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Introduction

When reading this issue of Space Policy, Issues and Trends it should be kept in mind that there is a remarkable lack of consistency in the publicly available figures on space activity. This is attributable to varying methodologies used by the data providers, currency conversion issues, and periodicity variances. The lack of consistency starts at the very top, with the estimates of the overall size of the global space economy, where there can be differences between sources of tens of billions of Euros; and it continues down to company to company comparisons, where different accountancy rules might bring considerable contortion. But it is, of course, also a commonplace that differences in purchasing power in different economies, and differences in wage and infrastructure cost make one-to-one comparisons very difficult. Some countries are very restrictive on providing institutional data, for instance on defence spending.

Still, this issue of Space Policy, Issues and Trends will provide many insights, since all the data uncertainties do not mask many important trends and developments. As Winston Churchill taught us, statistics must be taken with a grain of salt, yet purely by looking at relativities much can learned.

This is not a reason to be complacent about the precision of figures. Space has a great societal importance and the space community owes it to political decision makers to be able to provide normalised, accurate figures. In this domain, the United States is clearly ahead of the game, and Europe must perhaps consider whether institutions such as Eurostat should not become more involved in the data collection and processing for the space field.

1. Global Political and Economic Trends

1.1 Global Economic Outlook

In the second half of 2011 and the first half of 2012, it seemed, superficially, that the world economy was on a successful path out of the financial and economic crisis. The booming economies of China, India, Brazil, Russia in particular, and some other emerging and developing countries were providing impetus to global economic recovery. Due to strong export orientation, industrialised countries, such as Germany, were benefiting from demand from these countries. Thus Germany had record growth rates and declining unemployment.

Nevertheless, there are developments in the global economy that give cause for concern. For many countries the financial and economic crisis of the last three years has begun to acquire a more permanent character:

- Capital movements are rather detached from investments in the real economy;
- National and international financial markets are above all secondary markets;
- Financial markets are still highly speculative;
- Financial markets are volatile due to overreaction and underreaction in financial and foreign exchange markets, as well as abrupt and voluminous international and domestic capital movements;
- High reliance on liquidity interventions;
- IMF, central banks and governments have limited room for backup at this time.[1]

The combined effects amassed over time on a global scale are creating concerning new problems and negative dynamics. Not only has global economic activity weakened, but the economic pace has also become more uneven, exacerbating inequalities on a global, regional and societal scale. These growing imbalances in the global distribution of wealth and trade could potentially increase geopolitical tensions and encourage politically radical and economically protectionist reflexes. However, financial confidence in the United States is increasing, and the glacial European response to the Euro crisis has now possibly finally reached a turning point, despite recent events in Greece. Still, the world is facing a multitude of unresolved structural economic and financial deficiencies. Unforeseen geopolitical events, like the Arab spring, and natural disasters (such as the great earthquake of Japan) have multiplied the shocks to an already unsettled global financial and economic community.

In the past three years mainly public funds have been used to secure the European financial system and buffer the Euro crisis, in turn triggering austerity measures in almost all countries but the United States. The newly elected President of France, François Hollande, plans to reopen talks on the European Union's hard-won fiscal austerity pact in order to refocus the EU's economic policy on growth. The realism of reopening the austerity pact might be questionable, but there is growing recognition also within the European Commission that austerity alone will not solve the situation, and that active investment in growth must operate in parallel. In this sense, Europe will likely start to move in the direction of the approach of the United States, where growth has always been the priority.

Considering the aforementioned conditions, one must be cautious regarding the global economy's short term prospects. In developed economies the pace of economic recovery continues to be sluggish at best, with real economic growth reaching only 1.5% in 2011 and not expected to increase beyond 2% in 2012. On the other side, emerging economies have demonstrated a much more robust expansion of approximately 6%, which is expected to continue in 2012 as well. As fiscal problems in developed economies persist, however, the prospects for emerging economies begin to look more uncertain too.[2] This is particularly true for countries that are more heavily dependent on

