickBird". Space News 15 Feb. 2010: 13.

²⁸⁷ De Selding, Peter B. "Booming Eutelsat Raises 3-year Growth Forecast, Eyes Asia". Space News 22 Feb. 2010: 6.



contract to build panels for Sentinels 1A and 1B (equipped with a C-band Radar payload). Simultaneously it was also contracted for the sum of €10.3 million by Astrium Satellites for Sentinels 2A and 2B (equipped with a super-spectral imaging instrument). The company consequently subcontracted Astrium to build the solar cells and Airborne Composites of Hague to provide the carbon-fibre panels²⁸⁸.

On 24 February, Thales Alenia Space announced it was chosen by the French space agency CNES to build the Jason-3 ocean altimetry satellite. The Jason series satellites are a joint effort by the U.S. National Oceanic and Atmospheric Administration (NOAA), Europe's EUMETSAT meteorological agency and CNES. The Jason-3 budget was estimated at €252 million, including launching and three years of operation costs. Thales Alenia Space would be responsible for providing the spacecraft's Proteus platform, its principal instrument (the Poseidon 3B altimeter), as well as for the system's integration, testing and launch preparations. NOAA would provide secondary payloads and it would be in charge of its launch, which was scheduled for July 2013. The satellite was planned to work in tandem with Jason-2, already in orbit since July 2008²⁸⁹.

Due to problems of a Russian mobile gantry, the first launch of the European Soyuz version is scheduled to the end of 2010, not allowing a second flight in 2010. Also this means additional costs for ESA that will be asked for an additional \$50 million funding. The delay also led Arianespace to reactivate its Starsem affiliate to launch four Soyuz rockets from Baikonur Cosmodrome in Kazakhstan beginning in September. The first launch of Arianespace's new light-lift rocket is likely to be not before 2011. After successful demonstration flights of the two new rockets, Arianespace expects to launch annually six to seven Ariane 5 rockets, three to four Soyuz and one or two Vega spacecrafts from the European spaceport in French Guiana²⁹⁰.

5.2 United States

One of the most noteworthy events in 2009 was the bankruptcy of the commercial launch services provider Sea Launch Co. LLC. Sea Launch was struggling to meet its 22 June deadline of paying back \$245 million in ma-

turing bank loans. Efforts to refinance this debt continued throughout June. These included loan guarantees by two of its main shareholders, Boeing Co. and ASA Group of Norway. In the meantime Sea Launch was continuing to lose contracts, as several of its clients (such as SkyTerra) transferred launches to its competitors, Arianespace and International Launch Services, amongst rumours that Sea Launch would not be able to meet its scheduled launch dates²⁹¹.

Unable to refinance its \$2 billion debt (half of which was to Boeing, its main stockholder and hardware supplier), Sea Launch had to file for Chapter 11 bankruptcy protection on 22 June. The suspension of its activities for an entire year in 2007 (following an on-pad launch failure) together with a precipitous rise in raw material prices finally took their toll on the company. As U.S. legislation excluded Sea Launch from launching U.S. government payloads, maintaining a stable revenue base in the long-term proved impossible. Sea Launch's bankruptcy weighed heavily on its main shareholder, Boeing, which was facing up to \$478 million in pre-tax charges related to the uncollected debt²⁹². Sea Launch's bankruptcy also increased fears of a possible escalation in launch prices from the other two major launching services contractors, ILS and Arianespace²⁹³.

In the face of such fears both Intelsat and SES, the two most important commercial fleet operators, announced in September that they were willing to support Sea Launch's exit from bankruptcy by guaranteeing future launch contracts with it. Intelsat, which had several launch contracts pending with Sea Launch prior to its failure, reiterated its commitment to using Sea Launch services. Boeing and Space Systems/Loral also voiced support for the company. At the same time, Intelsat and SES also asked for the U.S. government to address the space launch services gap that Sea Launch's bankruptcy has created. In their opinion, this should include reconsidering the U.S. ban on satellite exports to China and encouraging the return of

²⁸⁸ "Dutch Space Will Provide Solar Arrays for Sentinel". Space News 1 Mar. 2010: 8.

²⁸⁹ "Thales Alenia Space Gets Jason-3 Satellite Contract". Space News 1 Mar. 2010: 8.

²⁹⁰ De Selding, Peter B. "Delays Continue To Affect Vega, European Soyuz Programs." Space News 3 May 2010: 6.

²⁹¹ De Selding, Peter B. "Sea Launch Expects Dept Refinancing To Close in June". Space News 1 June 2009: 6.

²⁹² De Selding, Peter B. "\$2Billion Dept Forces Sea Launch into Bankruptcy". Space News 29 June 2009: 6.

De Selding, Peter B. "Failed Negotiations Over Arbitration Payment Was Last Straw for Sea Launch". Space News 29 June 2009: 6.

²⁹³ De Selding, Peter B. "Sea Launch Bankruptcy Stokes Fears of Rising Launch Prices". Space News 29 June 2009: 1.

the Atlas and Delta rockets to commercial activities²⁹⁴.

Soon after Sea Launch's bankruptcy disputes arose among its principal shareholders on sharing payments due to its creditors. Boeing, which prior to the bankruptcy had reimbursed \$448 million to Sea Launch creditors, demanded that other shareholders participate in it proportionally. The Norwegian participating company Aker agreed to do this, but Russian and Ukrainian owners declined. On 19 October Boeing filed a request for arbitration on this issue with the Stockholm Chamber of Commerce. In addition to this, Boeing had loaned another \$523 million directly to Sea Launch and demanded that the rest of the owners participate in it as well. The Sea Launch bankruptcy was the main cause for a 13% decline (to a total of \$672 million) in profits that Boeing manifested in the first three quarters of 2009²⁹⁵.

On 11 June, Lockheed Martin, Northrop Grumman, and Raytheon were each awarded a \$30 million contract from the U.S. Air Force to start development work on the ground-based radar segment of the future USAF space surveillance system, known as Space Fence. Preliminary plans include the construction of three S-band radars, one of which will be located outside the U.S. The system is expected to have higher resolution than the existing one. The contracts awarded included system design review, present trades and analysis data, operating simulations and lifecycle cost estimates. The prime contractor for the project is to be selected in 2012²⁹⁶.

On 10 June, Lockheed Martin was awarded a \$1.49 billion contract to build the third of a total of six USAF Space Based Infrared System satellites (SBIRS). They are set to replace the existing U.S. ballistic missile launch warning constellation. The system includes the geosynchronous SBIRS satellite, as well as a highly elliptical orbiting payload. The launching of the constellation's second satellite is scheduled for 2011. At the same time, Lockheed Martin also announced the commercialisation of a low cost GPS enabled wireless tracking device that can be monitored across radio frequency identification and satellite communication networks. This

product is addressed to civilian as well as military users²⁹⁷.

On 19 May 2009, the USAF launched TacSat-3, its first hyper-spectral reconnaissance satellite. TacSat-3's main payload was the Advanced Responsive Tactically Effective Military Imaging Spectrometer (ARTEMIS). The ARTEMIS spectrometer can distinguish the spectral signatures of different materials, enabling it to identify camouflaged objects or to detect freshly dug earth. TacSat-3 is part of the U.S. Defence Department's Operationally Responsive Space (ORS) programme. It has an on-board computer that enables it to process data before transmitting it directly to the battlefield and its tactical response time should be less than ten minutes. The ARTEMIS payload was built by Raytheon within only 15 months and on a \$15 million budget. Off-the-self commercial technology was used extensively in its construction. The entire programme's budget was \$90 million, including launching costs. Should TacSat-3 prove the reliability and effectiveness of the technologies involved, USAF is planning to launch a constellation of similar satellites, able to cover multiple operational theatres simultaneously²⁹⁸.

On 15 June, Northrop Grumman announced that it had delivered the second of a pair of the long-delayed Space Tracking and Surveillance System (STSS) satellites to the U.S. Missile Defence Agency. These were built in 1999, under a cancelled system demonstration project. The programme was resumed in 2002. When launched, the satellites will enable the USAF to track ballistic missiles in every stage of their flight, something that current space-based assets cannot do. Their payload includes a multi-band infrared tracking sensor that other missile tracking satellites lack. STSS is a technology demonstrator that will determine the usefulness of a constellation of such satellites for U.S. ballistic missile defence. The post-2002 cost of the programme was approximately \$1.35 billion²⁹⁹.

On 21 June Northrop Grumman and Israel Air Industries concluded a three week technology demonstration test of the Israeli Synthetic Aperture Radar (SAR) reconnaissance satellite TecSAR for the U.S. Defence Department. The test included tasking, downlinking, processing and delivering TecSAR images from a mobile control station inside a van, within

²⁹⁴ De Selding, Peter B. "Sea Launch Promised Future Contracts". Space News 14 Sept. 2009: 12. Also see below

²⁹⁵ De Selding Peter B. "Boeing Seeks To Reduce Losses From Sea Launch Bankruptcy". Space News 2 Nov. 2009: 4.

²⁹⁶ "U.S. Air Force Sows Seeds For Next-Gen Space Fence". Space News 15 June 2009: 3.

²⁹⁷ Ibid.

²⁹⁸ Matthews, William. "TacSat-3 Earth Observing Satellite Puts Hyperspectral Imagery Analysis in Space". Space News 22 June 2009: 16.

²⁹⁹ Brinton, Turner. "Missile Tracking Demonstration Satellites Readied for Launch". Space News 22 June 2009: 12.



less than 15 minutes of their request. The demonstration was conducted in Key West Florida under U.S. Southern Command's Project Thunderstorm, an initiative seeking to utilise next-generation imaging capabilities to counter asymmetric threats.

Intelsat and SES, the world's largest commercial satellite fleet operators, announced on 23 July that they would jointly try to "persuade" Washington to allow them to launch commercial satellites from China and India. The two companies were expected to be joined by Space Systems/Loral, the largest U.S. builder of commercial communications spacecrafts. The two companies noted that ITAR procedures and the Sea Launch bankruptcy had practically reduced launching services providers to only two (Arianespace and ILS). They therefore insisted on lifting the ban on Indian launches of U.S. satellites, which the U.S. department has maintained in spite of the latest U.S.-India bilateral cooperation agreement on defence and technology trade. However, Congressional sources noted that this lobbying initiative could result in effects on the Hill exactly opposite than expected³⁰⁰.

In September, the two companies were joined by satellite operators Telesat and Echostar and intensified their lobbying by hiring former U.S. Senate Armed Service Committee Chairman John Warner to address to executive branch officials, although ethics rules forbid ex-Congress members from lobbying. Warner would try to convince top officials that the absence of a U.S. launch provider is harmful to its national security interests, and this should be addressed by lifting the ban on Chinese launchers and facilitating commercial flights on board the Atlas and Delta rockets³⁰¹.

On 11 August, Raytheon Space and Airborne Systems unveiled its new infrared light-wave detector that is four times larger in dimension than the current one. Its 4k×4k focal plane array comprises 16 million pixels in 4,096 columns and rows, laid on a 64 square centimetre surface. The new detector promises greater sensitivity and higher frame rates, while at the same time simplifying systems design and lowering construction costs³⁰².

On 1 July, Terrestar-1, the world's largest commercial spacecraft ever built, was lifted

to orbit onboard an Ariane 5 ECA rocket. The 6,910 Kg satellite will provide mobile voice and data communications services in North America, using the 2 GHz and S bands³⁰³. The satellite's most striking feature is its unfurlable 18-metre-diameter s-band antenna. Concerns about whether the antenna would deploy properly had delayed its launch since early June³⁰⁴. The satellite will be operated by TerreStar Networks Inc. of Reston, VA³⁰⁵.

On 24 September, Space Exploration Technologies (Space X) Corp. announced it would launch a prototype of its reusable Dragon cargo capsule onboard the maiden flight of the Falcon 9 rocket. Dragon is a reusable capsule under development since 2006 for conducting cargo flights to the International Space Station (ISS). In December 2008 Space X won a \$1.6 billion contract from NASA's Commercial Orbital Transportation Services to conduct 12 such flights to ISS by 2016. Dragon's launch has been delayed since 2007 because of problems with the development of the Falcon launcher³⁰⁶.

In an important development, Raytheon announced on 26 October that it had been awarded a \$3 million contract to study the integration of the new U.S. Missile Defence Agency sensors to USAF's Space Surveillance Network. USAF is already using MDA's fixed radar stations for space surveillance purposes, but it would like to add its new mobile radars (like AN/TPY-2 X-band radar) to the mix. According to Raytheon it was the company itself that came unsolicited to the Air Force with a proposal to develop an open command and control architecture able to merge all available sensors into one dual-purpose system. Full-scale development of the programme could begin in 2012. At the same time, Raytheon has been in contact with MDA and the intelligence community in order to allow the dedicated Space Surveillance sensors to be used for early missile launch warning and intelligence gathering³⁰⁷.

In a separate development, representatives of the Israeli Space Agency suggested during a Space Security workshop on 3 November in Tel-Aviv, that Israel's planned Arrow-3 high-altitude ballistic missile defence system could be easily adapted to an Anti-Satellite (ASAT)

³⁰⁰ De Selding, Peter B. "SES, Intelsat Asking Lawmakers to Rethink Launch Ban on China, India". Space News 3 Aug. 2009: 1.

³⁰¹ De Selding, Peter B. "Satellite Firms Tap Warner in Bid for Wider Access to Launchers". Space News 21 Sept. 2009: 5.

³⁰² "Raytheon Unveils Bigger, Better Infrared Detector". Space News 24 Aug. 2009: 11.

³⁰³ "Ariane 5 Launcher Puts Terrestar-1 into Orbit". Space news 6 July 2009: 3.

³⁰⁴ De Selding, Peter B. "TerreStar-1 Launch Slips as Insurers Request More Info". Space News, 15 June 2009: 4.

³⁰⁵ "Ariane 5 Launcher Puts Terrestar-1 into Orbit". Space news 6 July 2009: 3.

³⁰⁶ Klamper, Amy. "SpaceX: Dragon Prototype Will Fly on First Falcon 9". Space news 28 Sept. 2009: 7.

³⁰⁷ Brinton, Turner. "U.S. Air Force Studying Wider Use of MDA Radars for Space Tracking". Space News 2 Nov. 2009: 16.

role as well. According to workshop participants, Arrow-3's agile last stage exoatmospheric hit-to-kill vehicle could be modified to intercept LEO satellites and the system's Green Pine radar could be used for tracking them. During the workshop, Iran's future deployment of earth observation satellites was identified as a possible motive for Israel to acquire an ASAT capability³⁰⁸.

In the meantime, the U.S. Operationally Responsive Space (ORS) Office disclosed in November that it was making a capability assessment of the German-built LAPAN-TUBSats. The ORS office could order up to 8 such satellites to complement U.S. tactical imaging capabilities, at an estimated cost of \$60 million. The 50Kg low-cost spacecrafts are built by the Technical University of Berlin (TUB) and they are equipped with a near real-time remote-controlled digital video camera, with an 8 to 10 metres ground resolution. TUB had already built such satellites for Indonesia and Morocco, among others. The system's main operational advantages were its good price-capability ratio and its remote-controlled camera that allows for shorter re-tasking times³⁰⁹.

On 23 November, mobile satellite operator Inmarsat announced the acquisition of the U.S. communications services provider Segovia Inc. for \$110 million. In 2008 Segovia had reported a net profit of \$18 million on \$67 million total revenues. With this purchase, Inmarsat was expected to boost its position in the U.S. government contract market. The company was already a customer of Inmarsat's L-Band services. It also operates a network of Very Small Aperture Satellite (VSAT) satellite Earth stations for the U.S. Defence Department, which is relevant to Inmarsat's involvement in DARPA's "Persistent Broadband Ground Connectivity for Spacecraft in Low Earth Orbit Effort" programme. According to Segovia's Chief Executive M. Wheeler, 80% of the company's business was with the Pentagon. Prior to its acquisition, Segovia had also begun to provide services from Inmarsat's competitor, Iridium Communications. With this acquisition, Inmarsat could expand its BGAN broadband service to new distributors³¹⁰.

In a related event, on 23 November Cisco Systems Inc. saw its first space-based inter-

net router launched aboard a commercial communications satellite. The router was built for the U.S. Defence Department's Internet Routing in Space (IRIS) technology demonstrator, launched aboard the Intelsat 14 satellite. IRIS was the first dedicated U.S. military payload to reach orbit on a commercial satellite. In 2008, SES Americom had also signed a contract with USAF to host an experimental missile warning sensor aboard a communications satellite scheduled for launch in 2011. Although the experiment is funded by the Pentagon, Cisco has property rights over the router that it hopes to commercialise with satellite communications service providers. Intelsat also had expressed its interest in adding internet routers to its future spacecrafts. The demonstration acquired renewed interest since the cancellation of USAF Transformational Communications Satellite (T-Sat), which was also set to feature space-based routers³¹¹.

On 7 December Virgin Galactic unveiled its passenger carrying SpaceShipTwo suborbital space-plane, during a gala presentation at the Mojave Air and Space Port in California. The vehicle is designed to carry 6 passengers and a 2 member crew. The company's officials expected commercial operation to begin in 2011 from the Space Port America field, currently under construction in N. Mexico. Until then the space-plane was scheduled to contact extensive flight testing³¹².

In January 2010 the Denver-based United Launch Alliance (ULA), a Lockheed Martin-Boeing joint venture operating the Atlas 5 and Delta 4 rockets, announced it had posted a strong campaign in 2009. The year ended with a total of 8 successful launches, whereas 10 more were scheduled for 2010 for the two vehicles combined. ULA is the principal space launch services provider for the U.S. Department of Defence and civil agencies and it was created in 2006. Both the rockets it uses were developed under the USAF's Evolved Expendable Launch Vehicle (EELV) programme. In spite of the high launching rate maintained in 2009, ULA has a backlog full of government launches that would not leave room for commercial payloads before 2012 at the earliest. This queuing up of payloads was caused by launch stagnation in 2008, when both rockets were grounded for technical reasons. This situation had prompted ULA to take measures such as reducing launch intervals by 20–25%, developing a dual payload adapter for its rockets and delaying the as-

³⁰⁸ Opall-Rome, Barbara. "Israeli Experts: Arrow-3 Could Be Adapted for Anti-Satellite Role". Space News 9 Nov. 2009: 16.

³⁰⁹ Iannotta, Ben. "Pentagon Eyes Satellites Equipped with Joystick-controlled Video Cameras". Space News 23 Nov. 2009: 12.

³¹⁰ De Selding, Peter B. "Inmarsat Acquires Segovia to Boost Government Business". Space News 30 Nov. 2009: 10.

³¹¹ Brinton, Turner. "Cisco Views IRIS Experiment as market Primer for Space Routers". Space news 30 Nov. 2009: 12.

³¹² "SpaceShipTwo Rolls Out at Mojave Air and Space Port". Space News 14 Dec. 2009: 8.



signment of payloads to 6 months prior to each launch³¹³.

In the mean time, a series of legislative and administration delays within the U.S. Department of Defence has caused a considerable revenue decrease in 2009 for U.S. commercial satellite image providers. On the one hand, Pentagon's existing contracting vehicle called NextView was only renewed in December 2009, three months later than expected. As a result, the U.S. National Geospatial Agency (NGA) that is the contracting authority on behalf of the U.S. government could not procure any images from commercial companies in the aforementioned period. Furthermore, this situation was not expected to change in the first half of 2010, as a new contracting vehicle called EnhancedView was not yet put into place, in spite of the fact that the existing one was set to expire in June 2010. Although NGA assured commercial providers that it would renew it on a monthly basis until the new one came into force, it was clear that they could not expect any increase in revenues from U.S. government contracts in 2010³¹⁴.

In the face of these events DigitalGlobe, one of the country's major commercial satellite image providers, announced it would have to count on foreign customers to support its growth in 2010. DigitalGlobe projected a 22 % total revenue increase in 2010, even assuming that U.S. government contracts would remain in 2009 levels. The additional income necessary to boost the company's growth rate was expected to come from sales to commercial and foreign government customers. Commercial sales income in particular was thought to increase by 15% in 2010, in spite of its 3.6% decline in 2009 (amounting to approximately \$50.9 million). Given that U.S. government contracts account for almost 75% of the firm's revenues, the bulk of its growth would have to come from foreign government customers. To increase that source of income, DigitalGlobe had set up a mechanism known as the Direct Access Programme (DAP). Under this scheme, foreign countries approved by the U.S. government could downstream images from DigitalGlobe's satellites directly to ground stations in their territory for an annual fee of roughly \$35 million. DigitalGlobe planned that 25% of its spacecrafts' operational time would be used by foreign governments under this short of lent-lease agreement. The company announced that it had already secured five such

customers and it was negotiating with another two, the identity of which it did not disclose³¹⁵.

Should this development materialised, it would bring about a significant change in the company's revenue sources. Overtime DigitalGlobe expected these customers to pay on average \$50 million for its services. Given that the firm's total revenues in 2009 amounted to \$281.9 million, it becomes obvious that in the future DigitalGlobe would rely solely on these clients for its growth. Even at a \$35 million annual fee, the seven foreign government clients would provide the company with \$245 million in revenues per year, which would be over 60% more than the \$150 million that it is currently receiving from its U.S. government. In this sense, one could argue that the DAP programme signifies a change in the U.S. commercial satellite image providers business model, obliging them to rely more on their foreign customers than on their domestic ones. It is also worth noticing that all DAP clients would have access to DigitalGlobe's latest and more accurate WorldView-2 satellite, while the U.S. government usually purchases products from the older Quickbird and WorldView-1 spacecraft³¹⁶.

5.3 Russia

On 28 May 2009, the Russian space agency Roskosmos announced a \$360 million extension to its long-running space transportation contract with NASA. Under this contract modification, Roskosmos will launch an additional six U.S. astronauts onboard four Soyuz capsule missions, scheduled for 2012. The same capsules will return their crews to Earth by spring 2013³¹⁷.

During a meeting with Russian Prime Minister Vladimir Putin in July, the Head of Russia's Roskosmos space agency Anatoly Perminov envisaged that Russia's Glonass satellite navigation system will count a complete 24 satellite constellation by the end of 2009. Perminov also promised that delays in constructing the Soyuz launch pad in Europe's Guiana Space Centre would be completed in time for its first launch in February 2010. Soyuz rockets launched from Guiana are scheduled to lift two spacecraft for Europe's Galileo satellite navigation system in 2010³¹⁸.

³¹⁵ Ibid.

³¹⁶ Ibid.

³¹⁷ "NASA, Roskosmos Sign \$306 Million Soyuz Deal". Space News 1 June 2009: 3.

³¹⁸ De Selding, Peter B. "Perminov Briefs Putin on Glonass, Other Russian Space Programs". Space News 20 July 2009: 6.

³¹³ Brinton, Turner. "2010 Shaping Up as Busiest Year Yet for EELV". Space News 11 Jan. 2010: 15.

³¹⁴ De Selding, Peter B. "With U.S. Contracts Delayed, DigitalGlobe Looks Elsewhere for 2010 Growth". Space News 1 Mar. 2010: 10.

On the other side, in September Roskosmos was obliged to postpone its Phobos-Grunt mission to the largest of Mars's two moons. The mission, which is Russia's first inter-planetary mission since its failed Mars orbiter and lander mission in 1996, was originally scheduled for October. However it was postponed until the next launch window in 2011, due to delays in the final testing of the spacecraft. The Phobos-Grunt mission consists of an unmanned lander and a sample-return craft³¹⁹.