[1] Kamppeter, Werner. "International Financial Crises in Comparison - Lessons for Managing the Current Crisis." May 2011. Friedrich-Ebert-Stiftung - International Policy Analysis. 11 May 2012 <http://library.fes.de/pdf-files/id/ipa/08081.pdf>.
[2] International Monetary Fund. World Economic Outlook 2011. Washington DC: IMF, 2011.

foreign demand for their products and services. The current global outlook is based on a series of assumptions, such as the containment of the Euro crisis; continued and successful fiscal consolidation in the U.S. without obstruction of economic recovery, especially on the demand side; the ability of markets in advanced economies to absorb the shock of the gradual withdrawal of quantitative easing measures previously applied; the absence of further major geopolitical shocks; and that global market volatility and risk aversion will not become more pronounced .

Concerns about banking sector losses and fiscal sustainability have lowered credit confidence and widened the sovereign spreads for a great number of Euro area countries, which towards the end of 2011 reached highs not seen since the launch of the Economic and Monetary Union. As a result of this deterioration, bank funding came to a near stop across the entire eurozone towards the end of 2011, prompting the European Central Bank to initiate debt re-monetarisation measures through its Long-Term Refinancing Operation (LTRO). In general, bank lending conditions deteriorated across most advanced economies. More importantly, currency market volatility increased significantly, witnessing a sharp appreciation of the Japanese Yen and an equally violent depreciation of the currencies of several emerging countries.

The uneven nature and geographical distribution of post crisis economic expansion is a major reason behind the significant risks to global economic activity. In fact, two simultaneous balancing acts should take place. On the one hand, private demand should take over again from public demand. Worryingly enough, advanced economies seem to be lagging behind on this front. On the other hand, an effort should be made to rebalance global trade volumes and international payments to pre-crisis levels. This would imply that economies with large external surpluses should increase their domestic orientation, while countries with trade deficits should do the opposite or radically increase their productivity. At present, this transition is still underway, and much of its eventual success depends on the ability of policy makers in crisis-hit economies to resist the temptation of choosing accommodating monetary policies to mend balance sheets.

In many advanced economies, notably those with external deficits, the drop in house prices is expected to continue in the longer term. Furthermore, structural reforms are still needed to boost production, including measures to reform the labour and production markets and strengthen their resistance to the adverse effects of population aging.

Youth unemployment, with extremes in Greece and Spain, but high in almost all industrialised countries, is a short and a long-term challenge with a possible fundamental societal impact on the wealth and stability paradigm of these countries.

1.2 Political Developments

1.2.1 Geopolitics

The year 2011 ushered in a wave of political demonstrations and unrest within the Arab world. Dubbed the Arab Spring, the consequences of this mass social-political upheaval continued to show throughout the year with profound influence on the geo-political climate. Following the initial uprisings in Tunisia, inciting similar action in neighbouring states, the Arab Spring spread with varying results across all of North Africa, and to most of the Middle East countries. Syria is currently experiencing its own long-lasting turmoil, and the crisis there has other regions promoting conflicting interests. While Western Europe and the United States are backing the uprising, Russia has sided with traditional government interests, and China is adopting a policy of non-interference, politically motivated by Tibet and Taiwan. As a natural consequence, the UN Security Council is stuck between two stools, despite very active and constructive diplomacy by some members, such as France and the United Kingdom. A sort of ‘Great Game’ is being replayed in the Middle East as a result of the Arab spring, with neighbouring states taking traditional positions based on historical and religious affiliations, along with internal influences. Iran is a prime example, expounding its religious and geopolitical interests, and seizing the opportunity to deflect attention from its own nuclear affairs.

The Arab Spring situation illustrates the vulnerability of old regimes faced with modern attitudes and the supra-regional interconnectedness among neighbouring states stretching from Morocco to Asia. Whereas the Arab Spring sparked other regions to assess their current situation, Palestine and Israel have struggled with there own autonomy issues since World War II, yet have been profoundly affected by the uprisings. The problems with Iran both directly and indirectly influence the situation in Iraq, with a chain reaction affecting the situation in Afghanistan, and complicating the already highly critical situation in Pakistan, which thereafter touches India, and introduces their

local nuclear weapons issues into the equation, along with the problems with North Korea. From there both China (as a neighbour of Pakistan and North Korea), and Japan are affected – with an eventual trickledown effect that reaches the United States and Western Europe.

Pakistan is still struggling with overcoming the results of the disastrous flooding that affected it, while also showing signs of being marginalized which is highly alarming for the nuclear state, and for the already uneasy relations with its neighbour India.

North Korea is in the throes of dealing with the death of Kim Jong-Il, and the installation of his inexperienced son as successor. The succession is likely to give rise to internal power struggles creating difficulties not only for China, but for all regional powers in addition to all countries concerned about proliferation of nuclear arms. However, should current power structures crumble, the result while unappealing in the short term might also provide an opportunity for normalisation.

The overall context was heavily influenced by the start of the election process in the United States. The upcoming elections there meant that political compromise across party lines was nearly impossible as illustrated by the debt ceiling debacle. Real progress on the 2013 budget will have to follow the November elections.

The overall context was also heavily influenced by the continued assertiveness of China on the global stage. China is undergoing a very different kind of leadership election and eventual transition. Notwithstanding the Bo Xilai debacle, tensions in China are barely noticeable with the likely future president, Xi Jinping, visiting the United States in a symbolic gesture of comity. Still, China has continued its aggressive investment policies in Africa, and continued to leverage its strength in space geopolitically, as well as domestically. The rendezvous and docking of two Chinese spacecraft was a triumph, setting the scene for a full-blown space station. Less noticeable, was Russian assistance behind the scenes; quickly absorbed and internalised by China

Russia, having finished its presidential elections, recently re-elected Vladimir Putin. Interestingly, Putin's absolute grip on power - typical of the last twelve years - was increasingly questioned in the run-up to the election and even thereafter; with the lingering effects of the Arab Spring noticeable even in Russia.

The proactive civic spirit injected into the political process thanks to the Arab Spring and social media was an underlying theme during the reporting period, the Occupy Wall Street movement with its many off-springs is but a further example.

1.2.2 Environment

Space applications have an important role in monitoring and protection of the environment. Space assets are uniquely positioned to offer a global perspective on climate change. Moreover they are helping to better manage disaster situations around the world. They often represent a common multinational platform for collecting relevant meteorological and environmental data. These characteristics make them ideal promoters of international understanding and cooperation in this field. Satellite based systems, for example, have recently been used to gather information about the situation of the melting of the ice-caps; to scan the rising global sea level and for mapping of regions mostly affected by global warming. Remote sensing technologies can also be used to monitor deforestation and land use, and are important for better utilization of fresh water sources. There is no doubt that space technologies will play an important role in human and environmental security in the future, hence technical development of their capabilities is necessary.

Despite the financial crisis, climate change remains one of the commonly recognized agenda topics within the global political debate. After the complicated acceptance and application of the 1997 Kyoto Protocol, which expires in 2012, and the "Copenhagen Accord" of 2009 establishing voluntary emissions cuts,[3] the new round of negotiations over the next internationally binding document was continued in 2011. From 28 November to 11 December 2011, the 17th Conference of Parties to the UN Framework Convention on Climate Change (UN FCCC/COP) took place in Durban, South Africa. After days of difficult negotiations, at the last moment delegates agreed on the preparation of a new legally binding treaty to address global warming and its solutions. The treaty is supposed to be prepared by 2015 and enter into force by 2020.[4] With this effort, the international community showed willingness to move away from the long lasting deadlock and towards real political

[3] "United Nations Climate Change Conference kicks off in Copenhagen." 7 Dec. 2009. United Nations Development Programme 20 Feb. 2012 <http://content.undp.org/go/newsroom/2009/december/historic-united-nations-climate-change-conference-kicks-off-in-copenhagen.en>.
[4] "Durban Climate Change Conference – November/December 2011." United Nations Framework Convention on Climate Change 20 Feb. 2012 <http://unfccc.int/meetings/durban_nov_2011/meeting/6245.php>.

solutions. Traditional differences between the positions of developed and developing countries were significant and were again stressed during the conference. Nonetheless, emerging economies like India or China and the representatives of major current CO2 emitters (except the U.S.), took leading roles during the final negotiations.