In September, the French export-credit agency Coface announced it would guarantee the necessary loans for the construction of two Yamal-400 communication satellites from Thales Alenia Space on behalf of the Russian operator Gazprom Space Systems. Both spacecrafts would be launched aboard an Ariane 5 rocket. However, the programme was criticised by Russian authorities that are currently reviewing the country's satellite communication sector, because of its lack of Russian technology content³²⁰.

On 17 October, Roskosmos published a summary of its planned Yasny spaceport in the Russian Far East. The document stated that development of the site would require building an entire 30,000 people city almost from scratch. The Russian federal government has estimated that total construction costs might reach as high as \$13.9 billion. At the same time, the site still faced long launch delays because of rocket-debris cleanup disputes with Uzbekistan. In October, the launch of two Swedish Prisma satellites and the French Picard were delayed for the same reason. Apparently, the new launching site could face the same availability issues as the Baikonur Cosmodrome has faced because of similar disputes with Kazakhstan³²¹.

On 2 March 2010 Russia successfully launched three Glonass-M navigation and positioning satellites. All three were lifted to orbit onboard a Proton M rocket launched from the Baikonur Cosmodrome. The launch was postponed from the previous October due to the need to inspect a critical component suspected of malfunction. Russia is currently running a programme to replenish and modernise its Glonass satellite constellation. Another three space craft were launched in late 2009 and three more were expected to follow in August 2010. After that, the initially

³¹⁹ "Russia Delays Phobos-Grunt Mars Mission Until 2011". Space News 28 Sept. 2009: 9.

³²⁰ De Selding, Peter B. "National Export-Credit Agencies Stepping up Satellite Financing". Space News 14 Sept. 2009: 10.

³²¹ De Selding, Peter B. "Dnepr Launch Stalled by Rocket-Debris Cleanup Negotiations". Space News 26 Oct. 2009: 11.

planned 24 satellite constellation would be fully operational³²².

5.4 Japan

On 11 July, the Japan Aerospace Exploration Agency (JAXA) and Mitsubishi Heavy Industries Ltd announced the completion of ground tests for the H-2B rocket³²³. This is a more powerful version of the H-2A rocket, designed to lift the H-2 Transfer Vehicle 1 (HTV-1) cargo spacecraft to the International Space Station (ISS). HTV-1 is a solar-powered cylinder-shaped spacecraft approximately 10 metres long and 4.4 metres wide³²⁴. It can carry 6 tons of pressurised and/or unpressurised cargo. Its development started in 1997 and cost about \$680 million³²⁵.

HTV-1 was successfully launched on September 10 from the Tanegashima Space Centre and arrived at the ISS on 17 September. Apart from carrying various provisions for the ISS crew, HTV-1's payload included two highly sophisticated earth observation instruments on behalf of the U.S. Navy. These were the Hyperspectral Imager for the Coastal Ocean (HICO) and the Remote Atmospheric and Ionospheric Detection System (RAIDS). Both instruments are experimental. They were developed by the U.S. Naval Research Lab and were mounted on the external payload platform of the ISS's Japanese Experiment Module Kibo. Both instruments are intended for military and civilian purposes alike. HICO will provide high resolution real-time imaging of coastal areas and RAIDS will monitor the earth's Ionosphere and Atmosphere in order to provide space weather data. These are the first high-performance observation instruments mounted on the ISS³²⁶. On 2 November, HTV successfully completed its 59-day mission and was destroyed as planned by re-entering the atmosphere above the Pacific Ocean³²⁷.

In September, the U.S. headquartered company BB Sat acquired a licence to provide satellite broadband services in Japan. The company has concluded agreements to use Ka-band capacity onboard a Japanese satel-

³²² "Russian Proton Lofts Trio of Glonass Navigation Satellites". Space News 8 Mar. 2010: 8.

³²³ "Japan Conducts Ground Test of H-2B Rocket". Space News 20 July 2009: 8.

³²⁴ Malik, Tariq. "Japan's First Space Cargo Ship ready to Fly". Space News 7 Sept. 2009: 14.

³²⁵ Malik, Tariq. "Japan's HTV-1 Bound for Station". Space News 14 Sept. 2009: 22.

³²⁶ Klumper, Amy. "Japan's HTV Delivered U.S. Navy Experiments to Station". Space News 28 Sept. 2009: 14.

³²⁷ "Japanese Cargo Tug Burns Up Over Pacific Ocean". Space News 9 Nov. 2009: 8.



lite already in orbit and to cooperate with Japan's Internet Service Providers (ISP) in handling sales and customer services.

On 17 November the Government Administration Reform Committee, an advisory committee to the Japanese government set up to eliminate wasteful budget spending, proposed the cancellation of the future GX rocket. GX has been under development since 2003 and was originally scheduled to fly in 2006. However, development of the rocket's second-stage liquid gas engine was not expected to be completed before 2011 and at a cost that was double the originally estimated budget (¥35 billion instead of an estimated ¥15 billion)³²⁸. The final decision on the GX's fate was taken 16 December 2009, when the Japanese government opted to cancel the programme, but continue development work on its intended eliquified natural gas-powered engine. As it was announced, the principal reasons behind the programme's cancellation were its budget overrides and an increase in its expected launching cost that was bound to compromise any future commercial prospects³²⁹.

On 28 November, Japan successfully launched the first of its new generation earth observation satellites aboard an H-2A rocket. The space craft, called the Information Gathering Satellite (IGS) Optical-3, would provide optical imagery of 60 cm ground resolution, a considerable improvement on Japan's current 1 metre capability. The \$562 million satellite was the first of a total of four reconnaissance satellites, two optical and two radar, scheduled for launch through 2012. Further spacecrafts with even higher resolution capability are planned for 2014³³⁰.

5.5 China

On 31 August the Chinese Long March 3B rocket failed to place Indonesian commercial communications satellite Palapa-D into Geosynchronous transfer orbit, when the engine of its third stage malfunctioned. This was the launcher's second failure in 12 flights, the last one being during its maiden flight in 1996. Long March 3B is China's principal communications satellite launcher. The incident also grounded Long March 3A and 3C rockets, as they all share the same engine.

³²⁸ "Japan's GX Rocket Targeted for Cancellation in 2010". Space News 23 Nov. 2009: 8.

³²⁹ "Japan Scraps GX Rocket Development Project". I StockAnalyst 16 Dec. 2009. 30 May 2010. <<http://www.istockanalyst.com/article/viewiStockNews/articleid/3716870>>.

³³⁰ "H-2A Rocket Lofts Japanese Reconnaissance Satellite". Space News 7 Dec. 2009 : 8.

The launch services provider China Great Wall Industry Corp. declined to comment on the causes of the failure, but later in September it appointed an independent enquiry board to investigate them. Palapa-D was eventually salvaged, when satellite constructor Thales Alenia was able to propel it into a geosynchronous orbit using its own propulsion module³³¹.

On 19 November the enquiry board, comprising of officials from the China Academy of Launch Vehicle Technology (CALT) and the Academy of Aerospace Propulsion Technology, published its findings. It had reached the conclusion that the upper stage's engine had delivered 38% less thrust than expected for 43% of its total working time. The cause of this underperformance was determined to be a burn-through of its gas generator, caused by foreign matter or icing in the engine's liquid hydrogen injectors. To prevent any future similar accidents, the rocket's manufacturer China Great Wall Industry Corp. of Beijing decided to install a filter to the liquid hydrogen gas feed system. The company also stated it would flight test the new system before the end of 2009³³².

The Chinese launch-service provider China Great Wall Industry Corp. (CGWIC) is expecting to be responsible for more than ten launches per year during the next two years. An aim of the company is to attract Western Business. Helpful could also be the low insurance rates of the well-proven Long March Series that are not far from Ariane 5 or Proton rockets. CGWIC is pretending that customer satellite teams have the full control over the facility – including access-permissions. Due to the U.S. International Traffic in Arms Regulations (ITAR), it remains nearly impossible to bring U.S. satellite components to Chinese launch bases³³³.

5.6 India

The Indian space programme suffered an important setback on 29 August, when ISRO announced it had lost contact with its lunar orbiting probe Chandrayaan-1, launched in October 2008. The spacecraft, carrying 11 scientific instruments (including six supplied

³³¹ De Selding, Peter B. "Palapa-D to be Salvaged After Being Launched into Wrong Orbit". Space News 7 Sept. 2009: 10.

"Long March Mishap Report Due by Mid-Nov." Space News 14 Sept. 2009: 16.

³³² De Selding, Peter B. "Burn-through Blamed in China Long March Mishap". Space News 23 Nov. 2009: 4.

³³³ De Selding, Peter B. "With High Launch Rate in Tow, China Great Wall Courts Western Business." Space News 19 Apr. 2010: 6.

by U.S. and European partners), had already lost both of its star tracking instruments earlier in the year. ISRO announced that the \$85 million programme was officially terminated, more than 14 months in front of its scheduled completion. Chandrayaan-1's loss was officially attributed to multiple instrument failures due to excessive spacecraft temperatures. ISRO admitted having underestimated the temperature levels the probe would experience during its 100km mapping orbits³³⁴.

In the aftermath of this failure, ISRO came under heavy criticism for its lack of transparency in dealing with the satellite's problems. In fact, it was disclosed that overheating problems had started just two weeks after its launch, forcing its operators to regularly deactivate several of its instruments. Finally, in a desperate attempt to reduce inside spacecraft temperature, Chandrayaan-1 was lifted to a higher 200 km orbit³³⁵. However, ISRO preferred not to acknowledge the problem in public. As late as 17 July, an ISRO spokesman was insisting that the spacecraft continued to perform its mission as planned, using its onboard gyroscopes to determine pointing position. According to the same announcement, all its mission objectives were supposedly accomplished in this way³³⁶. As critics pointed out, ISRO even presented the change of orbit as a way to study lunar surface at a wider swath, instead of an emergency manoeuvre in order to reduce temperature levels.

On 20 July, U.S. Secretary of State Mrs Clinton and her Indian counterpart Minister S.M. Krishna signed a Technology Safeguards Agreement that allows India to launch civil and non-commercial satellites containing U.S. made components. The agreement however does not yet allow India to provide commercial launch services to operators using satellites with such components. Nevertheless, Antrix representatives announced that negotiations for a similar commercial space agreement were well under way, and they expressed their optimism that they would soon reach their objective³³⁷.

On 23 July, the Indian Cabinet approved ISRO's request to develop a new advanced communications satellite, called GSAT-11. This spacecraft, with an expected mass of 4.5 tons, will be heavier and more advanced than

any of its predecessors. It is expected to field a multi-beam Ku- and Ka-band capacity and to be ready for launch aboard India's new GSLV-3 rocket by 2011. Project cost is estimated at Rp5 billion (\$104 million)³³⁸.

On 12 August, ISRO released its own version of Google Earth for India. The software, named Bhuvan, has a spatial resolution of at least 6 metres per pixel and it complies with Indian laws prohibiting the imaging of defence installations and objects smaller than one square metre³³⁹.

On 23 September, India launched its second ocean monitoring satellite, Oceansat-2. The spacecraft was put on a 720 km sun-synchronous polar orbit aboard by ISRO's Polar Satellite Launch Vehicle (PSLV). Its mission is expected to last 5 years and a third satellite is planned for launch in 2012. At the same time, EUMETSAT has expressed interest in acquiring Oceansat-2 data, as the agency is expanding its mandate to include ocean observation for the Global Monitoring for Environment and Security programme (GMES). Negotiations with ISRO are currently under way for EUMETSAT to be allowed to download the satellite's data from one of its stations in Europe³⁴⁰.

On 24 November, U.S. President B. Obama and Indian Prime Minister M. Singh agreed during the latter's official visit to Washington to expand their two countries' cooperation on science and technology research, nuclear energy and space. The announcement was preceded on 18 November by an agreement between the two countries' respective space agencies to share data from India's Oceansat-2 meteorological and oceanographic satellite. It also came less than a week after President Obama's return from a visit to Beijing, where similar pledges were made between U.S. and Chinese officials³⁴¹.

On 2 December the Indian Space Research Organisation (ISRO) announced it had earned \$21.5 million since 2007 from commercial launches of foreign satellites. This included a total of 12 spacecrafts from 7 countries, although the bulk of this revenue came from launching Israeli and Italian satellites³⁴².

On 3 March the Indian space agency ISRO successfully tested a new type of sounding

³³⁴ "Indian Lunar Orbiter Fails Abruptly". Space News 7 Sept. 2009: 8.

Jayaraman, K.S. "Chandrayaan-1's Early Demise Attributed to Overheating". Space News 14 Sept. 2009: 21.

³³⁵ Ibid.

³³⁶ Jayaraman, K.S. "ISRO Plays Down Glitch Aboard Chandrayaan-1". Space News 20 July 2009: 20.

³³⁷ "Accord Allows India To Launch U.S. Hardware". Space News 27 July 2009: 9.

³³⁸ "Indian Cabinet Approves Large Telecom Satellite". Space news 27 July 2009: 3.

³³⁹ "ISRO Launches Indian Version of Google Earth". Space news 24 Aug. 2009: 9.

³⁴⁰ Jayaraman, K.S. "India Successfully Lofts Ocean-Monitoring Satellite". Space News 28 Sept. 2009: 13.

³⁴¹ "U.S., India Agree to Expand Civil Space Cooperation". Space News 30 Nov. 2009: 3.

³⁴² "Foreign Satellite Launches Brought in \$21.5M for ISRO". Space News 7 Dec. 2009: 8.



rocket, intended for use as a scramjet engine technology demonstrator. The rocket, known as the Advanced Technology Vehicle (ATV), was launched from the Satish Dhawan space centre. Weighting nearly 3 tons, ATV is the heaviest sounding rocket used by ISRO to date. According to the official announcement, the rocket propelled its experimental ramjet engine payload to a Mach 6 speed, which was sufficient to achieve its ignition. Indian officials announced they would attempt to ignite the engine at the next test flight³⁴³.

5.7 Canada

On 7 January 2010 Canadian rural-broadband provider Barrett Xplore Inc. agreed to invest at least \$250 million in order to reserve 15% of ViaSat-1 Ka-band broadband communications satellite's capacity or 100% of its capacity reserved for Canada. This capacity, equivalent to 15 gigabits per second, was purchased from Loral Space and Communications of New York, the spacecraft's manufacturer for satellite services provider ViaSat Inc. of California. Barrett is Canada's biggest rural broadband provider and its decision to directly purchase satellite capacity would suggest that it would enter into direct competition to Telesat, the country's principal commercial satellite operator. In an earlier development, Barrett had also signed on 29 October 2009 a \$100 million contract to purchase an additional 10 gigabits capacity from Hughes Network Systems on the Jupiter satellite, also made by Loral and scheduled for launch in 2012. Finally, Barrett announced it had applied for a 50% reimbursement of their investment under a Canadian public broadband stimulus programme³⁴⁴.

On 3 March the Canadian space robotics manufacturer MacDonald, Dettwiler and Associates Corp. (MDA) announced it had also begun developing a technology and business model to build such spacecrafts. It plans to start an in-orbit satellite servicing business and a major investment in the end of 2010 – the most promising new business feature according to MDA Corp. A first satellite-servicing mission could be done in early 2013 and could be robots refuelling, repairing or moving satellites in-orbit³⁴⁵.

MDA has had a long experience in building robotic arms for the U.S. Space Shuttle and the International Space Station. According to the company's officials, its total investment on such technologies has exceeded the amount of \$3 billion, a quarter of which could have applications in building in-orbit service satellites. Contrary to the German effort, MDA's venture would be an exclusively private one and the firm had disclosed it was already into negotiations with potential commercial customers for the system. According to MDA's business plan, an in-orbit servicing satellite would have an operational life span of five years and it would be able to refuel approximately 10 satellites during this time. It should be noted that MDA targets exclusively commercial satellite communications companies with assets in geosynchronous orbit as its potential customers. MDA officials also clarified that they expected to be paid by kg of fuel successfully delivered to the recipient satellite. In total, they anticipated that every servicing satellite would provide an aggregate of 50 years of additional operational life time to its customers, considering that every GEO communications satellite uses approximately 30 kg of fuel per year. If one takes this statement on face value, MDA's servicing spacecraft would have to be a rather large satellite, capable of delivering up to 1.5 tons of fuel in total³⁴⁶.

On the other hand, insurance companies that underwrite commercial space activities have expressed some reticence regarding the financial feasibility of creating such a market. The most controversial issue is what would happen in case the target satellite would be damaged during its servicing. According to insurance industry officials, one possible approach would be for the owner of the satellite under service to assume liability, just as it is the case with maritime tugboat operations at sea. Another problem that would have to be resolved would be the technical feasibility of the project: fuel valves onboard the customer satellites would need to be opened and closed again for refuelling, something that they were not designed to do. Furthermore, a commercial communications satellite as a whole is usually designed to stay for approximately 15 years in orbit, and all its components are certified to last only that long. Therefore, even if it was refuelled, other parts of the spacecraft could eventually malfunction and render its replenishment futile. In conclusion, one could say that in-orbit refuelling is a promising technology and business concept, which nevertheless would require several years of development and a good number of

³⁴³ "ISRO Takes Step Toward Air-breathing Rocket Test". Space News 8 Mar. 2010: 8.

³⁴⁴ De Selding, Peter B. "Barrett Announces \$250 Million Investment in Ka-band Satellites". Space News 11 Jan. 2010: 7.

³⁴⁵ De Selding, Peter B. "Canada's MDA Sees Business Case for In-orbit Satellite Servicing." Space News 10 May 2010: 7.

³⁴⁶ De Selding, Peter B. "MDA Designing In-orbit Servicing Spacecraft". Space News 8 Mar. 2010: 14.

demonstrating flights before the commercial space industry is convinced of its reliability. In the mean time, one could foresee that government agencies would have to step in and finance the concept's development in its initial stages³⁴⁷.

5.8 Brazil

On 23 September PyroAlliance, the French pyrotechnical systems company, announced the successful conclusion of Brazil's VLS rocket motor-ignition ground tests. PyroAlliance, a subsidiary of SNPE Group, is under a 16-month contract to Brazil's Aerospace Technology Centre (CTA) to provide pyrotechnical systems expertise on the development of solid-fuel rocket engine for VLS, as well as on the pyrotechnical separation of the first stage. PyroAlliance is conducting similar work for Ariane 5 and Vega, but it is the first time the company is engaged in providing "ITAR-free" equipment and technology³⁴⁸.

5.9 Transatlantic Industrial Comparison

Europe and the United States are the two major space actors investing the most in space activities (Cf. Chapter 2). They also have the most diverse and competitive industrial bases. An overview of their respective dynamism and capabilities is therefore necessary to assess the health and competitiveness of their industrial base and will be provided in the next two paragraphs, beginning with Europe.

5.9.1 State of the European Space Industry

Unfortunately, data on the financial results of Europe's space industry for 2009 is only to be expected in the summer of 2010, which does not allow for final data to be included in this report. Nevertheless, by using long-term overviews this paragraph tries to give a basic insight into European space industry developments and character. The trends reviewed in this paragraph are mainly based on a report of the European Space Industry issued by ASD-Eurospace³⁴⁹.

In terms of size of the European space manufacturing sector, a trend of increasing consolidated turnover can be observed throughout the last few years (Figure 5.1). Bearing in mind that the worldwide satellite manufacturing industry experienced a big rise of revenues in 2009 and the number of launches increased again, it can be estimated that the trend showed in Figure 5.1 proceeded also in 2009.

During the last years, the revenues of the European space industry were dominated by institutional customers including civil and military programmes (Figure 5.2). While we can expect this to have proceeded in 2009, it is interesting to note that the share of institutional customers has been decreasing over several years. As we saw in chapter 4.7, the security related institutional spending in Europe decreased enormously, so that we probably see the trend of a growing commercial share and a decreasing institutional share also continuing in 2009.

³⁴⁷ Ibid.

³⁴⁸ "Brazil's VLS Rocket Clears Series of Ground Tests". Space News 28 Sept. 2009: 3.

³⁴⁹ ASD-Eurospace. "Facts & figures – The European Space Industry in 2008." 13th edition, rev. 1. July 2009.

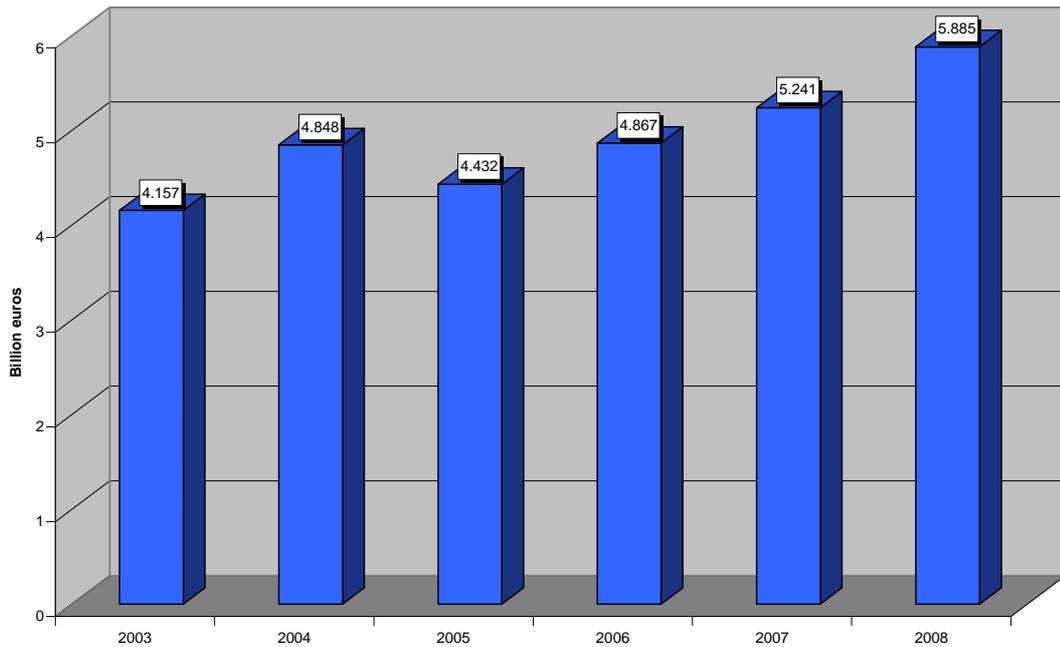


Figure 5.1: Estimated consolidated turnover of the European space sector (Source: ASD-Eurospace³⁵⁰).