The Durban conference also led to progress regarding creation of the Green Climate Fund by adoption of its management framework. In the future, this fund will gather and distribute approx. €75.5 billion to help developing countries handle the side-effects of global warming and climate change.[5] The other important outcome was the progress on the UN Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN REDD). Deforestation and soil degradation are well known, not only as the negative effect of global climate change, but also as a significant contributor to it.

In sum, recent progress on global climate issues shows that the gap between leading industrialised countries and the countries in the development process is slowly changing. It seems that developing and emerging countries are moving to acceptance of greater involvement in avoidance in the future. Despite the abovementioned progress, one event immediately following the Durban conference might in the future undermine the role of industrialised countries in the climate change negotiations. The reaction of Canada, which a day after the conference in Durban decided to formally withdraw from the Kyoto protocol to save an estimated $14 billion in penalties, illustrated that real progress in the international community can be counteracted by unilateral action.[6]

Environmental and sustainable development issues are still important for both internal and external EU policies. At the EU level, several important initiatives regarding environmental issues were undertaken during the Polish Presidency in the second half of 2011.[7] Thus the EU Council stressed the urgency of establishing an ambitious international regime to solve global climate changes and called for agreement on a global and comprehensive legally-binding framework to keep the future increase of global temperature below 2°C.

Furthermore, the European Council adopted a decision establishing the position of the EU for the 10th Conference of the Parties (COP 10) to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal. In parallel, the European Commission stressed the urgent need to effectively prevent, combat and significantly reduce illegal waste shipments. According to EU officials, this should be achieved through improved use and coordination of existing tools, such as the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL), and inter-agency cooperation.[8]

During the Polish presidency, the EU Council also adopted conclusions on the assessment of the EU's 6th Environmental Action Programme (EAP) 2002-2012. The conclusions proposed by the European Commission are seen as comprehensive and forward-looking, and take into account existing initiatives such as the Europe 2020 Strategy; the EU positions on the UN Conference on Sustainable Development (Rio +20); the post-2010 Biodiversity Strategy; and more. The 6th EAP should allow for the consolidation and completion of legislation in almost all areas of EU environmental policy.

Regarding the 2012 Rio +20 UN Conference the Polish Presidency significantly assisted in establishing the EU's general positions, mostly stressing the use of green energy in the context of sustainable development and poverty eradication, and the establishment of an institutional framework for sustainable development.[9]

1.2.3 Energy

Despite the fact that economic recovery in 2011 and 2012 remained sluggish and uneven, and with future economic prospects still uncertain, global primary energy demand in fact marked a remarkable 5% increase on the preceding year of 2010, thus pushing CO2 emissions to a new high. One

[5] Black, Richard. "Climate Talks End With Late Deal." 11 Dec. 2011. British Broadcasting Corporation 20 Feb. 2012 <http://www.bbc.co.uk/news/science-environment-16124670>.
[6] "Canada Pulls Out of Kyoto Protocol." 12 Dec. 2011. CBC News 21 Feb. 2012 <http://www.cbc.ca/news/politics/story/2011/12/12/pol-kent-kyoto-pullout.html>.
[7] Council of the European Union. The 318th Council Meeting: Environment. Press Release 15321/11 final of 10 Oct. 2011. Brussels: European Union.
[8] Council of the European Union. Preparation of the Tenth Meeting of the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Cartagena de Indias, Colombia, 17 – 21 Oct. 2011. Council Conclusion 15393/11 final of 11 October 2011. Brussels: European Union.
[9] Council of the European Union. Rio+20: Towards Achieving Sustainable Development by Greening the Economy and Improving Governance. Council Conclusion 15388/11.

of the key planks during the period in review has been an increased effort in many countries to improve their energy efficiency. In spite of this, global energy use has increased for the second consecutive year. Furthermore, events such as the Fukushima Daiichi nuclear power plant disaster, the resultant nuclear energy scepticism, and continued turmoil in parts of the Middle East and North Africa have cast doubts on the reliability of energy supply. But also the persisting global economic crisis has considerably lowered market confidence in sovereign financial performance, further weakening government resolve to implement comprehensive energy policies and achieve global climate change objectives.