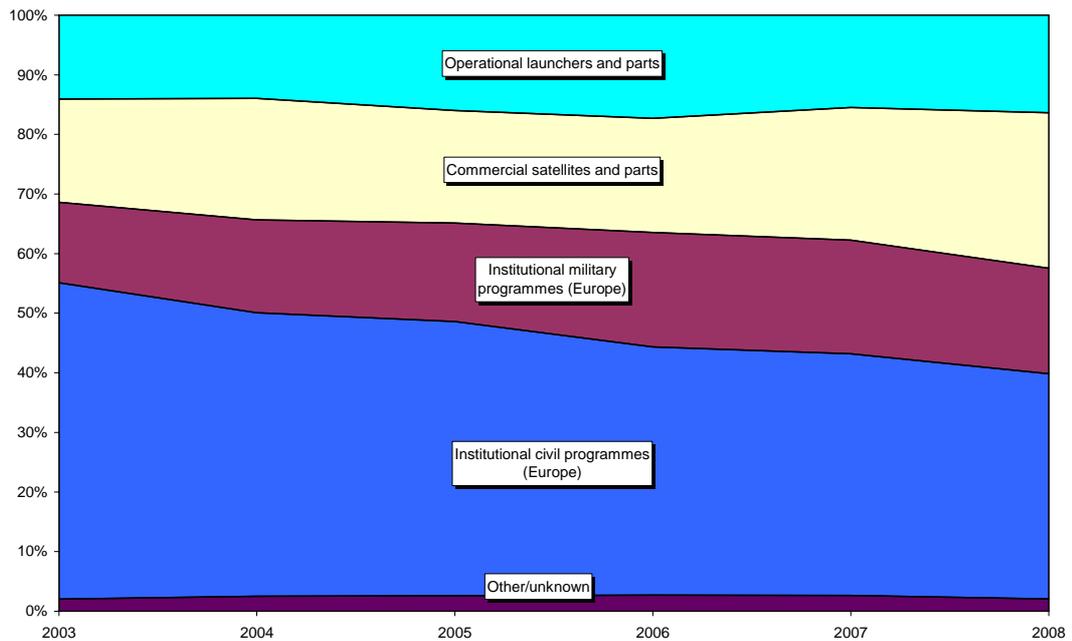


Figure 5.2: Estimated share of the European space industry consolidated turnover per institutional customer (Source: ASD-Eurospace³⁵¹)

³⁵⁰ ASD-Eurospace. "Facts & figures – The European Space Industry in 2008." 13th edition, rev. 1. July 2009: 14.
³⁵¹ Ibid.

Another indicator to assess trends is the FAA report³⁵² that estimates the commercial launch revenues to account for \$1.02 billion in 2009 which shows a rise by about 45% compared to 2008. This strengthens the estimation to see also in 2009 a smaller share of institutional consumers of the European space industry turnover.

Furthermore, looking at the sectors of the European space industry another trend can be observed. Since 2005, the sector of satellite applications covering development and manufacturing of space systems for navigation, Earth Observation and telecommunications has been growing, while other sectors nearly have remained stable (Figure 5.3).

As we see after a time of rising employment figures in the aerospace sector the first time a decreasing employment in the U.S. (cf. chapter 5.9.2) and also decreasing general employment in Europe (cf. chapter 1), we likely have to state also for the first time less employers in the European space industry after 2005 (Figure 5.4).

5.9.2 State of the United States' Space Industry

The estimated figures given in this subchapter come from the 2009 Review of the Aerospace Industries Association (AIA) Research Center³⁵⁴. According to this document, space sales in 2009 rose to the record amount of \$214.1 billion, compared to \$205.7 billion in 2008. U.S. aerospace industry profits increased 6.5% to \$15.6 billion after taxes in 2009.

U.S. aerospace industries are still suffering from the global financial crisis, which also affected some parts of the aerospace branch. This is reflected for example by the significant decreases in the import and export rates. However, the bigger aerospace companies went through the last year with a certain level of growth. The further prospects for the U.S. aerospace industries are good, opening the perspective of continuing the present upturn. The unusual circumstance that commercial and military market segments are booming at the same time supports this outlook³⁵⁵.

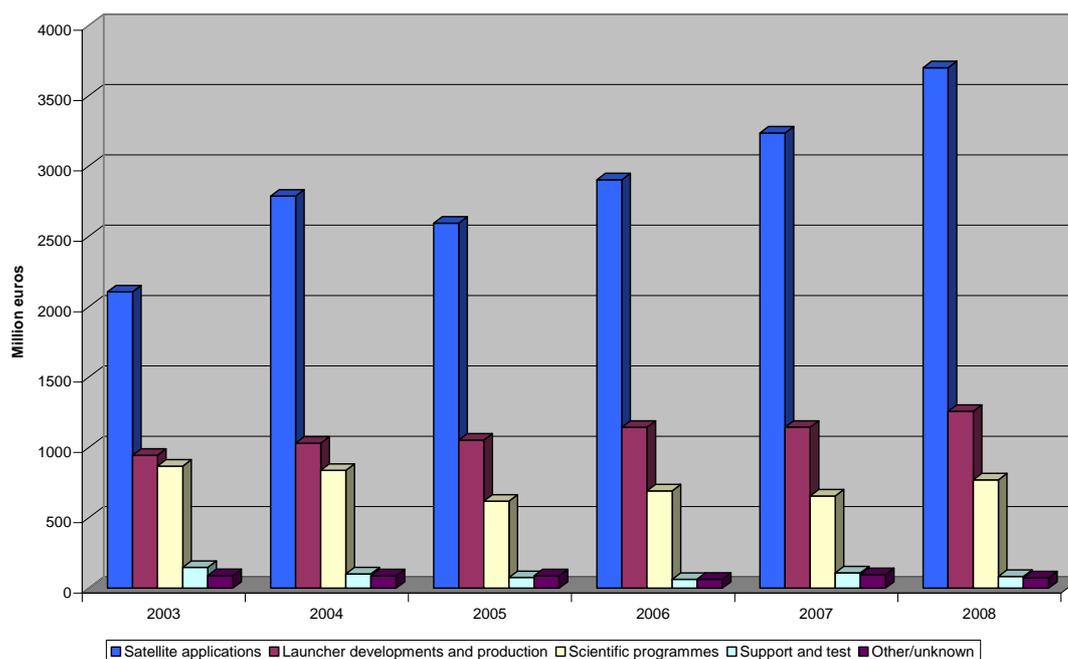


Figure 5.3: Estimated share of the European space industry consolidated turnover per sector (Source: ASD-Eurospace³⁵³)

³⁵² Federal Aviation Administration. "Commercial Space Transportation: 2009 Year in Review." Jan. 2010. Washington DC: FAA. 30 April 2010. <http://www.faa.gov/about/office_org/headquarters_offices_ast/media/year_in_review_2009.pdf>: 9.

³⁵³ ASD-Eurospace. "Facts & figures – The European Space Industry in 2008." 13th edition, rev. 1. July 2009: 14.

³⁵⁴ Aerospace Industries Association. 2009 Year End Review and 2010 Forecast. Arlington: AIA, Dec. 2009. <http://www.aia-aerospace.org/assets/year-end-09_Review_and_Analysis.pdf>; <http://www.aia-aerospace.org/resource_center/economics/year_end_review_and_forecast/aia-year-end_data_tables>.

³⁵⁵ Ibid.

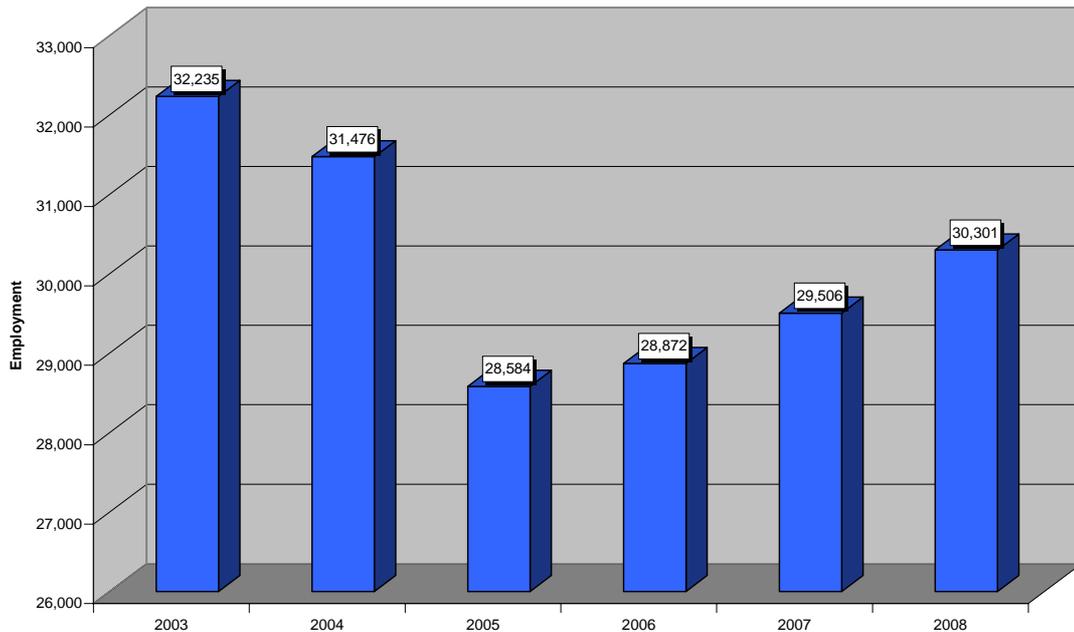


Figure 5.4: European space industry employment (Source: ASD-Eurospace³⁵⁶)

Aerospace's growth of sales was largely driven by U.S. defence spending due to the operations in Afghanistan and Iraq. Given the scaling back of the Iraq involvement, funds are likely to decrease. However, military aircraft sales increased from \$57.0 billion in 2008 to \$61.7 billion in 2009 and missile sales from \$13.3 billion to \$14.8 billion. According to the same sources, an 8% improvement in military aircraft sales and an 11% increase in missile system sales can be seen as a significant contribution to a resilient U.S. aerospace industry³⁵⁷.

Space sales in 2009 were \$40.4 billion, representing a 4.1% increase when compared to \$38.8 billion in 2008. Research and Development spending was not very high, as in 2008. Space-related contracts from NASA and the Department of Defence went up only slightly. The missile segment sales rose by 11.3%, up to \$14.8 billion³⁵⁸.

Regarding export matters, U.S. aerospace companies did not manage to lessen their dependence on the domestic market. Accordingly, foreign trade has become ever more important, but at the same time less certain. Unlike in previous years, France moved into the role of the leading purchaser, followed by

the UK and Japan. Actually, the relative depreciation of the U.S. dollar should have contributed to export success by making products cheaper for foreign customers. However, the global financial and economic crisis and oil price volatility led to delayed orders. For the coming years, the good economic relations between the U.S. and India could result in a new improvement of U.S. aerospace exports. In total, exports amounted to \$78.9 billion, representing a significant 17% drop. This represents 7.2% of the total value of U.S. exports³⁵⁹.

In the civilian domain, exports decreased by 16% to \$69 billion in 2009. Military exports fell even further to \$9.9 billion, or -23%. Within the military domain, missiles, rockets and associated parts exports amounted to \$1.3 billion, while spacecraft, satellites and associated parts exports stood at \$187 million³⁶⁰.

U.S. aerospace imports are estimated at \$25 billion, equal to \$12.7 billion or nearly a 34% decrease, negatively influencing all different product categories of U.S. aerospace imports. The largest import sector by value remains aircraft and engine parts. 50% of the entire imports originate from Canada and France. Taking into account all exports and imports, the aerospace trade balance surplus stood at

³⁵⁶ Aerospace Industries Association. 2009 Year End Review and 2010 Forecast. Arlington: AIA, Dec. 2009. <http://www.aia-aerospace.org/assets/year-end-09_Review_and_Analysis.pdf; http://www.aia-aerospace.org/resource_center/economics/year_end_review_and_forecast/aia-year-end_data_tables>.

³⁵⁷ Ibid.

³⁵⁸ Ibid.

³⁵⁹ Ibid.

³⁶⁰ Ibid.

\$53.9 billion in 2009, down from \$57.4 billion in 2008³⁶¹.

The total employment figure in the U.S. aerospace industry was expected to be 641,000, 16,000 less than the year before. In fact, employment decreased for the first time in 5 years. Aircraft manufacturing accounted for approximately one third of the total workforce. The domain of guided missiles, space vehicles and parts employed almost 76,300 workers³⁶².

5.10 Sectoral Overview

In order to get a more detailed overview of the main developments of the space industry in 2009, a segmental appraisal will be undertaken in the following section. Three main activity areas will be presented: the launch sector, the satellite manufacturing sector and the satellite operators. These three segments make up the two main components of the overall space industrial business, namely the launch sector and the satellite industry. The two strands of the business are closely inter-related, as none of these industry branches can prosper without the other. Indeed, satellite manufacturers and satellite operators need a guaranteed and stable access to space, whereas launch providers rely on orders from the satellite industry to sustain their activities.

It is important to clarify some central concepts which will be at the centre of the analysis in the following sections, in particular the notions of commercial launch and commercial payload. Indeed, since the commercial space industry is growing in significance and progressively replacing the traditional forms of government-operated space activities, it has become more difficult to define and interpret what commercial launches and commercial payloads encompass. In the following section, a launch classification differentiating commercial and non-commercial launches and payloads will be used. A commercial payload is described as having one or both of the following characteristics³⁶³:

- a) The payload is operated by a private company.
- b) The payload is funded by the government, but provides satellite service partially or to-

tally through a private or semi-private company.

5.10.1 Launch Sector

Despite its crucial importance for the satellite industry, the launch sector is an enabler rather than a significant economic activity. The revenues it generates are far less important than the ones originating from the satellite manufacturing and satellite services business.

The year 2009 was an even more active year for the launch sector than 2008, with a total of 78 launches conducted by launch providers from Russia, the United States, Europe, China, India, Japan, North Korea, South Korea, Iran and the multinational consortium Sea Launch. Three non-commercial launches failed: a Taurus XL launch in February 2009, a North Korean Taepodong 2 launch in April 2009 and a South Korean KSLV-1 launch³⁶⁴.

The main events for the rocket industry in 2009 were the successful launch of RazakSAT on the Falcon-1 vehicle by the privately-funded Space Exploration Technologies Corporation (SpaceX) from the company's Kwajalein pad, and the collision of the Iridium satellite and Cosmos 2251 spacecraft in February 2009. Furthermore, the Sea Launch Company's bankruptcy and the following protection actions had a major influence on the launch industry sector. Additionally, 2009 was marked by Iran's first orbital launch in February, successfully deploying its payload into LEO on a Safir three-stage rocket. As mentioned above, South Korea also performed its first orbital launch. However, the deployment of the satellite named STSAT 2A in August 2009 failed. In 2009 North Korea also conducted its first launch since 1998, albeit an unsuccessful one³⁶⁵.

When looking into specific countries, Russia was again the world leader in the launch sector, representing approximately 37% of the total number of launches. It was followed by the United States (app. 31% of the total), Europe (app. 9%), China (app. 8%), Sea Launch (app. 5%), Japan (app. 4%), India (app. 3%) and South Korea, North Korea and Iran which launched one vehicle each, or

³⁶¹ Ibid.

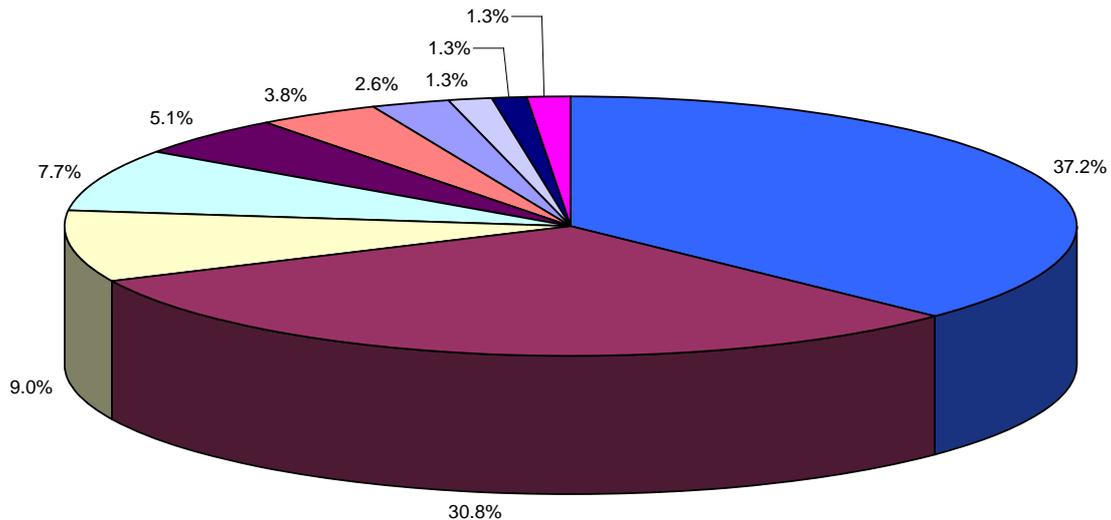
³⁶² Ibid.

³⁶³ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010.
<http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

³⁶⁴ Ibid.

³⁶⁵ Ibid.

Milbank Space Smart. Space Business Review. Los Angeles: Milbank, Dec. 2009. <http://www.milbank.com/NR/rdonlyres/4429D43E-4A1A-4F8C-B129-067607E6530A/0/December_2009_Space_Business_Review.pdf>.



■ Russia ■ USA □ Europe □ China ■ Multinational ■ Japan ■ India □ North Korea ■ South Korea ■ Iran

Figure 5.5: Worldwide launches by country/entity in 2009 (Source: FAA³⁶⁷)

approximately 1% of the total launch figure (Figure 5.5)³⁶⁶.

Russia launched 29 vehicles in 2009, using eight different systems (as much as in 2008) whereas the United States conducted 24 launches with eight different launch systems as well (three more than in 2008). China used five different systems for six launches,

Japan two systems for three launches, Europe one system for seven launches, Sea Launch one system for 4 launches, India one system for two launches and North Korea, South Korea and Iran each used one system for their respective launches. A total of 29 different launch systems were used in 2009, eight more than in 2008 (Table 5.1)³⁶⁸.

Regarding the share of payload launched in 2009, Russia, the United States, Europe and India launched more than 80% of the total payload units launched in space in 2008. When considered in detail, Russia launched 37.8% of the total, while performing 37.2%

Launchers	Number of launch systems	Total number of launches
Russia	8	29
USA	8	24
Europe	1	7
China	5	6
Multinational	1	4
India	1	2
Japan	2	3
North Korea	1	1
South Korea	1	1
Iran	1	1
Total	29	78

Table 5.1: Worldwide launches per country/entity and number of launch systems used in 2009 (Source: FAA)

of the launches. The United States accounted for 30.8% of launches and 25.2% of payloads. Europe launched 12.6% of the payloads with a share of only 9% of the total launches. China accounted for 7.7% of the launches, but carried only 8.1% of total payloads in orbit (Figure 5.6³⁶⁹). The difference between the share of launches and the share of payloads carried by Europe is attributed to the fact that continent's main contractor Ari-

³⁶⁶ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>. The category "Multinational" refers to the consortium Sea Launch with Land Launch.

³⁶⁷ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010.

<http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

³⁶⁸ Ibid.

³⁶⁹ The category "Multinational" refers to the consortium Sea Launch with Land Launch.

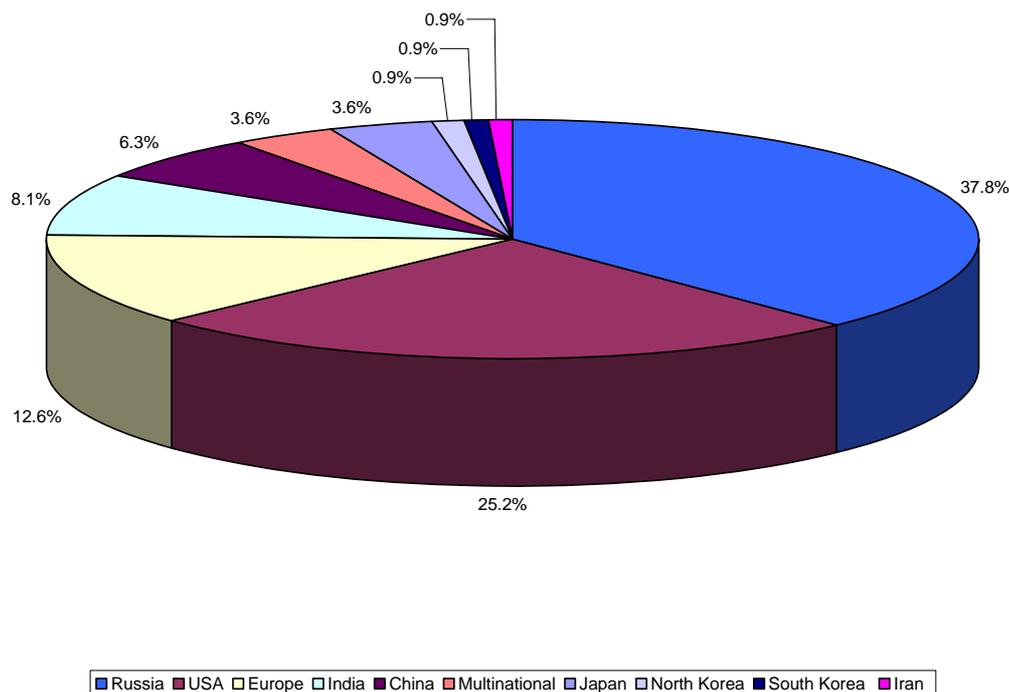


Figure 5.6: Share of the total payloads launched in 2009 by country/entity (Source: FAA)

anespace concentrated on the launch of heavier payloads. Indeed, the Ariane-5 vehicle can carry two GTO satellites at a time, thus sending heavier payloads in orbit with fewer launches³⁷⁰.

In total, 111 payloads were launched in orbit

in 2009, five more than in 2008. Russia was the world leader again, as it launched 42 payloads. It was followed by the United States, which launched 28 payloads and by Europe which launched 14 payloads. India launched nine and China seven. The remain-

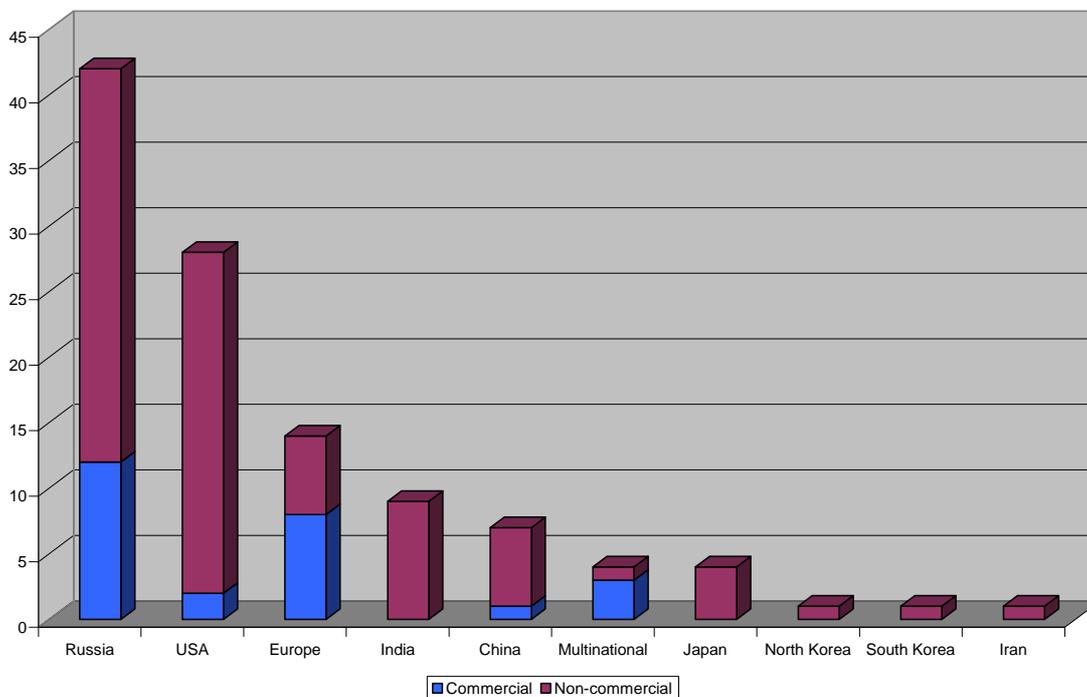


Figure 5.7: Payloads launched in 2009 by country/entity and by commercial status (Source: FAA)

³⁷⁰ Ibid.

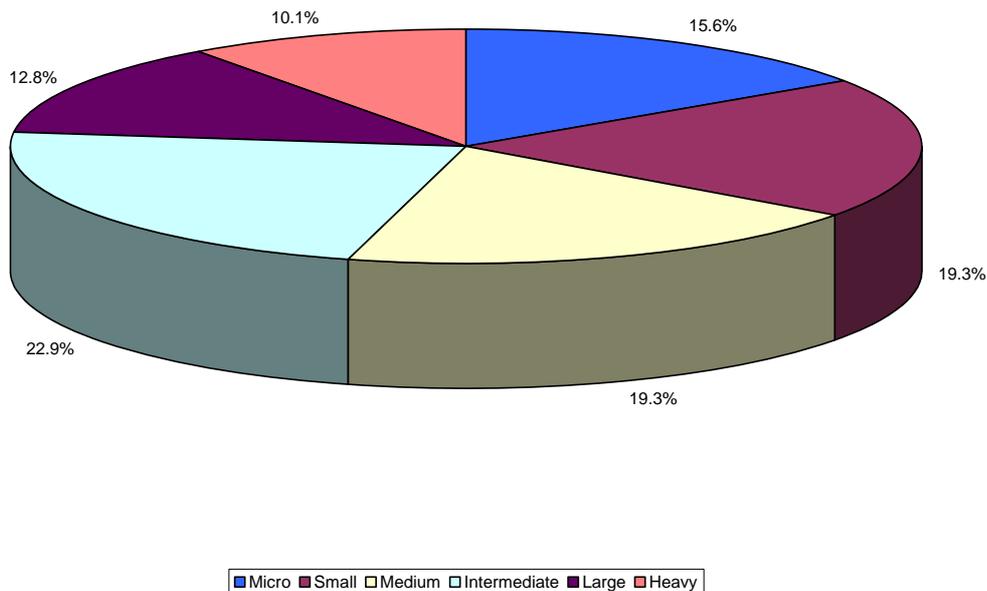


Figure 5.8: Distribution of the payloads launched between April 2009 and March 2010 by mass class (Source: FAA)

ing Sea Launch consortium, Japan, North Korea, South Korea and Iran accounted for 11 payloads. In 2009, Russia took the lead in terms of commercial payloads as well (12 payloads), followed by Europe and Sea Launch (eight and three payloads), the United States (two payloads) and China (one payload – Figure 5.7)³⁷¹.

There is a fairly equal distribution of payloads among the different mass classes. In the period from April 2009 to March 2010, micro, small, intermediate and large payloads were roughly equally distributed, as each class made up around 20% of the total number of payloads launched. Large spacecrafts represented around 13% of the total number of payloads, and heavy ones accounted for only around 10% (Figure 5.8)³⁷².

Micro payloads are mainly science satellites, technological demonstrators or small communications satellites, like the Orbcomm series. Small payloads are very often Earth Observation satellites, such as SAR-Lupe,

Jason or the RapidEye series. Medium payloads feature the most diverse set of satellites, including small satcoms in geostationary orbit, Earth Observation satellites, and most of the Russian military satellites from the Kosmos series. Intermediate payloads encompass medium satcoms and big scientific satellites. Large payloads refer to big satcoms, as well as to the Soyuz and Progress spacecrafts flying to the ISS. Lastly, heavy payloads are all linked to the ISS: the modules Kibo and Columbus, as well as the cargo spacecrafts ATV and Leonardo³⁷³.

Of the total launches conducted in 2009, 69% were non-commercial, representing 54 launches, and 31% were commercial, representing 24 launches. Only five actors performed commercial launches, whereas five actors performed non-commercial launches. As a whole, there was a decrease of commercial launches from 28 in 2008 to 24 in 2009, after an increase in 2008 by comparison to the previous year.

As in 2008, GEO launches were again the top commercial activity, and the whole space transportation market was largely driven by the demand for GEO satcoms. This trend is likely to continue in the near term. Commercial launches were particularly important for Europe and Sea Launch. U.S. launch services in contrast, continued to rely heavily on the governmental market, with only four out of 24 U.S. American launches being of a commercial nature. This was the case in Russia as well, where the relatively important do-

³⁷¹ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

³⁷² According to the mass classification of payloads of the FAA: Micro: 0 to 91 kg. (0 to 200 lbs.); Small: 92 to 907 kg. (201 to 2000 lbs.); Medium: 908 to 2268 kg. (2001 to 5000 lbs.); Intermediate: 2269 to 4536 kg. (5001 to 10000 lbs.); Large: 4537 to 9072 kg. (10001 to 20000 lbs.); Heavy: over 9072 kg. (20000 lbs.). Federal Aviation Administration. Semi-Annual Launch Report: Second Half of 2009. Washington DC: FAA, 2009. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/10998.pdf>.

³⁷³ Ibid.

domestic institutional demand continued to support the launch sector as ten out of 19 payloads related to government activities. India and Japan focused on non-commercial launches, as well as the newcomers North Korea, South Korea and Iran. Russian launchers conducted ten commercial launches, followed by the European Ariane-5 with five commercial launches. Sea Launch and the U.S. conducted four commercial flights each and China one (Table 5.2)³⁷⁴.

Launchers	Commercial	Non-commercial	Total No. of launches
USA	4	20	24
Russia	10	19	29
Europe	5	2	7
China	1	5	6
Multinat.	4	0	4
India	0	2	2
Japan	0	3	3
No. Korea	0	1	1
So. Korea	0	1	1
Iran	0	1	1
Total	24	54	78

Table 5.2: Worldwide launches in 2009 by country/entity and by commercial status (Source: FAA)

Regarding the launch service providers, Arianespace again dominated the market, as its Ariane-5 vehicle (ECA and GS versions) flew seven times in 2009³⁷⁵. Arianespace has won more than 50% of the commercial launch contracts worldwide in the last two years³⁷⁶. In 2009 it placed 14 payloads into orbit in seven launches, totalling 35 successes in seven years and confirming its technological maturity³⁷⁷. A core feature of the company is the ability to carry two satellites at a time, a characteristic which maximises the benefits of using Ariane-5, but which also makes the company more

vulnerable to satellite schedule slips³⁷⁸. In 2009, the company's sales are estimated at €1 billion. At the beginning of this year, Arianespace announced that 6 to 7 launches are scheduled for 2010³⁷⁹.

As for the U.S. American launch providers, Boeing Launch Services (BLS) conducted two commercial launches. The first one was used to orbit the weather satellite GEOS into GEO in June and the second to place the World-View 2 satellite into LEO. Lockheed Martin Commercial Launch Services (LMCLS) launched one Intelsat satellite into GEO³⁸⁰. The two companies traditionally do not compete in the commercial launch market, as their launch vehicles would not be cost-competitive for such an endeavour and as they can count on steady revenues from governmental demand³⁸¹. SpaceX carried out its second successful commercial flight of the Falcon 1, transporting the Malaysian Razak-Sat satellite into LEO. Orbital Sciences Corporation (OSC) performed two non-commercial launches in 2009, one of which failed in February 2009³⁸². United Launch Alliance (ULA) and United Space Alliance (USA) carried exclusively non-commercial launches.³⁸³

The Sea Launch Company launched only one single satellite from its sea-based platform in 2009. This mission was carried out for the Italian army, deploying a communication satellite in GEO. Additionally, the company conducted three Land Launch missions from Baikonur. All in all, Sea Launch launched only four rockets in 2009 compared to six launches in 2008. This was due to the company's bankruptcy in June and the resulting effort to restructure its finances³⁸⁴. During the first quarter of 2010, the company planned to submit a reorganisation concept as a step toward emerging from bankruptcy status³⁸⁵.

³⁷⁴ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010.

<http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

³⁷⁵ Ibid.

³⁷⁶ Arianespace. Company Profile. Paris: Arianespace, Jan. 2010. <http://www.arianespace.com/Press-center/pdf/Company_Profile_EN_2010.pdf>

³⁷⁷ "Launch Log" 18 Dec. 2009. Arianespace 19 Mar. 2010 <<http://www.arianespace.com/news-launch-logs/2000-2010.asp>>.

³⁷⁸ De Selding, Peter B. "Commercial Launch Providers Looking Ahead to Busier 2009". Space News 5 Jan. 2009: 11.

³⁷⁹ Arianespace. Company Profile. Paris: Arianespace, Jan. 2010 <http://www.arianespace.com/Press-center/pdf/Company_Profile_EN_2010.pdf>.

³⁸⁰ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

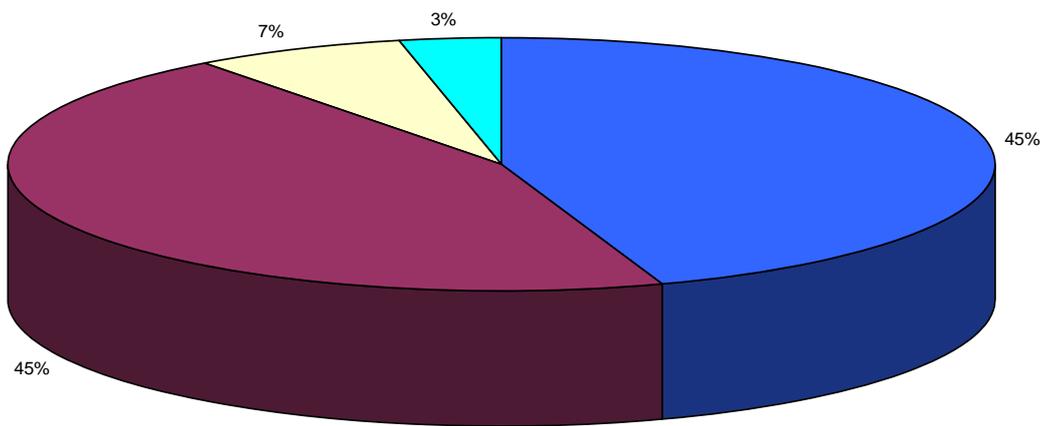
³⁸¹ Ibid.

³⁸² Ibid.

³⁸³ Foust, Jeff. "Satellites, launches, and the recession" 30 Mar. 2009. The Space Review 19 Mar. 2010 <<http://www.thespaceview.com/article/1341/1>>.

³⁸⁴ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010. "Year in Review". Space News 14 Dec. 2009: 22.

³⁸⁵ "Sea Launch Receives Final Approval for DIP Financing" 3 Dec. 2009. Sea Launch Company 19 Mar.



■ Arianespace ■ International Launch Services □ China Aerospace Corporation ■ Mitsubishi Heavy Industries

Figure 5.9: Share of launch contracts for GEO satellites in 2009 by launch service provider

As far as the Russian launch service providers are concerned, International Launch Services (ILS), International Space Company Kosmotras (ISC Kosmotras) and Eurockot Launch Services carried the ten commercial launches in 2009. ILS launched seven commercial Proton rockets in 2007, carrying mostly communication satellites. Additionally, ILS conducted three launches for its prime contractor Khrunichev, for example taking three GLONASS navigation satellites into their orbits in December 2009³⁸⁶. ISC Kosmotras launched one Dnepr-1 rocket and Eurockot one Rocket³⁸⁷.

Total commercial launch revenues in 2009 amounted to roughly \$2.5 billion, about \$500 million more than in 2008. Not surprisingly according to its market share in commercial space flights, Europe takes the lead accounting for approximately \$1 billion in revenues,

followed by Russia (app. \$750 million) and the U.S. (app. \$300 million)³⁸⁸.

An estimated 29 satellite launch contracts were signed in 2009 for geostationary spacecrafts. The two main actors in the sector were the same as in 2008, namely Arianespace and ILS, followed by China Aerospace Corporation and Mitsubishi Heavy Industries as minor actors (Figure 5.9)³⁸⁹.

Arianespace had a very solid year again in terms of contracts signed, winning more than half of the open competition commercial contracts. These "Services and Solutions" contracts include for instance the launches for satellite owners Hispasat, Arabsat, Intelsat, Inmarsat and Avanti Communication³⁹⁰. Furthermore, Arianespace signed a contract with the ESA in June 2008 for two Soyuz launch vehicles in order to orbit the first four operational Galileo satellites from Europe's Spaceport in French Guiana³⁹¹. The company plans to continue its steady launch rate in the near

2010 <http://www.boeing.com/special/sea-launch/news_releases/2009/nr_091203.html>.

³⁸⁶ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan.2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>. "Launch Archives" 12 Feb. 2010. ILS Launch 19 Mar. 2010 <<http://www.ilslaunch.com/launch-archives/>>.

³⁸⁷ Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan.2010. <http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

³⁸⁸ Ibid.

De Selding, Peter. "Arianespace 2009 Revenue Boosted by Higher Launch Rate" 5 Jan. 2010. Space News 19 Mar 2010 <<http://www.spacenews.com/launch/100105-arianespace-revenue-boosted-launch-prices.html>>.

³⁸⁹ De Selding, Peter B. "With Sea Launch Sidelined by Debt, Satellite Operators Want More Choices". Space News 4 Jan. 2010: 11.

³⁹⁰ Ibid.

³⁹¹ "Galileo IOV launch services contract signed" 16 June 2009. European Space Agency 19 Mar. 2010 <http://www.esa.int/esaCP/SEMCUA3XTVF_index_0.html>.

term³⁹². Arianespace also signed a contract with Astrium for the production of 35 Ariane-5ECA rockets in February 2009, at an estimated €4 billion value. With this contract, Arianespace has a total of 49 Ariane-5 in its backlog³⁹³.

ILS also signed 13 launch contracts for GEO satcoms in 2009, 6 more than in 2009 and as much as Arianespace. The contract partners include satellite owners AsiaSat, Intelsat, SES World Skies, Intelsat and Eutelsat, among others.

Sea Launch signed six launch contracts in 2008. Due to its mid-2009 bankruptcy, the company lost its status and the ability to sign contracts for future launches. The loss of Sea Launch as a main provider resulted in a market duopoly of Arianespace and ILS, a situation about which commercial satellite fleet operators expressed great concern. Sea Launch might emerge from bankruptcy by the end of this year³⁹⁴.

Among the remaining actors in the launch sectors, the China Great Wall Aerospace Corporation won a contract for the Nigerian Nigcomsat-2 satellite and the Apstar 7 of APT Satellite Holdings. Mitsubishi Heavy Industries on the other hand, signed a contract with the Korea Aerospace Research Institute for the launch of the Komsat-3 satellite³⁹⁵.

The main feature of the launch industry in 2009 was the more or less unexpected bankruptcy of Sea Launch and its side effects. The two remaining principal launch services providers Arianespace and ILS had to fill in the gap for former Sea Launch customers, which led to the creation of a duopoly market. The reaction among satellite operators led by Intelsat and SES was to increase pressure for loosening U.S. export controls on spacecraft launched in China. Arianespace and ILS however claim that they did not see much growth

in 2009, in spite of the elimination of Sea Launch as a competitor³⁹⁶. Nevertheless, launch prices worldwide have been increasing in the past two years. This process continued in 2009, especially due to the bankruptcy of Sea Launch³⁹⁷. Therefore, satellite operators have become increasingly worried by the launch market's diminishingly competitive nature.

5.10.2 Satellite Manufacturing Sector

Satellite services represent the most mature and lucrative market in the space sector. Indeed, space based communications is the core business for satellite service providers and satellite manufacturers alike. Therefore, looking at the market share of satellites launched and ordered in a given year is not only a good indication of the vitality of domestic space industries, but it also helps assessing the global trends in the space industry.

In 2009 111 payloads were launched. Only 23% of the payloads were commercial, significantly less than in 2008, when they represented 40%. 38% of the launched payloads were manufactured by Russia, 25% by the U.S. and 6% by China. Europe accounted for 13% of the payloads launched (Figures 5.6 and 5.7)³⁹⁸.

98 satellites were launched in 2009, nine more than in 2008. Most of them were manufactured by U.S. companies with 39 of the satellites launched (40% of the total figure), followed by Europe (24 satellites representing 24.5% of the total), Russia (15 satellites or 15.3%) and China (13 satellites or 14.5%)³⁹⁹.

When looking at the performances by the bigger satellite manufacturing companies, Thales Alenia had a very active year as 11 of its satellites were launched in orbit in 2009. Other European manufacturers such as Sur-

³⁹² Arianespace. Company Profile. Paris: Arianespace, Jan. 2010. <http://www.arianespace.com/Press-center/pdf/Company_Profile_EN_2010.pdf>.

³⁹³ "Arianespace orders 35 Ariane 5 ECA launchers from Astrium" 2 Feb. 2009. Arianespace 19 Mar. 2010 <<http://www.arianespace.com/news-press-release/2009/02-02-09-launcher-order-from-astrium.asp>>.

³⁹⁴ De Selding, Peter B. "With Sea Launch Sidelined by Debt, Satellite Operators Want More Choices". Space News 4 Jan. 2010:11. Kaiser, Dustin. "The Impact of the Sea Launch Bankruptcy On The Launch Industry" Oct. 2009. Satmagazine 19 Mar. 2010 <http://www.satmagazine.com/cgi-bin/display_article.cgi?number=1774104459>. "Sea Launch Preparing for Bankruptcy Exit" 12 Mar. 2010. Space News 19 Mar. 2010 <<http://www.spacenews.com/launch/100312-sea-launch-preparing-bankruptcy-exit.html>>.

³⁹⁵ De Selding, Peter B. "With Sea Launch Sidelined by Debt, Satellite Operators Want More Choices". Space News 4 Jan. 2010: 11.

³⁹⁶ Ibid.

³⁹⁷ de Selding, Peter. "Arianespace 2009 Revenue Boosted by Higher Launch Rate" 5 Jan. 2010. Space News 19 Mar. 2010 <<http://www.spacenews.com/launch/100105-arianespace-revenue-boosted-launchprices.html>>. Foust, Jeff. "How competitive is commercial launch?" 19 Oct. 2009. The Space Review 19 Mar. 2009 <<http://www.thespacereview.com/article/1493/1>>.

³⁹⁸ Payloads are assigned to the nation that commissioned them, not according to the nationality of the manufacturer. Federal Aviation Administration. Commercial Space Transportation: 2009 Year in Review. Washington DC: FAA, Jan. 2010.

<http://www.faa.gov/about/office_org/headquarters_offices/ast/media/year_in_review_2009.pdf>.

³⁹⁹ Futron Corporation. Satellite Manufacturing Report. Wisconsin: Futron, Jan. 2010. <http://www.futron.com/pdf/friends_of_futron_reports/satellite_manufacturing_reports/FutronSM2010-01.pdf>.

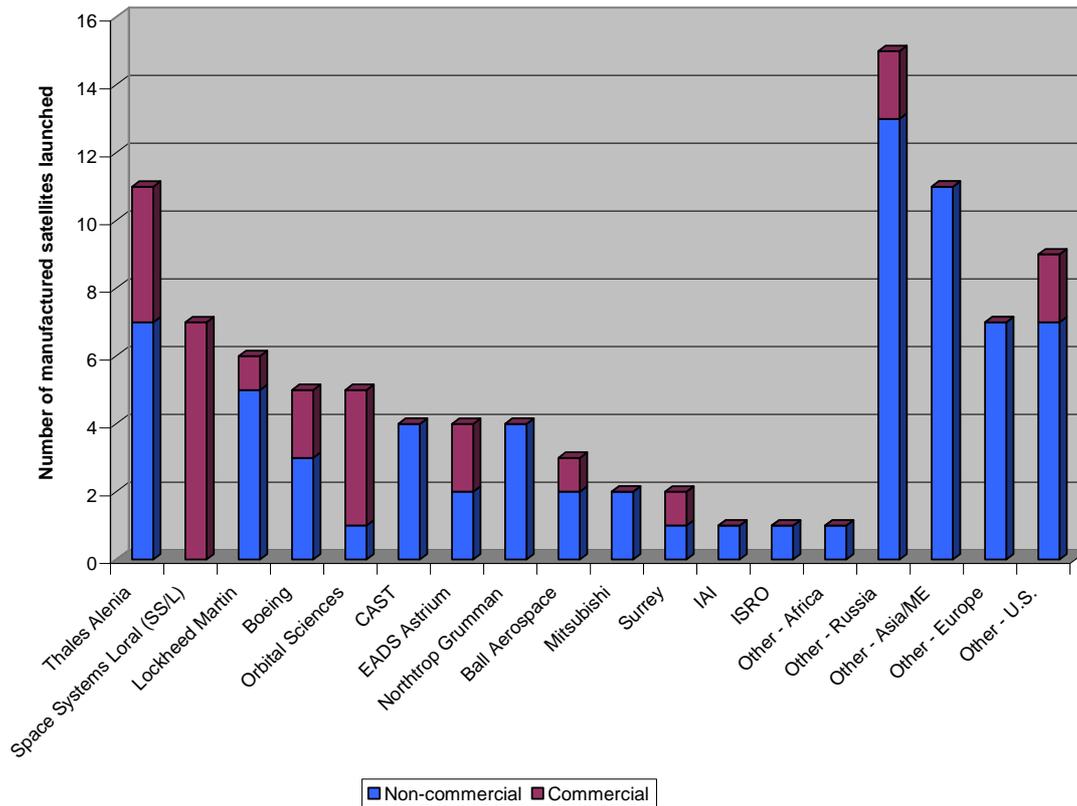


Figure 5.10: Satellites launched in 2009 by manufacturer and commercial status (Source: Futron)

rey and EADS Astrium accounted for two and four satellites respectively. The two top U.S. satellite manufacturers were Space Systems/Loral (SSL) and Lockheed Martin with seven and six satellites respectively, followed by Boeing and Orbital, with five spacecraft each (Figures 5.10 and 5.11)⁴⁰⁰.

Of the 98 satellites launched, 26 were commercial. The main part of the commercial satellites launched were European or U.S. built: seven of the commercial satellites were European, representing only 27% of the total number of commercial satellites launched, whereas 17 commercial satellites were manufactured in the U.S., accounting for 65% of the total. 28 satellites were launched to GEO and 70 into other orbits. When looking at GEO satellites, Europe lost the lead it held in 2009: 25% of the GEO satellites launched in 2009 were European (three made by EADS Astrium and four by Thales Alenia). In contrast, 61% of the GEO satellites launched were U.S. built, whereas Russian ones accounted for 11% of the total figure⁴⁰¹.

2009 was an extremely successful year in terms of satellite contracts awarded. 41 commercial GEO satellites were ordered, nearly twice as many as the 23 orders in

2008. Manufacturers from the U.S. won 19 contracts, whereas European manufacturers signed 12 and Russian manufacturers 5. There were also satellite orders with two co-prime contractors: The two Arabsat 5C and 6B satellites will be built by Thales Alenia and EADS Astrium, and the OverHorizon satellite of OverHorizon AB by Orbital and Thales Alenia (Figure 5.12)⁴⁰².

As for market trends compared to the previous year, in 2009 the sector witnessed the entry of two new actors in the commercial export business. The German-based OHB System AG won a contract for its first Small-GEO mission. The building contract for the Spanish Hispasat AG-1 communication satellite has a value of €48 million⁴⁰³. Additionally, OHB attracted the industry's attention by

⁴⁰² De Selding, Peter B. "Export-Credit Financing Helps Boost 2009 Satellite Orders". Space News 4 Jan. 2010: 12.

Futron Corporation. Satellite Orders Report. Wisconsin: Futron, Dec. 2009. <http://www.futron.com/pdf/friends_of_futron_reports/satellite_manufacturing_reports/FutronSM2009-EOY.pdf>.

⁴⁰³ "OHB und Hispasat unterzeichnen Vertrag über Bau und Test des Small Geo-Satelliten 'Hispasat AG1'" 18 June 2009. OHB Technology AG 19 Mar. 2010 <<http://www.ohb-technology.de/media-relations/pressemitteilungen-detail/items/ohb-und-hispasat-unterzeichnen-vertrag-ueber-bau-und-test-des-small-geo-satelliten-hispasat-ag1.html>>.

⁴⁰⁰ Ibid.

⁴⁰¹ Ibid.

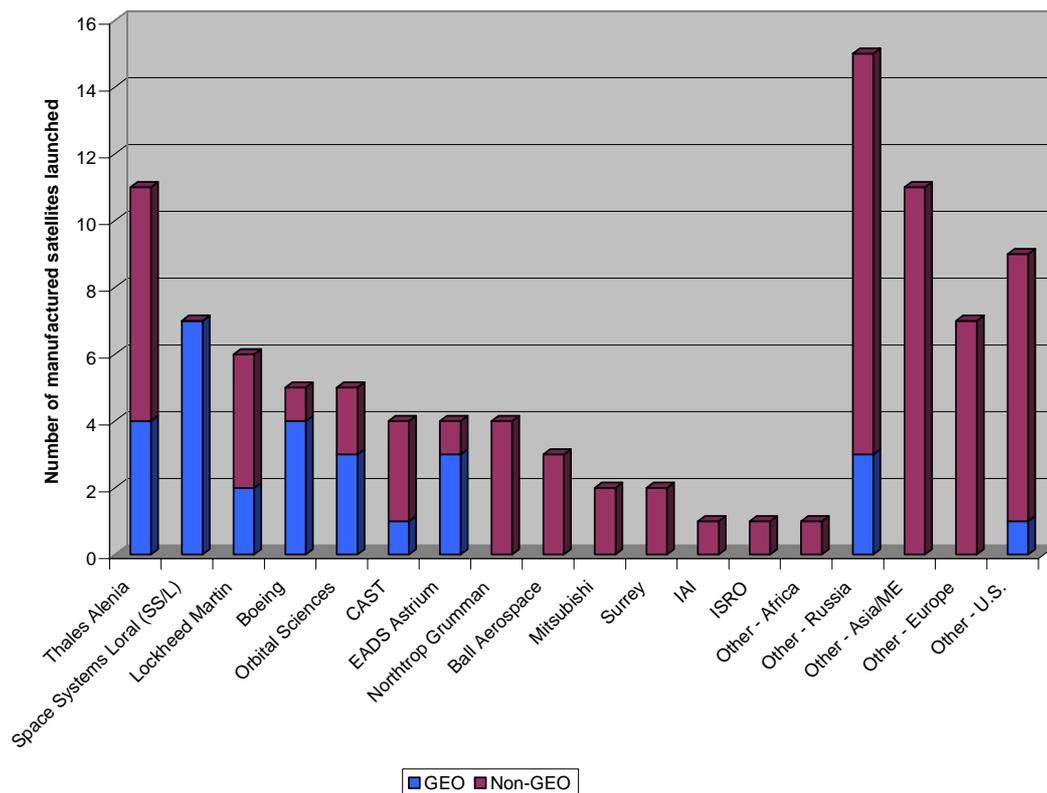


Figure 5.11: Satellites launched in 2009 by manufacturer and orbit type (Source: Futron)

winning the contract to build 14 Galileo satellites for €566 million⁴⁰⁴. The second newcomer was the Canadian MacDonald Dettweiler and Associates Company, chosen to build a communication satellite system for the National Space Agency of Ukraine, which also includes a GEO communication satellite. This satellite will support direct broadcast television and high-speed Internet access in Ukraine⁴⁰⁵.

The Russian manufacturer ISS-Reshetnev won, among others, a contract with the Russian Radio Research and Development Institute for developing the Express AM5 and AM6 satellites in May 2009. For this project, ISS-Reshetnev cooperates with Thales Alenia. Additionally, the company negotiated a contract on a TELKOM-3 telecommunication satellite for PT Telekomunikasi Indonesia⁴⁰⁶. The

rising number of contracts and the international involvement of Russian companies are indicators of the increasing integration of Russia's satcom industry into the global market.

In 2009 China's presence in the satellite market was also confirmed by contracts attributed to Chinese companies from Nigerian satellite services providers, the Asia-Pacific Mobile Communications Satellite Company Limited and the Laos National Authority for Science and Technology⁴⁰⁷. However, there is still some uncertainty regarding the long term sustainability of the Chinese market presence, due to a Long March 3B rocket failure in August. The rocket's malfunction did not allow it to place the Indonesian commercial

⁴⁰⁴ "OHb-System und ESA unterzeichnen Galileo-Vertrag" 26 Jan. 2010. OHb Technology AG 19 Mar. 2010 <<http://www.ohb-technology.de/media-relations/pressemitteilungen-detail/items/ohb-system-und-esa-unterzeichnen-galileo-vertrag.769.html>>.

⁴⁰⁵ "MDA contracted to deliver the national communications satellite system of Ukraine" 15 Dec. 2009. MacDonald Dettweiler and Associates 19 Mar. 2010 <<http://www.mdacorporation.com/corporate/news/index.cfm?year=2009>>.

⁴⁰⁶ "ISS Reshetnev Names Express AM5, AM6 Partners; RSCC Reveals Plans for New Fleet" 17 Aug. 2009. Satellite Today 19 Mar. 2010

<http://www.satellitetoday.com/twitter/ISS-Reshetnev-Names-Express-AM5-AM6-Partners-RSCC-Reveals-Plans-for-New-Fleet_31855.html>.

"New international contract of the JSC 'ISS'" 5 Mar. 2009. Reshetnev 19 Mar. 2010 <<http://www.iss-reshetnev.com/?cid=news&nid=105>>.

De Selding, Peter B. "Export-Credit Financing Helps Boost 2009 Satellite Orders". Space News 4 Jan. 2010: 12.

⁴⁰⁷ "CGWIC Signs LaoSat-1 Communications Satellite Contract" 25 Feb. 2010. China Great Wall Industry Corporation 19 Mar. 2010 <http://www.cgwic.com/news/2010/0225_LaoSat-1.html>.

Futron Corporation. Satellite Manufacturing Report.

Wisconsin: Futron, Jan. 2010. <http://www.futron.com/pdf/friends_of_futron_reports/satellite_manufacturing_reports/FutronSM2010-01.pdf>.

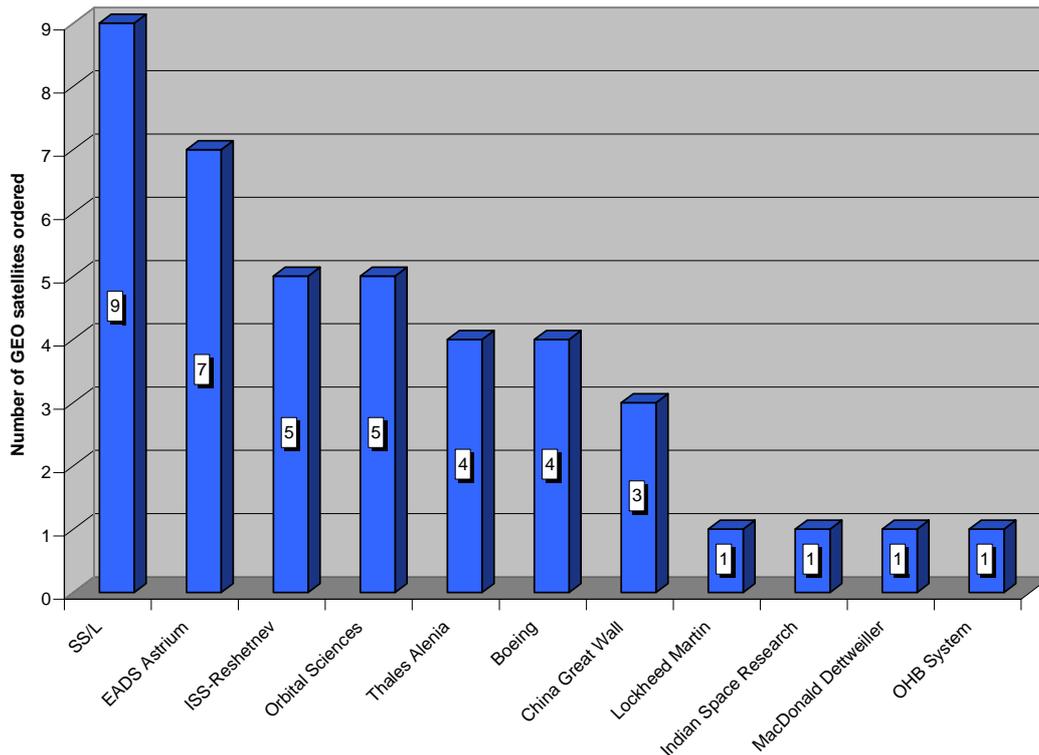


Figure 5.12: GEO satellite orders in 2009 by manufacturer

communications satellite Palapa-D into GTO⁴⁰⁸.

Despite the emergence of the new actors, the traditional satellite manufacturers from Europe and the U.S. had a very good year. As a whole, the business stayed stable despite the crisis, and the main buyers of satellites remained the major satellite fleet operators: SES and Intelsat alone accounted for more than a third of the orders. If the growth of the sector continues at this pace, one could expect a stable rate of replacement satellite orders, at around 20 spacecrafts per year. The growing commercial capabilities in Japan, South Korea, India and elsewhere could have further positive effects. However, the main commercial satellite providers such as SES, Intelsat and Eutelsat have already promised to subside investing now that they have completed their hardware replacement expansion cycle⁴⁰⁹.

Looking at the European satellite manufacturers in more detail, EADS won seven contracts in 2009, whereas Thales Alenia had four orders, excluding the co-orders with EADS Astrium and Orbital Sciences. New-

comer OHB System AG won one contract with Hispasat. As for the U.S. satellite manufacturers, Boeing was contracted by Intelsat to build four new 702B satellites, which could give the company a chance to rapidly re-enter the commercial market within the course of this year. Orbital Sciences won five contracts, including orders from Intelsat and OverHorizon. Loral Space and Communications has invested \$350 million in the past few years into its SSL division. This enabled the company to sign nine contracts in 2009. Loral is the only satellite manufacturer which depends entirely on commercial contracts. Consequently, it is also more vulnerable to market fluctuations than other manufacturers⁴¹⁰.

With the exception of Loral, no satellite manufacturer relies on commercial orders alone. Therefore, institutional orders constitute an important segment for the satellite manufacturing sector, particularly in the United States. For example, Orbital an-

⁴⁰⁸ De Selding, Peter B. "Palapa-D to be Salvaged After Being Launched into Wrong Orbit". Space News 7 Sept. 2009: 10.

⁴⁰⁹ De Selding, Peter B. "Export-Credit Financing Helps Boost 2009 Satellite Orders". Space News 4 Jan. 2010: 12.

⁴¹⁰ Ibid.

Futron Corporation. Satellite Orders Report. Wisconsin: Futron, Dec. 2009. <http://www.futron.com/pdf/friends_of_futron_reports/satellite_manufacturing_reports/Futron_SM2009-EOY.pdf>.

"Boeing Signs 4-Satellite Contract With Intelsat" 16 July 2009. Boeing 19 Mar. 2010 <<http://boeing.mediaroom.com/index.php?s=43&item=748>>.

"2009 – ein glänzendes Jahr für Astrium" 19 Jan. 2010. EADS 19 Mar. 2010 <http://www.eads.net/1024/de/pressdb/pressdb/Astrium/20100119_astrium_2009.html>.

nounced that its advanced space programme division increased revenue by 15.6 percent in 2009 and will continue to grow in 2010, mainly thanks to manufacturing classified and unclassified satellites for the U.S. government⁴¹¹. In Europe, the biggest non-commercial order was that of the 14 Galileo satellites to the German OHB company, leaving behind the main competitor, EADS Astrium. In 2009, only a little more than 25% of all launched satellites was commercial. Consequently, the

government related satellite manufacturing business still represents the greatest revenue source for the sector's companies.

In terms of future perspectives, 20 to 25 satellites are expected to be launched annually in the next few years. Rising technologies e.g. HDTV are keeping up the demand for new satellites.⁴¹² However, the current "high cycle" of the manufacturing market should last until 2013 and corresponds to replacement of older satellites.

⁴¹¹ De Selding, Peter B. "Orbital Bullish on U.S. National Security Satellite Market" 19 Feb. 2010. Space News 19 Mar. 2009 <<http://www.spacenews.com/military/100219-orbital-bullish-national-security-satellite-market.html>>.

⁴¹² De Selding, Peter B. "Export-Credit Financing Helps Boost 2009 Satellite Orders". Space News 4 Jan. 2010: 12.



6. The Defence Perspective

The following chapter briefly presents key developments in the field of military related space activities. These include the military space government programmes and related spending, the industrial achievements in military space technologies and the evolution of space security doctrines of all the major space-faring nations. Nevertheless, one should take into account that studying military space activities based on open sources is always a difficult task, given the confidentiality clauses that usually apply to them. Consequently, all the verifiable facts and figures given below cannot provide a fully detailed picture of all related developments. They do however put them in perspective by providing an overall estimate of the general trends in this field.

6.1 Recent Trends in Military Expenditure

Space-related military spending remained generally stable in 2009 and 2010. While the worldwide military spending on space rose slightly by 7% from \$29.4 billion in 2008 to \$31.8 billion in 2009, the share nearly remained the same. Again, the United States led by far with a share of 90% of worldwide space-related defence expenditures, but the sum of the other countries now occupy a bigger share of 10% compared to 5% in 2008. However, the European space spending dedicated to military use decreased in 2009 by 32% to approximately \$752 million⁴¹³.

It has to be stated that money spent on dual-use programmes or research is not included in this overview. It should also be kept in mind that spending is not always clearly allocable, because some budget positions can be assigned to various categories. The standard confidentiality and secrecy along with potential opaqueness can further complicate matters. Different purchasing powers and work force costs add another degree of ambiguity, calling for relativisation of numerical budget values (cf. chapter 2.2).

⁴¹³ Figures are derived from Euroconsult data.

6.2 Europe

6.2.1 National Military Space Programmes

Although European cooperation in dual-use space technologies is increasing, military space activities in 2009 and 2010 remain predominantly within the national government's field of competences. Consequently, European cooperation in such matters remained into the sphere of bilateral or at best multilateral arrangements among the major European space-faring nations.

The domain of Space Situational Awareness in particular has been one of the areas that attracted particular attention in the last 12 months. The German Armed Forces for example, proceeded to the creation of a separate military command to coordinate space surveillance activities, known as the German Space Situational Awareness Centre (GSSAC). The command's facility was inaugurated in 2009 and it was projected to reach the planned staffing ceiling already within 2010. The centre's creation was deemed necessary not only to facilitate German military participation in the future European space-monitoring capability, but also to develop the country's national competencies in this field⁴¹⁴.

Furthermore, Germany and France are the only EU members that have a limited space surveillance capability through the use of two nationally operated Radars. These are the German TIRA, which is capable of tracking objects in orbit and determining their nature, and the French Graves, which is more suitable for wide area surveillance. Given the complementarity of the two systems there has been a strong incentive for bilateral cooperation on their use. Therefore, the two countries have initiated in 2009 an exchange of surveillance data programme, enabling them to coordinate the use of both systems and to multiply their operational usefulness. Nevertheless, even the combined systems' accuracy is not always sufficient for the accu-

⁴¹⁴ De Selding, Peter B. "Europe Keeping Increasingly Capable Eye on Orbital Debris". Space News 26 Apr. 2010: 6.

rate identification and tracking of objects in orbit. Therefore, both countries still have to rely on USAF's space monitoring network for more accurate measurements in order to avoid losing their military space assets to collisions with space debris⁴¹⁵.

However, since military space still remains predominantly under strict national jurisdiction, European cooperation does not proceed at the same pace in all areas of activity. Contrary to the dual-use SSA where cooperation has been increasing, negotiations on the MUSIS system stagnated throughout 2009 and 2010. MUSIS is a six-nation European effort to build a common ground segment for its members' Earth observation satellites. Some participating countries would contribute their optical reconnaissance satellites to the common system, others their Radar satellites and others would only share its operating financial burden. This complicated arrangement however has made it difficult to quantify each participating country's contribution to and expected returns from MUSIS. Consequently, negotiations among the participants have been fruitless for the past 12 months and the programme's future was threatened as certain participant countries could be inclined to proceed independently with their national projects⁴¹⁶.

In spite of the difficulties that the multilateral MUSIS programme has encountered, the bilateral cooperation between Germany and France in the field of Earth observation (EO) satellite data exchange moved forward in 2009 and 2010. On 4 May, satellite manufacturer OHB of Bremen announced it had secured a €14 million contract in order to provide ground stations to both countries permitting access to data from each other's EO spacecraft. Under this Franco-German bilateral agreement known as the Europeanisation of Satellite-Based Reconnaissance programme (E-SGA), France would be granted access to data from the German radar EO SAR-Lupe satellites and Germany from the French Helios 2 optical EO satellites. Ground stations in both countries were already under construction and they were expected to become operational by July 2010⁴¹⁷.

The increasing importance attributed to military space activities in Europe was also reflected in their increasing budgets, which showed remarkable resilience to the past 12 months' adverse financial conditions. On 25 November 2009 for example, French Defence

Ministry officials announced they were on track to increase military space spending by 8% annually through 2014, in accordance with the defence policy announced by President N. Sarkozy in 2008, before the financial crisis's consequences were fully felt. This would mean that French military space budget would rise to €600 million by that year, from €380 million in 2008. An additional €200 million would be channelled to the French space agency CNES for dual-use technologies development. At the same time, the country's joint defence staffs was set to create a Joint Space Command by July 2010 in order to coordinate military space assets use better. At the same time, France was actively seeking participation from other EU countries in its future optical and electronic surveillance satellites⁴¹⁸.

At the same time in the UK, Defence Ministry officials announced they were considering a revision to the Skynet 5 contract with Paradigm, an EADS Astrium Services subsidiary, to allow for the addition of a fourth satellite to the Skynet 5 constellation. According to the same sources, tactical imagery transmission demand from UK forces in Afghanistan has brought the existing three satellite constellation to its capacity limits. Furthermore, demand was expected to double in the next 5 years, or quadruple by comparison to the initial bandwidth demand models made back in 1998, on the basis of which the contract with Paradigm was concluded. For the time being, UK officials said they were dealing with the situation by scrutinising transmission demands and using the Skynet 5C spacecraft, which was originally planned as a back-up spare satellite. Military satellite communications providers in France and other NATO countries admitted facing the same problem as well⁴¹⁹.

Finally, the decision to deploy a fourth Skynet 5 satellite was officially announced on 9 March 2010. The original Skynet 5 contract with Paradigm was valued at £3.5 billion through 2020 for the lease of three communications satellites and related services. This contract was extended through 2022 for an additional cost of £400 million, allowing Paradigm to launch a fourth satellite by 2013 in order to meet the increased demand. Since the Skynet 5 contract was originally set up as a public-private partnership (PPP), with Paradigm maintaining the ownership of the spacecrafts and leasing their services to the military, the extension costs would only burden the UK government towards the end of

⁴¹⁵ Ibid.

⁴¹⁶ "MUSIS Ground System Deal Teeters on Edge of Collapse". Space News 26 Apr. 2010:6.

⁴¹⁷ "OHB To Support Franco-German imagery Sharing". Space News 10 May 2010: 9.

⁴¹⁸ De Selding, Peter B. "France Seeks Military Space Investment Partners". Space News 30 Nov. 2009: 6.

⁴¹⁹ De Selding, Peter B. "British Military's Satellite Capacity Nearing Its Limit". Space News 23 Nov. 2009: 11.



its duration. Thus, British armed forces would be able to use the fourth satellite and only pay for it in 2020. This outcome clearly demonstrated the advantage of PPP's adaptability to changing operational needs, especially at a time of budgetary difficulties for the UK⁴²⁰.

The satellite manufacturer Thales Alenia Space and the ground-services provider Telespazio are to build the Sicral 2 military telecommunications satellite, going to be launched in 2013. The satellite will be used by both the Italian and the French defence ministries, containing separate UHF- and SHF-frequency payloads for both countries. However, this joint military satellite project marks a clear break to previous European politics where countries have their own military communications satellite systems. Noteworthy is the fact that both contracting companies are in a joint French-Italian ownership. The satellite is to be included in France's Syracuse 3 system and will enforce Italy's capacities to contribute UHF bandwidth to NATO⁴²¹.

6.2.2 European Union

In 2009 and 2010 the European Union has been increasing its involvement in dual-use military applications that could potentially have a military usefulness. EU security related space activities are mostly managed through the European Union Commission, the European Defence Agency and the European Union Satellite Centre. The European Space Agency also acts as a programme coordinator and procurement authority for most of these projects. The EU's principal security related programmes include the Galileo navigation and positioning satellite constellation, the Global Monitoring for Environment and Security (GMES) Earth observation programme and the Space Situational Awareness (SSA) project. As all of the aforementioned programmes are of potentially dual civil-military usefulness, they were already presented in details in chapter 3 of this report. However, a brief analysis of developments related more closely to their space security aspects would be pertinent in this chapter.

One of the key planks in the past 12 months in European space security policy has been the drive to achieve strategic non-dependence in critical space capabilities. This trend was confirmed in March 2010, when the European Commission made known it was considering the removal of all non-European built components from the Galileo satellites

currently under final assembly. This decision would mainly affect Chinese-built parts of the spacecrafts, for which European-made substitutes would have to be found. Furthermore, should this decision materialise, it might also impede the procurement of the Canadian-built search and rescue terminals currently envisaged for the system. This significant change in the programme's procurement policy could also be seen as a result of its change from a private-public partnership to a 100% public financed project⁴²².

Furthermore, this decision was reinforced by China's own step towards the development of its own national satellite navigation system called Beidou (Compass). The system was originally planned to provide only regional coverage, with China relying on Galileo for global wide use. However, this policy is now changed and China is developing Beidou as a global system, directly competitive to Galileo. This development has also created friction between European and Chinese authorities over radio frequencies reserved for each system's government-only use, known in Europe as the Public Regulated Service (PRS) and in China as the Authorised Service. Although these systems should in principal emit in different frequencies, negotiations over allocating them between Galileo and Beidou have been fruitless up to now. On the contrary, a similar agreement between Europe and the U.S. was signed already in 2004 and similar negotiations with Russia on cooperation with its Glonass system also saw progress in 2010⁴²³.

Finally, in a related development EU member-states reached in March a preliminary agreement on the service use policy of PRS. Negotiations were expected to conclude by the end of 2010, but it appeared that EU governments would be granted direct and unconstrained access to Galileo's encrypted military signal. This arrangement would imply that EU member-states would all create their own national points of contact with the system's two Galileo Security Monitoring Centres (GSMC) in France and the UK and they would be solely responsible for the service's use by their authorities. Furthermore, officials from the Galileo Supervisory Authority (GSA) disclosed that all member-states would have unrestrained access to the service and no prior approval by EU institutions or authorities would be required for its military use. However, according to the same sources, the question of whether the PRS would be completely free of charge like its GPS counterpart

⁴²⁰ "Extension Prompts Paradigm To Order 4th Skynet 5". Space News 15 Mar. 2010: 8.

⁴²¹ De Selding, Peter B. "Thales Alenia Space, Telespazio To Build Sicral 2 Satellite." Space News 10 May 2010: 5.

⁴²² De Selding, Peter B. "European Officials Poised to Remove Chinese Payloads From Galileo Sats". Space News 15 Mar. 2010: 1.

⁴²³ Ibid.

or if its use would entail a certain fee was not yet decided. Needless to say that any charge related to PRS could damage Galileo's competitiveness to its U.S. counterpart⁴²⁴.

6.2.3 ESA

One of the principal trends in 2009 and 2010 has been the increasing involvement of the European Space Agency (ESA) to the development of dual-use space capabilities for Europe. This tendency has led to an increased level of cooperation with the European Defence Agency (EDA), which is the only other European institution tackling this issue.

This trend was especially evident in the development of the future European Space Situational Awareness (SSA) system. Both agencies were scheduled to start official discussions in 2010 on the subject of how the European dual-use SSA should be created and managed. Although the SSA started as an ESA programme, EDA became quickly involved, mostly upon the insistence of European governments. In fact, the past 12 months have witnessed increasing pressure in favour of the active participation of EU military personnel in SSA's development and operational use, with certain voices even calling for the complete militarisation of the system's operating concept. This trend has been also induced by the rising number of European military space assets in use, as well the growing realisation of their vulnerability to space debris collisions described above⁴²⁵.

Another example of ESA-EDA coordination appeared in February 2010, when they both issued parallel contracts of a €400,000 value and 6 month duration each for the realisation of two preliminary concept studies investigating the use of Unmanned Aerial Vehicles (UAVs) for domestic and maritime security purposes in Europe. Although the two agencies demanded separate studies, they nevertheless issued a common request for proposals. This fact undoubtedly illustrates the gradual expansion of ESA's mandate into the field of security-related activities. Although it is forbidden for UAVs to fly over European civilian airspace in order to avoid accidents, it is anticipated that this regulation will change as UAVs demonstrate an increasing degree of operational reliability. The future UAV system envisaged would use satellite communications to downstream surveillance data and it is expected to operate complementary to

Earth observation satellites, offering shorter revisit periods than space assets⁴²⁶.

Finally, ESA involvement into space security applications became greater in May 2010, when the agency began the concept development of a system of systems focused on utilising existing and future European space capabilities for security purposes. The programme, known as the Global Integrated Architecture for Innovative Utilisation of Space for Security (or Gianus), intends to integrate all existing European Earth observation, communications and navigation satellites into a single interface. By creating a unified operational system from all European space assets, Gianus would facilitate its use for security purposes and eventually make it more adaptable to specific military operational needs. At a time when military budgets across Europe are strained by the ongoing financial crisis, dual-use space systems developed could be a viable option for the majority of its member-states⁴²⁷.

6.3 The United States

As the Operationally Responsive Space concept is maturing in the United States, more and more major U.S. space contractors, such as Boeing or Lockheed Martin, are becoming interested in it. Boeing's Phantom Work's Advanced Network and Space Systems are currently working on small satellites that they qualify as "disruptive technology". Analysts in the U.S. expect 17 more small satellites to be built within the next decade, for a projected total value of \$1.4 billion (a 40% increase from current levels). The Pentagon is moving forward with purchasing smaller, simpler and cheaper satellites to cover ORS needs for a number of reasons, including their affordability, survivability and launch-on-demand capability⁴²⁸.

In a related development, the U.S. National Reconnaissance Office (NRO) has started a new program to use tiny satellites, known as "cubesats", as in-space test platforms for future satellite technologies. "Cubesats" satellite buses, which typically measure 10x10x10 cm, are relatively cheap, they can be purchased in bulk and be ready on demand to serve as test platforms. They could help NRO to validate new instruments, missions and capabilities, such as hyperspectral

⁴²⁴ "Individual European Nations To Determine Uses for PRS". Space News 15 Mar. 2010: 16.

⁴²⁵ De Selding, Peter B. "Europe Keeping Increasingly Capable Eye on Orbital Debris". Space News 26 Apr. 2010: 6.

⁴²⁶ De Selding, Peter B. "European Space, Defence Agencies Study New Unmanned Aerial Vehicle Service". Space News 22 Feb. 2010: 12.

⁴²⁷ "ESA Eyes Military Addition To Civil Satellite Network". Space News 26 Apr. 2010: 6.

⁴²⁸ Bennett, John T. "Small Satellites Attract Interest from Large U.S. Companies". Space News 27 July 2009: A4.



sensors, attitude control systems, or radio-frequency modules. NRO has reportedly asked for acquiring approximately 20 to 50 "cubesats" at a \$250,000 unit cost, over a two-year period beginning in 2010. One more advantage of using "cubesats" would be that they could be launched in a timely fashion aboard the first available launcher. NRO was even considering placing them on top of NASA's boosters⁴²⁹.

In a parallel development, U.S.A.F. Space and Missile Systems Centre (SMC) issued on 13 November a Request for Information (RfI) on the possible development of its first cubesat demonstrator mission. SMC was particularly interesting in validating the operational utility of a cubesat constellation. The demonstrator would be used to collect space weather data, it should have an operational life span of 1 year at a 400 km altitude and it should de-orbit within 5⁴³⁰.

Furthermore, the U.S. Missile Defence Agency (MDA) was also reported to seek complementing its future Space Tracking and Surveillance System (STSS) with a constellation of small satellites, known as the Precision Tracking and Surveillance System (PTSS). MDA has been persistently asking the Congress to fund a 1,125 Kilogram demonstration satellite for several years now⁴³¹.

On the other side, the U.S. Senate Armed Services Committee's 2010 defence authorisation bill more than doubled the budget for ORS that the Pentagon had requested. In fact, Senators appropriated an additional \$170 million to the Air Force's \$112.9 million request for the ORS Office in 2010. Extra funding included a program to build prototype, low-cost, half-metre ground resolution imaging satellites within 36 months. The ultimate goal would be to field a large constellation of such satellites and to acquire them on a fixed-price basis for no more than \$100 million a piece, including launching costs⁴³².

In another development, the U.S. House of Representatives approved on 30 July an \$80 million funding for Northrop Grumman to continue development of its Kinetic Energy Interceptor (KEI), in spite of the Defence Department's repeated attempts to cancel the project⁴³³.

On 18 August, U.S.A.F. announced the results of the Schreiver War Games 5 space defence exercise, held at Nellis Air Force base in April 2009. During the exercise it became clear that a sophisticated space-faring nation could deny key U.S. military space capabilities in case of conflict. The exercise scenario also established the need for improved space surveillance capabilities, especially as far as tracking small satellites is concerned. In fact, U.S.A.F. admitted that during the exercise they were often unable to determine the nature and source of events involving small satellites⁴³⁴.

On 11 August the U.S. National Geospatial-Intelligence Agency (NGA) announced its plans to issue up to four \$85 million and 5 year duration contracts to commercial providers of radar satellite images. The request included Synthetic Aperture Radar (SAR) images both in the X and the C band. Since the U.S. lack commercial radar satellites, demand will have to be met by European (Cosmos Skymed and TerraSAR-X) and Israeli (TecSAR) satellites. The request represents a considerable budget increase from the \$10 million that NGA has been paying annually to the Canadian Radarsat-2 operator for similar services over the past ten years. Its broad requirements would also indicate that contracts will be most likely split among several operators⁴³⁵.

EnhancedView is part of a wider satellite imagery strategy for national security purposes announced by Director of national Intelligence Dennis Blair, on 7 April 2009 and approved by President B. Obama. The concept, known as "two-plus-two", has two piers. One is the purchase of two highly sophisticated imaging satellites by the National Reconnaissance Office (NRO) for strategic intelligence purposes, scheduled to be built by Lockheed Martin Space Systems. The other is the contractual purchase of lower resolution images from two less capable commercial satellites by the NGA, for geospatial and tactical military use. This approach was adopted in the U.S. House of Representatives' 2010 Defence Appropriations Bill.

On the contrary, the Senate's Defence and Intelligence Authorisation Bills asked for the deployment of a larger constellation of cheaper and less technically advanced satellites⁴³⁶. On 16 September the Senate's Defence Authorisation Bill upheld this option and effectively turned down the version of the Bill

⁴²⁹ Klamper, Amy. "NRO Embraces Cubesats for Testing Advanced Technologies". Space News 10 Aug. 2009: 11.

⁴³⁰ "SMC Looks to Demonstrate Military Utility of Cubesats". Space News 23 Nov. 2009: 3.

⁴³¹ "Missile Defence Agency Eyes Small Tracking Sats". Space News 24 Aug. 2009: 3.

⁴³² Brinton, Turner. "Low-Cost Imaging Satellites Encouraged in Defence Bill". Space News 13 July 2009: 7.

⁴³³ "Cancelled KEI Program Is Resurrected in U.S. House". Space News 3 Aug. 2009: 3.

⁴³⁴ "War Game Shows Need for Better Space Surveillance". Space News 24 Aug. 2009: 3.

⁴³⁵ Brinton, Turner. "NGA Solicits Proposals for Commercial Radar Imagery". Space News 14 Sept. 2009: 4.

⁴³⁶ *Ibid.*

preferred by the Obama Administration. NRO's Director Bruce Carlson his opposition to the Senate's proposed plan, which he deemed technologically riskier. Low technological risk was the primary driver behind Lockheed Martin's selection, after Boeing's failure to develop a more advanced system under NRO's Future Imaging Architecture (FIA) in 2005. According to press reports, the two companies' struggle for the contract could be behind the Senate's decision, as the two Senators that opposed NRO's plans the most have important Boeing facilities in their constituencies⁴³⁷.

On 17 September the U.S. Defence Advanced Research Projects Agency (DARPA) proceeded to an open call for new concepts for removing space debris from Low Earth Orbits (LEO)⁴³⁸. The announcement was made as DARPA and NASA were preparing to host a joint conference on this subject later that year. According to NASA's Office of Safety and Mission Assurance, coming up with innovative and inexpensive solutions could prove difficult. They were particularly concerned by the threat to space environment posed by increasing numbers of tiny satellites, such as cubesats. Since cubesats are currently almost undetectable, their proliferation creates uncontrolled space debris and increases the danger of cascade collisions. However, finding ways to remove debris from LEO could also run into diplomatic disagreements, as any such system would inherently also be capable of working as an orbital Anti Satellite weapon (ASAT)⁴³⁹.

On 9 October U.S.A.F. issued a request for information for the development of its next generation of space-weather monitoring satellites. U.S.A.F. is currently using sensors onboard its Defence Meteorological Satellite Program spacecrafts. Nevertheless, similar payloads have been eliminated from its successor, the civil-military National Polar-Orbiting Operational Satellite System, because of budget cuts. This request for information would be a first step in exploring alternatives for a space-weather monitoring system that could involve payloads onboard commercial satellites, or small dedicated satellites. The program has secured an initial \$15 million budget and launch is expected in 2015⁴⁴⁰.

On 22 October U.S. Defence Secretary R. Gates announced during an official visit to the Republic of Korea (RoK) that the U.S. would extend its missile defence shield over that country. Under this doctrine of "extended deterrence", he said, the U.S. would use the full range of its military capabilities (conventional, nuclear and missile defence) to defend RoK against any incursion from the North. The announcement was made as RoK is moving forward with its own autonomous ballistic missile defence system, based on Aegis destroyers and Patriot Advanced Capability-2 interceptors⁴⁴¹.

In an interesting technology development, the U.S. Defence Advanced Research Projects Agency (DARPA) issued a Request for Information (RFI) on 22 October for a system that could provide internet connectivity to Low Earth Orbit (LEO) satellites. The Request, issued by DARPA's Tactical Technology Office, called for a 100 Kilobit per second broadband connexion to all LEO satellites flying at a 500 km altitude and in any orbit. The RFI also asked for 95% operational availability and the capacity to be used not only for downloading data, but also for telemetry and controlling the satellite. Information from government laboratories, universities and private companies were due in 5 November⁴⁴².

Following on this RFI, DARPA issued on 3 February 2010 a Notice of Intent to award a sole source contract to develop and build the necessary hardware to Inmarsat plc of United Kingdom. The contract, under a program called the "Persistent Broadband Ground Connectivity for Spacecraft in Low Earth Orbit Effort", solicited the Broadband Global Area Network (BGAN) service provided by Inmarsat's I-4 communications satellite. The project's objective would be to provide near-24/7, very low latency, on-demand ground-to-spacecraft connectivity for LEO satellites. From an operational perspective this would greatly enhance Operationally Responsive Space capabilities, allowing performing of missions such as time-sensitive satellite control directly from the theatre of operations, rapid data transfer and direct-to-theatre data delivery on small portable devices⁴⁴³.

⁴³⁷ Brinton, Turner. "NRO Director Defends Plan for Electro-Optical Spy Satellites". Space News 12 Oct. 2009: 1.

⁴³⁸ "DARPA Seeks Ideas for Orbital Debris Removal". Space News 21 Sept. 2009: 3.

⁴³⁹ David, Leonard. "Orbital Debris Cleanup Takes Centre Stage". Space News 28 Sept. 2009: 15.

⁴⁴⁰ Brinton, Turner. "Air Force Weighing Options For Space Weather Data". Space News 5 Oct. 2009: 16.

⁴⁴¹ Sunk-Ki, Jung. "U.S. Promises Missile Shield for South Korea". Space News 2 Nov. 2009: 14.

⁴⁴² "DARPA Plan Would Connect Satellites to the Internet". Space News 9 Nov. 2009: 8.

⁴⁴³ United States Department of Commerce, Federal Business Opportunities. "Persistent Broadband Ground Connectivity for Spacecraft in Low Earth Orbit (LEO)". Sol. No DARPA-SN-10-28, 3 Feb. 2010. <https://www.fbo.gov/index?s=opportunity&mode=form&id=08e21adc3b19b1a900dd2b8c3643cff9&tab=core&_cview=0>.



For this purpose, a space-based version of Inmarsat's BGAN airborne terminal would be developed, tested, certified and integrated into the planned F6 fractionated spacecraft demonstration cluster, scheduled for launch in 2013. According to the same announcement, Inmarsat has been selected as the sole source contractor for this program because of its considerable expertise in the field of end-to-end satellite broadband services⁴⁴⁴. Inmarsat itself had sought to boost its business with U.S. government agencies, when it acquired the U.S. based communication services provider Segovia Inc. on 23 November 2009⁴⁴⁵.

On 10 October Lockheed Martin Aerospace launched the scaled prototype of a rocket plane from Space Port America in New Mexico, U.S. The self-propelled 90 Kg winged vehicle was launched on a vertical ramp provided by UP Aerospace of Denver and it reached the altitude of 915 metres. The test was the third since 2007 and the second successful. The vehicle is considered a demonstration of an advanced reusable launcher, under the U.S. Department of Defence Operationally Responsive Space concept. Further details on its development were restricted⁴⁴⁶.

On 19 December 2009 U.S. President B. Obama signed the 2010 Defence Appropriations Act that included funding for military space programmes. This Bill, approved by Congress, called for the formulation of a long-term space investment strategy through 2025, which should be delivered to its defence committees by 1 May 2010. Accompanying documents of the legislation particularly demanded that the U.S. maintains a robust space launch capability, by ensuring the Evolved Expendable Launch Vehicle's (EELV) utilisation through 2030. This effort would also include the development of a common upper stage for both of EELV's variants, notable the Delta 4 and Atlas 5 rockets. Other major space programmes that secured funding were the civil-military National Polar-orbiting Operational Environmental Satellite System (NPOESS) and USAF's Third Generation Infrared Surveillance system. On the contrary, the Bill did not foresee budgeting of the seventh Wideband Global Satcom communications satellite⁴⁴⁷.

On 29 December 2009 the U.S. National Geospatial-Intelligence Agency (NGA) awarded

three contracts to commercial radar satellite imaging companies. These included EADS North America, Lockheed Martin Space Systems and MDA Geospatial Services of Canada. The first two would provide imaging from European commercial spacecraft, notably the German TerraSAR-X and the Italian Cosmo-SkyMed (through its commercial branch e-Geos) spacecrafts respectively. The third would use imaging from Canada's Radarsat-1 and -2 satellites. The total value of the contracts was estimated to reach \$85 million over a period of 5 years. Commercial images would act complementary to data acquired through more sophisticated U.S. military radar observation satellites⁴⁴⁸.

In an interview on 14 December 2009, the U.S. Defence Information Systems Agency (DISA) Director Mr Bruce Bennett announced that DISA had plans to lease the Netted Iridium Service on behalf of the U.S. Navy. This service would allow ground military operators in Afghanistan not only to communicate from point to point as before, but also to transmit voice and data broadcasts to several recipients simultaneously and at much faster speeds. Netted Iridium is a retooled variant of the standard Iridium service using special radios built by NexGen Communications LLC of Dulles, an ITT subsidiary. DISA spent approximately \$70 million in 2009 acquiring bandwidth for military purposes on the 66 LEO satellite constellation owned by Maryland based Iridium Communications. This figure was expected to rise to \$80 million in 2010. The Netted Iridium Service became the U.S. Navy's only option for obtaining narrow-band communications capacity after continued delays in the development of its new generation communications satellites, known as the Mobile User Objective System (MUOS)⁴⁴⁹.

In the same interview, DISA's Director announced that his agency had spent over \$400 million to acquire commercial satellite communications services in 2009, \$50 million more than the year before. In fact he admitted that commercial operators contribute the bulk of U.S. Armed Forces satellite connectivity world-wide. In the mean time satellite operators increasingly deploy Ka- and X-band capacity to complement their standard Ku-band transponders and DISA is expected to triple its demand of X-band capacity in 2010. Finally, DISA Director announced the implementation of a new contracting vehicle for communications satellite capacity called the Future Comsatcom Services Acquisition. Under this new contracting scheme, DISA would

⁴⁴⁴ Ibid.

⁴⁴⁵ See below.

⁴⁴⁶ "Lockheed Martin Launches Secret Rocketplane Prototype". Space News 19 Oct. 2009: 8.

⁴⁴⁷ Brinton, Turner. "Defence Spending Act Pushes Smarter Investments in Space". Space News 4 Jan. 2010: 4.

⁴⁴⁸ Brinton, Turner. "NGA Awards Three Contracts for Radar Satellite Data". Space News 4 Jan. 2010: 5.

⁴⁴⁹ Brinton, Turner. "U.S. Navy To Rely on Netted Iridium Service as Gap-Filler". Space News 11 Jan. 2010: 16.

be able to acquire bandwidth directly from commercial operators, without having to pass through intermediate private companies, as it is the case today⁴⁵⁰.

At the same time, back in the United States commercial satcom operators were asking of the Defence Department to adopt a more comprehensive and long term approach in commercial bandwidth acquisition. At present the Pentagon is funding these acquisitions, which account for nearly 80% of its global satellite connectivity demand, through supplemental war funds that are approved by Congress on an annual basis along with each year's defence budget. This would mean that no long term acquisition planning would be possible under the current purchasing scheme. To complicate things further, supplemental war funding, which represents roughly 20% of U.S. defence spending, is expected to be curtailed over the next few years.

At the same time, USAF's plans to develop its next generation military communications satellite were set back by the cancellation of the Transformational Satellite system in 2009. In response to this situation, commercial operators have asked in January 2010 for the creation of a dedicated regular line in the U.S. defence budget to cover satcom services procurement on a longer term and not on the current year to year basis. Such a decision, they said, would enable them to make the necessary investments to respond to the Pentagon's growing commercial satcom use, as well to offer services that are more adapted to specific military needs. However, according to industry officials the problem remained that commercial capacity demand was highly unpredictable, as it depended mostly upon unforeseen geopolitical events and contingent operations⁴⁵¹.

On 13 January 2010, the California based telecommunications company Cisco announced it had completed a successful in-orbit test of its space internet router component onboard Intelsat's IS-14 satellite. The router was part of the U.S. Defence Department's technology demonstration project on Internet Routing in Space (IRIS). Although the Pentagon was funding the experiment, the router itself was owned by Cisco, which planned on commercialising the device immediately after the conclusion of its testing period in April 2010⁴⁵².

⁴⁵⁰ Ibid.

⁴⁵¹ Brinton, Turner. "Pentagon Urged To Budget for Commercial Satcom". Space News 11 Jan. 2010: 17.

⁴⁵² "Cisco Completes Test of Orbiting Internet Router". Space News 18 Jan. 2010: 9.

On 26 January 2010, the U.S. Defence Department announced that a consortium led by satellite operator Intelsat had secured a five year \$542.7 million contract to provide end-to-end satellite communication services to the U.S. Navy. The project, known as Commercial Broadband Satellite Program (CBSP) called for the procurement of 449 megahertz of Ku-band, 329 megahertz of C-band and 82 megahertz of X-band capacity, which should be accessible to 95% of the Earth's populated regions. For that reason, the consortium included no less than 17 companies (including major providers such as SES), in order to achieve constant global coverage. Intelsat's proposal included as many as 20 satellites and 8 teleports. This contract is expected to replace the U.S. navy's existing one for the procurement of L-band mobile services from Inmarsat of London⁴⁵³.

The U.S. Missile Defence Agency (MDA) successfully launched two new generation Space Tracking and Surveillance System (STSS) demonstration satellites on 25 September 2009. The spacecrafts included considerable improvements from previous systems, including the capability to track cold bodies in space for the first time. However, their initial testing period run into serious delays due to numerous technical problems. In fact, officials of Northrop Grumman Aerospace Systems of Los Angeles, the satellites' manufacturer, confirmed only on 21 January 2010 that the system's testing and sensor calibration had resumed. By then, the entire programme came under scrutiny by the Congress for budget overruns and poor programme management, which resulted in the curtailing of several scheduled tests of the system. As a result, MDA's medium term Integrated Master Test Plan that was completed in mid-2010 did not include even a single test related to STSS. It should be noted that although MDA estimated the programme's total cost since 2002 at \$1.35 billion, the U.S. Government Accountability Office (GAO) raised it in its own project assessment to \$ 3.1 billion. According to MDA sources, development of an operational version of the system would not begin before the completion of current demonstrator testing⁴⁵⁴.

On 1 February 2010 the U.S. Air Force announced its budget appropriation request for 2011. Although the overall USAF budget request was up 3% from 2010 (at \$170.8 billion), space procurement and development expenses were curtailed by more than 8% (to approximately \$8 billion). This development

⁴⁵³ Brinton, Turner. "Intelsat Nabs Big U.S. Navy Satcom Contract". Space News 1 Feb. 2010: 6.

⁴⁵⁴ Brinton, Turner. "Testing Plans Uncertain for Missile Tracking Satellites". Space News 1 Feb. 2010: 12.



ended the upward trend in USAF space activities spending over the last few years. In fact, the proposed budget focuses on capitalising on the operational use of existing space systems and foresees only limited funding for new development projects. Even transformation programmes that were given priority until now, such as these run by USAF's Operational Responsive Space (ORS) Office for example, suffered budget cuts. The disproportionate decrease in defence space appropriations was attributed by government officials to the general trend of limiting R&D spending in the 2011 defence budget. Since R&D related expenses are proportionately higher in space activities than in other USAF programmes, the same officials claimed, the resulting budget cuts were also greater. Among the most important defence budget cuts, one can single out the termination of the \$26 billion Transformational Satellite communications system, the scaling down of the Third Generation Infrared Surveillance (TGIRS) programme and the 25% decrease in funding for ORS projects (\$94 million in 2011 from %124.3 million in 2010)⁴⁵⁵.

As it seems, operational programmes already in use or in their final development stages represent the bulk of the requested appropriations. These include \$426.5 million for space situational awareness projects (\$188.1 million more than in 2010) and the purchase of additional spacecraft for a number of USAF programmes, like the fourth SBRS satellite, the seventh Wideband Global Satcom and the fifth Mobile User Objective System narrow-band communications one. The USAF space surveillance system stands out among the programmes with the greatest increase in spending. Funds are mostly diverted to upgrading the system's ground-based radar network known as Space Fence, as well as developing follow-on to the Space Based Space Surveillance satellite due for launch in June 2010⁴⁵⁶.

At the same time the Obama administration requested on behalf of the U.S. Missile Defence Agency (MDA) \$8.4 billion for Ballistic Missile Defence (BMD) in 2011, representing a \$500 million increase from the previous year. The planned budget was heavily influenced by the new BMD posture announced on 1 February 2010 through the Ballistic Missile Defence Review Report published by the Pentagon. This new BMD orientation adheres to the deployment of SM-3 interceptor equipped warships in European waters, in order to compensate for the cancellation in September

2009 of the more capable ballistic missile interceptors that would be installed in Poland. At a later stage, the new planning also calls for the development of a land based version of SM-3 (with an initial \$281 million budget for 2011). Furthermore, the new doctrine calls for longer development and operational evaluation periods for the new ABM systems, as well as for increased international cooperation in this field. This new policy document also gives considerable attention to developing new ballistic missile warning sensors, both airborne and in space. The space component under development is known as the Precision Tracking Space System, for which MDA has requested \$67 million. The programme should benefit from initial work done over the Space Tracking and Surveillance System demonstration satellites, three of which are in orbit since 2009. In an effort to limit development costs and streamline the required system tests, MDA has thoroughly reviewed its testing programme in late 2009 and it has requested increased funding for such activities in 2011 (\$1.11 billion compared to \$823.3 million in 2010). Finally, funding for the development of the experimental high-power chemical Airborne Laser is terminated. The budget only foresees \$99 million for the transformation of the system into a ground based test bed for directed energy weapons⁴⁵⁷.

In the U.S., the Department of Defence disclosed that it was experiencing mounting problems related to poor hardware manufacturing and quality control. Space and missile defence programmes in particular suffered from repeated delays and failures caused by deficient components. For example, a failed Missile Defence Agency (MDA) test of the Ground-based Midcourse Defence system on 31 January 2010 may have been caused by faulty components. In February, Pentagon officials confirmed that USAF increasingly discovers hardware and software flaws in satellite and launcher components during their final assembly and testing. According to the same sources, deficient parts included crucial pieces of hardware, such as gyroscope and reaction wheels on satellites. These manufacturing flaws were attributed by government officials to the retirement of older generations of space industry skilled workers and the low rate of their replacement. At the end of this process, the U.S. space industry could be facing a permanent loss of space systems manufacturing know-how. On the other hand, this situation could partially explain the resistance that the new US space

⁴⁵⁵ Brinton, Turner. "U.S. Air Force Scales Back Missile Warning Technology Program". *Space News* 8 Feb. 2010: 12.

⁴⁵⁶ *Ibid.*

⁴⁵⁷ Brinton, Turner. "MDA Budget Request Reflects New European Strategy, More Emphasis on Testing". *Space News* 8 Feb. 2010: 12.

policy has met within certain department of Defence circles⁴⁵⁸.

On 11 February 2010 the U.S. Missile Defence Agency (MDA) announced a successful test of the Airborne Laser system. A Boeing 747 aircraft carrying a high power chemical laser tracked down and destroyed its intended target, a short-range liquid-fuelled ballistic missile. However, in a second test later the same day the weapon malfunctioned and failed to destroy a sounding rocket that simulated a solid-fuelled ballistic missile. Nevertheless, MDA qualified the test as a success, since ABL had reportedly achieved to intercept a similar solid-fuelled target in a separate test on 3 February. In spite of its success as a system demonstrator, ABL has been deemed as an operationally non-viable and logistically expensive weapons platform. Therefore, MDA had apparently decided to terminate all funding for the programme in 2011 and to invest in other directed-energy technology research projects. As for ABL itself, it would be transferred to the Pentagon's Office of Defence Research to serve as a test bed for laser technologies⁴⁵⁹.

On 17 February, the satellite platform for USAF's first non experimental operationally responsive satellite was delivered by ATK Space Systems of Maryland. The spacecraft, known as ORS-1, was built in 16 months and it was transported to Goodrich ISR Systems of Connecticut, the programme's prime contractor, where the integration of its Earth observation payload would take place. Its launch was scheduled for the second half of 2010. ORS-1 is the first operational satellite developed under the Operationally Responsive Space (ORS) concept, a USAF project aimed at developing small satellites cheaper, faster and ready to launch on demand. The programme's objective is to achieve a quick launch capability for Earth observation satellites, as a response to urgent intelligence demands from units engaged in military operations. Although the satellite's exact cost had not been disclosed, government official's confirmed that the project had met its budget and timetable objectives. ATK announced that the platform's cost was approximately \$34 million, whereas the Pentagon's Operationally Responsive Space Office, which is the programme's contracting authority, had previously announced that the total budget could reach as high as \$162 million. The satellite bus of ORS-1 was based on the one manufactured by ATK for TacSat-3, Pentagon's latest

experimental operationally responsive satellite launched in May 2009. In spite of the programme's proclaimed success, the question of its exact cost remains pertinent, as the affordability of the satellites used is undoubtedly one of the most crucial parameters of the ORS concept⁴⁶⁰.

Although the budget for science and technology development programmes at the U.S. National Reconnaissance Office (NRO) was cut off half during the last five years, it intends to reverse the trend and come to the historical budget amount, according to NRO Director Bruce Carlson. Due to the classified character of the NRO's budget he didn't disclose any concrete figures on his speech of 14 April 2010. Nevertheless, the NRO will conduct its most aggressive launch campaign of the last 25 years until late 2011⁴⁶¹.

Finally on 22 April 2010 USAF launched the X-37B Orbital Test Vehicle, a winged unmanned spaceplane demonstrator. The vehicle was expected to perform evaluation manoeuvres for as long as nine months, before re-entering the atmosphere and landing as a conventional airplane. The 8.9 metres long spacecraft built by Boeing's Phantom Works of California was lifted in its maiden flight by an Atlas 5 rocket. It has a cargo bay similar to the space shuttle but of smaller dimensions, capable nevertheless of accommodating two small satellites. USAF hopes that when the spacecraft becomes operational it will add a quick and affordable satellite launch capability to its inventory. The programme was originally started by NASA in 1999, before it was passed on to DARPA in 2004 and finally to USAF's Rapid Capabilities Office, which currently has overall supervision of the project. A second test flight was scheduled for 2011⁴⁶².

6.4 Russia

The Russian military space programme remains highly classified and all available open source information regarding it is scarce. Consequently any attempt to analyse it should be considered by definition only indicative. Nevertheless, the available information does permit us to draw some conclusions on its overall nature and strategic orientation.

⁴⁵⁸ Brinton, Turner. "Parts Problems Still Plaguing U.S. Space and Missile Hardware". Space News 15 Feb. 2010: 12.

⁴⁵⁹ Brinton, Turner. "Airborne Laser Goes Two for Three in 1st Intercept Tests". Space News 15 Feb. 2010:14.

⁴⁶⁰ Brinton, Turner. "First Operational ORS Satellite Ready for Payload Integration". Space News 22 Feb. 2010: 13.

⁴⁶¹ Brinton, Turner. "NRO Chief Aims To Restore Technology Development Funding." Space News 19 Apr. 2010: 7.

⁴⁶² Brinton, Turner. "U.S. Air Force Official Touts Space Plane Applications". Space News 26 Apr. 2010: 11.



The basic lines of the Russian military space strategic plan follow in broad terms the orientation of its civil space programme. These are the following: to re-establish Russia as a major military space power on a global scale, limiting its capabilities gap with the U.S.; to revitalise the country's space industrial base in order to make it competitive on an international level and even export-oriented; and to use space related technologies' research and development as a pivotal point for the overall growth of the Russian scientific research and economy, especially in the field of electronics⁴⁶³. In spite of its long military space tradition, the Russian military space programme has been increasingly utilising dual-use systems, marking a possible change in its operating concept. For example, one should not forget that the Glonass satellite navigation constellation was initially meant to be a military system, whereas today the Russian authorities put more emphasis to its commercial use as well. As another example, Russian officials announced on 15 April 2010 that they were developing a meteorological satellite scheduled for launch in 2011, disclosing at the same time that it would also be of military use, as it would be capable of detecting submarines as well⁴⁶⁴.

Nevertheless, the Glonass satellite navigation constellation remains a militarily crucial space asset and its expected full operational deployment by the end of this year should be considered a major evolution step for the Russian military space capabilities. Apart from this project, the Russian armed forces proceeded to the launch of at least two publicised military satellite launches in the past 12 months, the mission of which was kept classified. In total, Russian military authorities publicly admit to operate a fleet of over 60 spacecraft dedicated to military missions, the bulk of which is used for Earth observation purposes⁴⁶⁵.

In addition to this, another system of inherent dual-use nature that should greatly upgrade Russian military space capabilities is the development of the Angara heavy launcher, capable of lifting up to 24.5 tons into orbit. The rocket is scheduled to replace both the Rockot and Proton vehicles, thus

improving the Russian fleet's homogeneity. It also encompasses the new dual-use oriented approach in space systems' development, as it would not only greatly improve the country's capacity to lift military payloads, but it is also expected to have a broader commercial launch services use as well. The rocket was planned to use the Plesetsk space centre instead of the Baikonur Cosmodrome in an attempt to reduce Russian space transport dependence on third countries and its first launch was expected in 2011. However, the vehicle's debut could be postponed for a year due to a cut in its 2009 budget expenses that were allocated to the construction of additional launching facilities at Plesetsk. Finally, in a related development the Khrunichev State Research and Production Space Centre that manufactures the launcher announced it had requested additional funds of 10 billion Rubbles (\$290 million) over the next three years in order to complete the project⁴⁶⁶.

Finally, in 2009 and 2010 the Russian armed forces have continued to develop the country's Earth-based counter space capabilities under their long-term air defence modernisation programme. This project, which treats air and space as an operating continuum for the purposes of air defence, aims at creating an integrated weapons system consisting of ground-to-air missile systems with anti-aircraft and anti-missile capabilities, as well as modernised MIG-31 supersonic interceptors⁴⁶⁷. In addition to these, the system is expected to include some kind of Earth-based anti-satellite (ASAT) capability as well, although this has not been officially confirmed. Nevertheless, there have been official statements to the effect that the Russian armed forces are in fact developing a new type of ASAT based on what was described as a "fundamentally new weapon [technology]"⁴⁶⁸. At the same time however, the Russian government also declared that it was continuing to oppose the development of co-orbital ASATs or any other form of space weaponisation, insisting that any such future systems would be exclusively Earth-based⁴⁶⁹.

⁴⁶³ "Russia Approves New Defence Industry Policy". 19 Mar. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100319/158253423.html>>.

⁴⁶⁴ "Russia to Build Submarine-Detecting Satellite". 15 Apr. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100415/158597419.html>>.

⁴⁶⁵ "Russia Launches Military Satellite". 16 Apr. 2010. RIANovosti May 2010 <<http://en.rian.ru/russia/20100416/158616394.html>>.

"Russia's Cosmos-3M Space Carrier Orbits Military Satellite". 27 Apr. 2010. RIANovosti 30 May 2010

<<http://en.rian.ru/science/20100427/158762058.html>>.

⁴⁶⁶ "Russian Military Lays Hope on New Angara Carrier Rockets". 15 Jan. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100115/157550645.html>>.

⁴⁶⁷ "Russia to Have Full Gamut of Air, Outer Space Defences by 2015". 2 Apr. 2010. RIANovosti 30 May 2010 <http://en.rian.ru/military_news/20100402/158414990.html>.

"Russia's Space Defences in Shambles-Experts". 13 May 2010. RIANovosti 30 May 2010 <http://en.rian.ru/military_news/20100513/159003853.html>.

⁴⁶⁸ "Russian Officer Says Developing New Weapon for Space Defence". 15 May 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/russia/20100515/159029349.html>>.

⁴⁶⁹ "Russia Has No Plans to Deploy Weapons in Space-Top Brass". 9 Apr. 2010. RIANovosti 30 May 2010

6.5 Japan

The Japanese national security strategy is evolving rapidly since the creation of a Defence Ministry in 2007 and space systems have a pivotal role in this transformation process. Japan is bound by its Constitution to pursue only the “peaceful” use of space. Nevertheless, the country is now in the middle of a policy shift that seeks to define “peaceful” not as “non-military”, as it was the case until now, but as “non-aggressive”. This will enable the regularisation of the use of dual-purpose satellites by Japan’s armed forces and it will reinforce the cooperation between the country’s space agency JAXA and the Ministry of Defence. The further development of space systems for national security purposes is one of the pillars of the new Japanese security strategy published in August 2009. The defence against ballistic missile attacks and the improvement of the country’s intelligence gathering apparatus through the use of Earth observation satellites are among the conditions identified as crucial for the realisation of the new strategy⁴⁷⁰.

For that purpose, Japanese space activities have been increasingly focusing on the development of their space applications segment. Japan is actively pursuing the development of dual-use space assets across all fields of applications. These include a new generation of Information Gathering Satellites (IGS) with greatly improved ground resolution, a satellite positioning system of regional coverage known as the Quasi-Zenith Satellite System (QZSS), an early warning system to cooperate with its ballistic missile defences and a space situational awareness system similar to the one currently used by the U.S.

The IGS programme is the most mature of these projects, both technologically and operationally. Japan currently operates four of these spacecraft, two equipped with optical and two with radar Earth observation apertures. Although their constellation was only completed in 2007, a new generation of improved IGS spacecrafts is at the final stages of development and they were scheduled for launch between 2009 and 2014. The first of these satellites was successfully launched on 28 November 2009. The IGS programme’s total budget from 1998 to 2014 is estimated to reach approximately ¥1 trillion, with an

<http://en.rian.ru/military_news/20100409/158497786.html>

⁴⁷⁰ “The Council on Security and Defence Capabilities Report”. Aug. 2009. Cabinet Office of the Prime Minister of Japan (Kantei) 30 May 2010 <http://www.kantei.go.jp/jp/singi/ampoboue/2/090928houkoku_e.pdf>.

expected average spending of ¥60 billion annually through 2014⁴⁷¹.

The flight testing of the Quasi-Zenith Satellite System (QZSS) is also expected to begin in the summer of 2010 with the launch of the programme’s first demonstrator spacecraft, QZS-1 (nicknamed “Michibiki”). Upon the successful conclusion of the testing schedule, QZS-1 should be joined by two more satellites to form the system’s complete operational constellation. It should be noted that QZSS is not intended to be an autonomous satellite navigation system; its mission would rather be to enhance the accuracy and redundancy of the GPS signal over Japan. Nevertheless, from a technological point of view QZSS’s development will greatly enhance Japanese know-how on building such systems, possibly allowing it to pursue the development of its own independent system in the future⁴⁷².

In general, Japan’s ambitions in developing a full range space security apparatus are adequately backed by sufficient budget resources. Out of the ¥348.8 billion reserved for space activities in the 2009 budget, ¥213 billion (or almost 40% of the total) was related to dual-use space applications. The IGS programme received the most funding (¥66 billion), followed closely by BMD related systems (¥58 billion), QZSS (¥14 billion) and GX rocket development (¥11 billion)⁴⁷³. The latter’s development was however cancelled on 16 December 2009 by the Japanese government, due to its continued budget overrides and unsure commercial prospects⁴⁷⁴. It is highly likely that Japan’s early warning satellite programme, which appears to be the nation’s next priority in military space capabilities development, would be funded from the BMD related budget line.

⁴⁷¹ Sawako, Maeda. “Transformation of Japanese Space Policy: From the ‘Peaceful Use of Space’ to ‘The Basic Law on Space’”. The Asia-Pacific Journal: Japan Focus Vol. 44-1-09 2 Nov. 2009. 30 May 2010

<<http://www.japanfocus.org/-Maeda-Sawako/3243>>. Clark, Stephen. “Japan Launches Spy Satellite Under Veil of Secrecy”. Space Flight Now 28 Nov. 2009. 30 May 2010 <<http://spaceflightnow.com/h2a/f16/>>.

⁴⁷² “Quasi-Zenith Satellite-1 Michibiki”. Japan Aerospace Exploration Agency (JAXA) 30 May 2010 <http://www.jaxa.jp/projects/sat/qzss/index_e.html>.

⁴⁷³ Sawako, Maeda. “Transformation of Japanese Space Policy: From the ‘Peaceful Use of Space’ to ‘The Basic Law on Space’”. The Asia-Pacific Journal: Japan Focus Vol. 44-1-09 2 Nov. 2009. 30 May 2010 <<http://www.japanfocus.org/-Maeda-Sawako/3243>>.

⁴⁷⁴ “Japan Scraps GX Rocket Development Project”. I StockAnalyst 16 Dec. 2009. 30 May 2010. <<http://www.istockanalyst.com/article/view/iStockNews/articleid/3716870>>.



6.6 China

As it is the case with Russia, the Chinese military space programme is also classified. Very little and always unofficial information exits the country regarding these projects. What it should be noted is that the Chinese military space programme also evolves around a dual-use concept. This means that all space assets are conceived from their very beginning as military use compatible. These include the country's communications satellites and the Beidou satellite navigation system, which will emit a government-only signal alongside its commercial one. However, the great difference with other space-faring powers is that the Chinese dual-use space assets are mostly run directly or indirectly by the Chinese Army, due to that country's unique political and administrative structure. The Shenzhou manned spaceflight and the Long March launcher programmes are among the most significant examples.

The Shenzhou manned spacecraft programme, also known as Project 921, did not see any significant changes in the past 12 months. After the spacecraft's successful 3rd flight in the September of 2008, the programme's focus has shifted to improving Extra Vehicular Activities know-how and testing in-orbit docking technologies for use in the future Chinese space station. This seems to be the next step in the Chinese human space flight programme. CAST has already three space docking stations under construction, with the first (Tiangong-1, meaning a palace in Heaven in Chinese) scheduled for launch in 2011⁴⁷⁵. The next two space stations are scheduled for launch before 2015. Each one will have an expected life span of only two years. They should be primarily used to demonstrate docking technologies, in cooperation with the three Shenzhou spacecraft also scheduled for the same period⁴⁷⁶.

6.7 India

India does not have a dedicated military space programme. However, future dual use satellites will have an inherent military utility and ISRO does not place any restrictions on their use. Nevertheless, an important new dimension for the country's nascent military space capabilities emerged earlier this year. During a press conference on 3 January 2010, the Director-General of India's Defence

Research and Development Organisation (DRDO) V.K. Saraswat disclosed that his country had begun development of an Anti-Satellite weapon system (ASAT). Mr. Saraswat said that the system had just entered its initial development phase and that it would not be made operational unless his country decided that it "needed" it. He predicted that the ASAT would consist of two components, a laser used for tracking targets and a direct ascent interceptor missile of a 120–140 km range, equipped with an exoatmospheric direct impact kill vehicle. Initial testing of the missile was expected to begin in September 2010, while the full system should be developed by 2014⁴⁷⁷

⁴⁷⁵ "China to Launch Module for Future Space Station in 2011". 3 Mar. 2010. RIANovosti 30 May 2010 <<http://en.rian.ru/world/20100303/158080728.html>>.

⁴⁷⁶ Euroconsult data.

⁴⁷⁷ "India Developing Means to Destroy Satellites". Space News 11 Jan. 2010: 9.

7. The Specific Role of Institutions

Institutions play an important role in space activities worldwide, both regionally and internationally. Although their specific space related programmes and policies were already presented in chapter 3 of this report, it is considered useful to give an overview of their activities on space issues in the following chapter as well.

7.1 Europe

Not only within Europe, the European Union has emerged in recent years as an important actor in space activities. Through its flagship programmes of Galileo and GMES the EU has de facto positioned itself as a major space-faring power, in close cooperation with its member-states governments. In this aspect it is significant to note that the EU is the only supranational entity with such an important presence in space activities worldwide, a fact that sets it apart from the rest of the major space actors. Being the only non-national space power, the EU has been obliged to set new norms and paradigms in formulating space policies and implementing space assets procurement programmes on behalf of its member states. So far, this has been a very dynamic, interactive and innovative process that has produced significant breakthroughs and revolutionised the way space activities are managed. EU space policies are formulated and implemented by both its member states and its various institutions that will be briefly described below.

The Council of the European Union and its Presidencies

The Presidency of the Council of the European Union is an institution held by each of its member states' governments successively for a period of six months. It has been instrumental in deciding and implementing the EU space policies by synthesising into a common EU policy the different views of its member states on space activities. It has specifically been important in prioritising among different propositions and providing the necessary drive forwards to the European space policy.

European Commission

The European Commission is the executive body of the EU, representing its supranational dimension. It has a central role in managing Galileo and GMES, the EU flagship space programmes, for which it acts as the administrative and finance body. In the period covered in the report these two projects entered the phase of operational development as described in chapter 3. Furthermore it oversees the settlement of a number of politically sensitive regulatory issues concerning their future use, such as their data distribution policy. In order to fulfil this task the European Commission works in close relationship with the European Space Agency (ESA), which it mandated to act as the concept development and industrial contracting authority for these programmes. However, in addition to the research and development work done by ESA the European Commission itself simultaneously promotes R&D as well on these projects through its FP7 technology development programme. This is an open tender programme addressed to European industries that wish to conduct R&D on six identified work areas: system support, ground mission segment, ground control segment, space segment, launching services and operations.

European Union Agencies

Apart from the central role of the European Commission, a number of European agencies is also involved in the development of space applications services. These can be divided into two categories, those involved in developing space systems and services on behalf of all EU member states and those which are their end product users. The former are the European Defence Agency (EDA), which is becoming increasingly involved in the development and coordination of the military use of EU' dual use space systems; the EU Satellite Centre (EUSC) responsible for the acquisition, process and distribution of satellite Earth observation products; and the European GNSS Supervisory Authority (GSA) responsible for the system's operational use. Among the latter are the European Maritime Safety Agency (EMSA), the European Aviation Safety Agency (EASA), the European Environmental Agency (EEA), or the European Agency for the Management of Operational



Cooperation at the External Borders (FRONTEX), which will be the EU space assets' products users along with the individual member states' government authorities. Of course, as the systems' prime users all of the above agencies actively participate through defining their operational requirements in the development of the space systems' technical specifications as well.

European Parliament

The European Parliament is another important entity of the European Union in space matters. It is the only body that is elected directly. Through the co-decision procedure it has the possibility to take political initiatives together with the Council. With the latter, it also represents the budgetary authority of the European Union. Various parliamentary committees like the Committee on Foreign Affairs (AFET) and its Subcommittee on Security and Defence (SEDE) also play an important role regarding space matters.

European Interparliamentary Space Conference (EISC)

The European Interparliamentary Space Conference (EISC) brings together members of national parliaments that are interested in space. It serves as a discussion platform for debating issues in the domain of the European Space Policy. Each year, it holds a conference organised by its rotating presidency in its home country. In 2009, the United Kingdom held the Presidency. The 11th European Interparliamentary Space Conference took place in London on 26 and 27 October 2009. Its conclusions put an emphasis on space as an instrument to deal with climate change as well as a problem solver, on space as a tool for economic growth and prosperity and on shaping a regulatory framework for a competitive European space sector.

In January 2009, Romania took over the presidency of EISC with the theme "Space Benefits for Society". As an intermediary step to the plenary conference of EISC in October, the Chairperson of EISC, Liana Dumitrescu (Member of the Romanian Parliament and Chairperson of its Subcommittee on Space), hosted on 17 May 2010 in Bucharest a workshop for EISC delegations dealing with issues related to security and governance. Participating were – besides the parliamentary delegations - representatives of EC, ESA, EUSC and space industry.

7.2 United Nations (UN) Institutions

Beyond the European frame, various institutions within or associated with the United Nations are relevant for space policy. In this subchapter, the UN General Assembly (UNGA), UNGA Committees and other UN bodies and organs are discussed regarding space activities.

7.2.1 United Nations General Assembly (UNGA)

In December, the 64th session of the United Nations General Assembly (UNGA) was held. On 2 December 2009, it adopted the Resolution 64/28 "Prevention of an arms race in outer space". In the resolution, the GA put emphasis on transparency and confidence building measures (TCBM) to avoid an arms race in space. TCBMs were seen to possibly form an integral part of broader agreements on the prevention of an arms race. The GA recalled that the existing legal framework for outer space does not guarantee the prevention of an arms race and asked the states, especially the major space faring nations, to negotiate further. The Conference on Disarmament (CD) was seen as the sole multilateral disarmament forum. The Resolution also called for establishing an Ad Hoc Committee on the Prevention of an Arms Race in outer space within the CD. In general, it also acknowledged the complementary nature of multilateral and bilateral efforts in this issue area.⁴⁷⁸

Also on 2 December 2009, the GA adopted the Resolution 64/49 "Transparency and confidence-building measures in outer space activities". The Resolution was identical to the one tabled in 2008. It stated that an arms race in space would constitute a significant danger to peace and security and it invited the Member States to continue submitting proposals on TCBM to the Secretary General. In addition, the GA decided to include the issue in the agenda of the 65th session.⁴⁷⁹

A Resolution on "International cooperation in the peaceful uses of outer space" (64/86) was adopted on 10 December 2009 by consensus without a vote. The resolution reminded of all central aspects and challenges of the peaceful use of outer space. It also recalled the crucial importance of international cooperation to tackle the corresponding

⁴⁷⁸ United Nations General Assembly. Resolution adopted by the General Assembly on 2 Dec. 2009. UN Doc. A/RES/64/28 of 12 Jan. 2010. United Nations.

⁴⁷⁹ United Nations General Assembly. Resolution adopted by the General Assembly on 2 Dec. 2009. UN Doc. A/RES/64/49 of 12 Jan. 2010. United Nations.

issues and it reviewed some of the steps that have been taken in this regard, like conferences, sessions of relevant entities and progress in implementation of corresponding programmes.⁴⁸⁰

7.2.2 UNGA Committees

The UNGA disposes of several committees that are involved in space policy and associated matters. Some of them are discussed here.

Disarmament and International Security Committee

The resolutions on the prevention of an arms race in outer space and on transparency and confidence-building measures had been introduced in the Disarmament and International Security Committee, also referred to as the First Committee, beforehand. The debates were marked by enduring differences between the U.S. on the one hand and Russia and China on the other hand.

Committee on the Peaceful Uses of Outer Space (COPUOS)

The activities of COPUOS were marked by its plenary session and the sessions of its subcommittees, along with various workshops and conferences. The Scientific and Technical Subcommittee held its 47th session from 8 to 19 February 2010. Topics discussed included the use of nuclear power sources in outer space, possible dangers from near-Earth objects, space debris, space-based disaster management support and developments in global navigation satellite systems. The Subcommittee received and considered information provided by the Member States on their activities in all these fields. Moreover, the implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) were reviewed.⁴⁸¹

A very important part of this session was the topic "Long-term sustainability of outer space activities". The Subcommittee discussed space situational awareness and agreed to establish a working group on the long-term sustainability of outer space activities, preparing a report and proposing measures and guidelines. This should include its contribution to the achievements of the Millennium

⁴⁸⁰ United Nations General Assembly. Resolution adopted by the General Assembly on 10 Dec. 2009. UN Doc. A/RES/64/86 of 13 Jan. 2010. United Nations.

⁴⁸¹ United Nations General Assembly. Report of the Scientific and Technical Subcommittee on its forty-seventh session, held in Vienna from 8 to 19 Feb. 2010. UN Doc. A/AC.105/958 of 11 Mar. 2010. Vienna: United Nations.

Development Goals and should be consistent with the peaceful use of outer space⁴⁸².

Also, a Symposium on National space legislation was held in Vienna during the 49th Session of the Legal Subcommittee. The topics discussed on this event were: needs for national space legislation, elements of national space legislation as well as their consequences.

7.2.3 Other UN Bodies Monitoring Space Activities

Beyond the UN General Assembly and its Committees, there are other UN bodies and programmes related to space activities. In the following, ITU (being a specialised agency of the UN), UN-SPIDER; the UN Programme on Space Applications, the International Committee on Global Navigation Satellite Systems (ICG), the United Nations Spatial Data Infrastructure (UNSDI), the Conference on Disarmament (CD) and UNIDIR are discussed.

International Telecommunication Union (ITU)

The International Telecommunication Union (ITU) held its World Radiocommunication Seminar (WRS) 2008 on 8 to 12 December 2008 in Geneva. Among other things, it discussed the application of the ITU Radio Regulations that had been changed in the course of the ITU World Radiocommunication Conference (WRC) 2007. The meeting provided a forum to exchange views on the associated technical, procedural and operational aspects. One of the relevant issues is given by the revisions made to the Fixed-satellite service plan that draws upon new technical developments and facilitates satellite system to access the frequency spectrum. The next World Radiocommunication Conference is scheduled for 6 to 10 December 2010.⁴⁸³

UN-SPIDER

Several workshops and regional meetings were organised in the framework of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER). This platform was set up by the UNGA in 2006 with the aim of providing universal access to all

⁴⁸² Ibid.

⁴⁸³ „ITU World Radiocommunication Seminar closes.“ 12 December 2008. International Telecommunication Union. 30 May 2010.

<http://www.itu.int/newsroom/press_releases/2008/NP08.html>.

„World Radiocommunication Seminar 2010 (WRS-10).“ 30 May 2010. <<http://www.itu.int/ITU-R/index.asp?category=conferences&link=wrs-10&lang=en>>.



types of space-based information and services relevant to disaster management support.

The International Charter on Space and Major Disasters was activated several times by the Office of Outer Space Affairs (OOSA) at the request of other UN entities. The concept model for a UN-SPIDER knowledge portal was developed further in cooperation with German institutional partners.

UN Programme on Space Applications (SAP)

The UN Programme on Space Applications (SAP) is concerned with cooperation in space science and technology. Several activities were carried out under its auspices in the reporting period which dealt with, for instance, Technology Contribution to Infection Surveillance and to the Health-related MDG Goals, Basic Space Science and the International Heliophysical Year 2007, Integrated Space Technologies and Space-based information for Analysis and Prediction of Climate Change, Space Law, Integrated Applications of Global Navigation Satellite Systems, and Integrated Space Technology Applications for Socioeconomic Benefits.⁴⁸⁴

International Committee on Global Navigation Satellite Systems (ICG)

The aim of the International Committee on Global Navigation Satellite Systems (ICG) is to promote cooperation in matters of satellite navigation. OOSA serves as the Executive Secretariat of the ICG and the associated Providers' Forum. The fourth meeting of the ICG took place in Saint Petersburg, Russia, on 14–18 September 2009. It saw attendance from industry, governments, non-governmental organisations and academia and it reviewed and discussed developments in global navigation systems.

The ICG work plan was organised in four working groups: on compatibility and interoperability, on enhancement of performances of GNSS services, on information dissemination, capacity building, and on interaction with national and regional authorities and relevant international organisations. In the joint statement it was noted "that substantive progress had been made in furthering the workplans of ICG and the Providers' Forum that had been approved at the previous

⁴⁸⁴ "United Nations Programme on Space Applications Activities Schedule: 2009." UNOOSA. 30 May 2010. <<http://www.oosa.unvienna.org/oosa/en/SAP/sched/2009.html>>.

meetings of ICG."⁴⁸⁵ The next ICG meeting will take place in Turin in October 2010.

United Nations Spatial Data Infrastructure (UNSDI)

The United Nations Geographic Information Working Group (UNGIWG) held its tenth annual meeting in Bonn, Germany, on 19–21 October 2009. The UNSDI is understood as a comprehensive, decentralised geospatial information network to facilitate decision-making.⁴⁸⁶

Conference on Disarmament (CD)

The Conference on Disarmament (CD) is the only multilateral disarmament and arms control negotiating forum within the international community. It was in session from 11 June to 2 September 2009 and from 19 January to 23 March 2010. The stalemate in its work regarding space security has been ongoing. In the course of the 2009 session, the prevention of an arms race in outer space was again a central topic on the agenda.⁴⁸⁷

United Nations Institute for Disarmament Research (UNIDIR)

Several projects of the United Nations Institute for Disarmament Research (UNIDIR) deal with space security, directly or indirectly. Among other things, UNIDIR intends to review former proposals and to propose new options for breaking the deadlock in space weaponisation matters at the Conference on Disarmament (CD).

7.3 Non-Governmental Organisations (NGOs)

International NGOs keep on playing a growing role in matters of space policy. The functions they provide include advocacy, inputs to the main debates and organisation of events to share knowledge and to trigger discussion among the actors engaged in space matters. A number of international NGOs have the status of permanent observers at the United

⁴⁸⁵ United Nations General Assembly. Committee on the Peaceful Uses of Outer Space. Fourth Meeting of the International Committee on Global Navigation Satellite Systems, held in Saint Petersburg, Russian Federation, from 14 to 18 Sep. 2009. UN Doc. A/AC.105/948 of 05 Nov. 2009. Vienna: United Nations.

⁴⁸⁶ „UNGIWG tenth meeting." United Nations Geographic Information Working Group. 30 May 2010. <<http://www.ungiwg.org/meeting2009.htm>>.

⁴⁸⁷ United Nations Conference on Disarmament. Report of the Conference on Disarmament to the General Assembly of the United Nations. UN Doc. CD/1879 of 17 Sep. 2009. Vienna: United Nations.

Nations Committee on the Peaceful Uses of Outer Space (COPUOS), which constitutes a link to the official actors and delegations.

These observers include the Association of Space Explorers (ASE), the International Academy of Astronautics (IAA), ESPI, Eurisy, the International Astronautical Federation (IAF), the Secure World Foundation (SWF),

the Space Generation Advisory Council (SGAC), the World Space Week Association (WSWA), the International Institute for Applied System Analysis (IIASA), the International Society for Photogrammetry and Remote Sensing (ISPRS), the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW).⁴⁸⁸

⁴⁸⁸ "United Nations Office for Outer Space Affairs." 30 May 2010. <<http://www.unoosa.org>>.



Acronyms

3DTV	3 Dimensions Television
ABAE	Agencia Bolivariana de Actividades Espaciales
ACI	Airports Council International
ADF	Australian Defence Force
ADM	Atmospheric Dynamics Mission
AEB	Agência Espacial Brasileira
AEHF	Advanced Extremely High Frequency
AFET	Committee on Foreign Affairs
AFRL	Air Force Research Laboratory
AG	Aktiengesellschaft
AGILE	Astrorivelatore Gamma ad Immagini ultra Leggero
AIA	Aerospace Industries Association
AIS	Automatic Identification System
ANGELS	Autonomous Nanosatellite Guardian for Evaluating Local Space
AP-MCSTA	Asia Pacific Multilateral Cooperation in Space Technology and Applications
APRSAF	Asia-Pacific Regional Space Agency Forum
APSCO	Asia-Pacific Space Cooperation Organisation
ARMC	African Resource Management and Environmental Constellation
ARTES	Advanced Research in Telecommunications Systems
ASAT	Anti Satellite
ASC	Army Space Council
A-SCOPE	Advanced Space Carbon and Climate Observation of Planet Earth
ASE	Association of Space Explorers
ASI	Agenzia Spaziale Italiana
AT&T	American Telephone and Telegraph Corporation
Athena-Fidus	Access on theatres for European allied forces nations-French Italian dual-use satellite
ATV	Automated Transfer Vehicle
AVIC	Aviation Industries of China
BAE	British Aerospace
BGAN	Broadband Global Area Network
BLS	Boeing Launch Services
BNSC	British National Space Centre
CASA	Construcciones Aeronáuticas Sociedad Anónima
CASC	China Aerospace Corporation
CASIC	China Aerospace Science and Industry Corporation
CASTC	China Aerospace Science and Technology Corporation
CBERS	China Brazil Earth Resources Satellites
CCD	Charged Coupled Device
CD	Conference on Disarmament
CEV	Centro Espacial Venezolano
CFSP	Common Foreign and Security Policy
CGWIC	China Great Wall Industry Corporation
CIP	Competitiveness and Innovation Framework Programme
CMA	China Meteorological Administration
CMSEO	China Manned Space Engineering Office
CNES	Centre National d'Etudes Spatiales
CNNC	China National Nuclear Corporation
CNSA	China National Space Administration
COPUOS	Committee on the Peaceful Uses of Outer Space
CoReH2O	Cold Regions Hydrology High-resolution Observatory
COREPER	Committee of Permanent Representatives
COSMO-Skymed	Constellation of small Satellites for the Mediterranean basin Observation

COSTIND	Commission for Science, Technology and Industry
CSI	Customer Service Improvement
CSSC	China State Shipbuilding Corporation
DARPA	Defense Advanced Research Projects Agency
DARS	Digital Audio Radio Satellite
DBS	Direct Broadcast Services
DEM	Digital Elevation Model
DG	Directorate General
DISH	Digital Sky Highway
DLR	Deutsches Zentrum für Luft- und Raumfahrt
DMO	Defence Material Organisation
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DoD	Department of Defense
DRC	Democratic Republic of Congo
DSTO	Defence Science and Technology Organisation
DTH	Direct-to-Home
EADS	European Aeronautic Defence and Space Company
EarthCARE	Earth Clouds, Aerosol and Radiation Explorer
EC	European Commission
ECA	Evolution Cryotechnique Type A
e-CORCE	e-Constellation of Observation by Recurrent Cellular Environment
EDA	European Defence Agency
EDEM	European Defence Equipment Market
EDRS	European Data Relay Satellite
EEA	European Environment Agency
EELV	Evolved Expandable Launch Vehicle
ELV	Expandable Launch Vehicle
EGNOS	European Geostationary Navigation Overlay Service
EIP	Entrepreneurship and Innovation Programme
EISC	European Interparliamentary Space Conference
ELINT	Electronic signals Intelligence
EMS	Electromagnetic Sciences
EMSA	European Maritime Safety Agency
EnMAP	Environmental Mapping and Analysis Programme
EOS	Earth Observation System
EPS	EUMETSAT Polar System
ESA	European Space Agency
ESDP	European Security and Defence Policy
ESOA	European Satellite Operators Association
ESP	European Space Policy
ESPI	European Space Policy Institute
EU	European Union
EUFOR	European Union Force
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUSC	European Union Satellite Centre
Eutelsat	European Telecommunications Satellite Organisation
EVA	Extravehicular Activity
FAA	Federal Aviation Administration
FAO	Food and Agricultural Organisation
FBI	Federal Bureau of Investigations
FCC	Federal Communications Commission
FED	Federal Reserve System
FLEX	Fluorescence Explorer
FP7	Framework Programme for research and technological development 7
FRONTEX	European Agency for the Management of Operational Cooperation at the External Borders
FSS	Fixed Satellite Services
FY	Fiscal Year
FY	Feng Yung
GAD	General Armaments Department
GCOM-W	Global Change Observation Mission-Water
GDP	Gross Domestic Product
GEO	Geostationary Orbit



GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GMES	Global Monitoring for Environment and Security
GNI	Gross National Income
GOCE	Gravity field and steady-state Ocean Circulation Explorer
GOES	Geostationary Operational Environmental Satellite
GOSAT	Greenhouse Gases Observing Satellite
GPS	Global Positioning System
GSA	GNSS Supervisory Authority
GSC	Guyana Space Centre
GSI	Global Security Institute
GSLV	Geosynchronous Satellite Launch Vehicle
GTO	Geostationary Transfer Orbit
HDTV	High Definition Television
HQ	Headquarters
HSPG	High-Level Space Policy Group
HTV	H2A Transfer Vehicle
HYLAS	Highly Adaptable Satellite
IAA	International Academy of Astronautics
IAEA	International Atomic Energy Agency
IAF	International Astronautical Federation
IATA	International Air Transport Association
IAU	International Astronomical Union
IBEX	Interstellar Boundary Explorer
IBMP	Institute for Biomedical Problems
ICBM	Intercontinental Ballistic Missile
ICG	International Committee on Global Navigation Satellite Systems
ICU	Islamic Courts Union
IEA	International Energy Agency
IGN	Institut Géographique National
IGS	Integrated Geo Systems
IIASA	International Institute for Applied System Analysis
ILS	International Launch Services
IMF	International Monetary Fund
IMO	International Maritime Organisation
IMS	Indian Mini Satellite
INKSNA	Iran – North Korea – Syria Nonproliferation Act
INPE	Instituto Nacional de Pesquisas Espaciais
IPCC	Intergovernmental Panel on Climate Change
IPO	Integrated Program Office
IRNSS	Indian Regional Navigational Satellite System
ISAF	International Security Assistance Force
ISB	Industry State Bank
ISC	International Space Company
ISPRS	International Society for Photogrammetry and Remote Sensing
ISRO	Indian Space Research Organisation
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
ITU	International Telecommunication Union
JAPCC	Joint Air Power Competence Center
JAXA	Japan Aerospace Exploration Agency
KARI	Korea Aerospace Research Institute
KHTT	Know-How-Technology Training
KSLV	Korea Space Launch Vehicle
LAMOST	Large Sky Area Multi-Object Fibre Spectroscopic Telescope
LCROSS	Lunar Crater Observing and Sensing Satellite
LEO	Low Earth Orbit
LISA	Laser Interferometer Space Antenna
LM	Long March
LMCLS	Lockheed Martin Commercial Launch Services
LRF	Lloyd's Register-Fairplay
LRG	Launch Risk Guarantee
LRO	Lunar Reconnaissance Orbiter
MAI	Moscow Aviation Institute

MASTIS	Maritime Advanced SATCOM Terrestrial Infrastructure System
MAVEN	Mars Atmosphere and Volatile Evolution
MDA	MacDonald Dettwiler and Associates
MDA	Missile Defense Agency
MEO	Medium Earth Orbit
METI	Ministry of Economy, Industry and Trade
MEXT	Ministry of Education, Science and Technology
MHI	Mitsubishi Heavy Industries
MHS	Microwave Humidity Sounder
MIC	Ministry of Internal Affairs and Communication
MLM	Multipurpose Laboratory Module
MoD	Ministry of Defence
MONUC	Mission de l'Organisation des Nations Unies en République démocratique du Congo
MoonLITE	Moon Lightweight Interior and Telecom Experiment
MoU	Memorandum of Understanding
MR	Medium Resolution
MRM	Mini Research Module
MSC	Missile Systems Center
MSG	Meteosat Second Generation
MSS	Mobile Satellite Services
MSV	Mobile Satellite Ventures
MTG	Meteosat Third Generation
MUOS	Mobile User Objective System
MUSIS	Multinational Satellite-based Imagery System
NASA	National Aeronautics and Space Administration
NASDA	National Development Space Agency of Japan
NATO	North Atlantic Treaty Organisation
NDPG	National Defence Program Guidelines
NERC	Natural Environment Research Council
NEREUS	Network of European Regions Using Space Technologies
NFIRE	Near Field Infrared Experiment
NGA	National Geospatial-Intelligence Agency
NGDI	National Geospatial Data Infrastructure
NGO	Non-governmental Organisation
NOAA	National Oceanic and Atmospheric Administration
NPOSS	National Polar-orbiting Operational Satellite System
NPP	NPOESS Preparatory Project
NRO	National Reconnaissance Office
NSR	Northern Sky Research
NSSA	National Security Space Authority
OGDR	Operational and Geophysical Data Record
OHB	Orbitale Hochtechnologie Bremen
OOSA	Office of Outer Space Affairs
OPEC	Organisation of Petroleum Exporting Countries
ORFEO	Optical and Radar Federated Earth Observation
ORS	Operationally Responsive Space
OSTM	Ocean Surface Topography Mission
PFI	Public Financing Initiative
PICC	People's Insurance Company of China
PLA	People's Liberation Army
PNAE	Plano Nacional de Atividades Espaciais
PND	Portable Navigation Device
POES	Polar Operational Environment Satellites
PPP	Public Private Partnership
PREMIER	Process Exploration through Measurement of Infrared Emitted Radiation
PRISMA	Precursore Iperspettrale della Missione Applicativa
PSIPW	Prince Sultan Bin Abdulaziz International Prize for Water
PSLV	Polar Satellite Launch Vehicle
R&D	Research & Development
RCA	République Centrafricaine
ROSA	Radio Occultation Sounding for Atmosphere
RSC	Rocket and Space Corporation
S&T	Science and Technology



SA	Sociedad Anónima
SAP	Programme on Space Applications
SAR	Synthetic Aperture Radar
SARA	Sub-kev Atom Reflecting Analyser
SBIRS	Space Based Infrared System
SBSS	Space Based Surveillance System
SC	Security Council
SDSTB	State Defense Science and Technology Bureau
SEDE	Subcommittee on Security and Defence
SES	Société Européenne des Satellites
SGAC	Space Generation Advisory Council
SHF	Super High Frequency
SHSP	Strategic Headquarters for Space Policy
SICRAL	Sistema Italiano per Comunicazioni Riservate ed Allarmi
SIGINT	Signals Intelligence
SIR-2	Spectrometer Infrared 2
SIRAL	SAR/Interferometric Radar Altimeter
SLA	Service Level Agreement
SMDC	Space and Missile Defense Command
SME	Small and Medium Enterprises
SMOS	Soil Moisture and Ocean Salinity
SMP	Systèmes Midi-Pyrénées
SNC	Sierra Nevada Corporation
SPIDER	Space-based Information for Disaster Management and Emergency Response
SS2	Space Ship 2
SSA	Space Situational Awareness
SSC	Swedish Space Corporation
SSL	Space Systems/Loral
SSOT	Sistema Satelital para Observacion de la Tierra
SSTL	Surrey Satellite Technology Ltd.
STFC	Science and Technology Facilities Council
STSS	Space Tracking Surveillance System
SWF	Secure World Foundation
TCBM	Transparency and Confidence Building Measures
TEN	Trans-European Networks
TEN-T	Trans-European Transport Networks
TFG	Transitional Federal Government
THEO	Thai Earth Observation System
TRAQ	Tropospheric composition and Air Quality
TSAT	Transformation Communications Satellite
TSB	Technology Strategy Board
TV	Television
UAE	United Arab Emirates
UHF	Ultra High Frequency
UK	United Kingdom
ULA	United Launch Alliances
UN	United Nations
UNCCC	United Nations Climate Change Conference
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNGIWG	United Nations Geographic Information Working Group
UNIDIR	United Nations Institute for Disarmament Research
UNISPACE	United Nations Conference on the Exploration and Peaceful Uses of Outer Space
UNSC	United Nations Security Council
UNSDI	United Nations Spatial Data Infrastructure
U.S.	United States
USAF	United States Air Force

USAT	Ultra Small Aperture Terminals
USN	Universal Space Network
VERTA	Vega Research and Technology Accompaniment
VHR	Very High Resolution
VSAT	Very Small Aperture Terminals
WEU	Western European Union
WFP	World Food Programme
WGS	Wideband Global Satcom
WHO	World Health Organisation
WK2	White Knight 2
WRC	World Radiocommunication Conference
WRS	World Radiocommunication Seminar
WSSD	World Summit on Sustainable Development
WSWA	World Space Week Association
XSS	Experimental Spacecraft System



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