Another recurring trend during the review period was the increasingly strong role of emerging countries in determining energy market behaviour. Emerging countries are projected to account for 90% of global population growth, 70% of global GDP increase and 90% of energy demand growth over the period 2010 to 2035.[10] China in particular expected to further strengthen its position as the world's largest energy consumer: by 2035 it is expected to consume almost 70% more energy than the United States. Even in this case, however, Chinese per capita consumption would remain by far inferior to that of the United States. At the same time, energy consumption growth rates in other emerging countries, such as India, Indonesia, or Brazil are expected to grow even faster than in China. An important side effect of this trend is that significant investments in energy production and distribution will have to be made, in order to keep pace with growing demand. By some estimates, as much as $32 trillion would have to be invested in related infrastructure by 2035, of which $20 trillion would be for fossil fuel exploitation.[11] On the supply side, market volatility and geopolitical events in oil-rich regions in 2011 and 2012 demonstrated the fragility of fossil fuel reliance. In the short term, the economic slow-down provoked by the crisis contributed to lowering pressure on oil prices. Long-term consumption trends remain unchanged, however, and prices are expected to rise significantly once global economic growth returns. All of the projected net increase in oil demand is expected to come from the transport sector of emerging countries.

Thus the age of fossil fuels is not over, in spite of a slight anticipated relative decline in their demand: despite the increase in energy consumption, the share of fossil fuels in the global primary energy consumption mix is projected to fall only slightly from 81% in 2010 to approximately 75% in 2035. Only natural gas is expected to increase its relative share within the fossil fuel mix. At the same time, the problem of decreasing the environmental footprint of fossil fuel energy consumption remains unsolved. As a matter of fact, 4/5 of the total energy-related CO2 emissions permissible by 2035 are already present today as a result of existing capital stock (power plants, buildings, factories, etc.). If no corrective measures are taken, energy-related infrastructure is projected to generate all of the 2035 allowed CO2 emissions, already by 2017.[12]

1.2.4 Resources

Space applications and Earth monitoring technologies are playing an important role in the area of resource management. Thus they are useful for better control and support of the utilisation of scarce natural resources. Likewise, satellite based technologies can perform indispensable tasks for accommodating international trade, for example by streamlining global business transactions and payments. Global navigation satellite systems are already an integral part of transportation and utilisation of natural, agricultural and industrial resources. Use of meteorological and imaging satellites is making agricultural output bigger and more reliable. For many developing countries the rationale for investment in space is the improvement of the management of their agricultural and natural resources

In 2011 and 2012 commodity prices and consumer price inflation receded, but risks remained. The observed tendency was attributed to the weaker global demand, as a result of the economic crisis. Still, in 2011/12 adverse weather in many regions affected several agriculture markets, as well as coal and metals production. The political situation, mainly in North Africa and the Middle East with the Arab Spring which resulted in political and economical destabilisation, and the international sanctions towards Iran, have resulted in a loss of oil supply. Furthermore, currency fluctuations affected domestic prices of commodities, sometimes increasing demand. The long period of dollar weakness, in particular, has contributed to upward pressure on commodity prices.[13]

In 2011, the growth of international trade was expected to return to a single-digit figure, in the range of 7-8%. However, the revival of trade has been uneven among countries and groups of

[10] International Energy Agency. World Energy Outlook 2011. IAE: Paris, 2011.
[11] Id.
[12] Id.
[13] The International Bank for Reconstruction and Development. Global Economic Prospects 2011. Washington DC: World Bank, 2011. 51-65.

countries. For instance, in industrialised countries trade has yet to bounce back to a level above its pre-crisis levels. These countries recovered part of their previous trade losses between mid-2009 and mid-2010, but there has been no further growth since. Another example is the situation in the economies in transition. Their trade failed to reach its pre-crisis level by the end of 2010. In sharp contrast, the volume of both imports and exports in most groups of developing and emerging countries already exceeded their 2008 peak in the course of 2010. In this case, the countries in the East Asia region took the leading position. In countries that produce durable and capital goods, such as China and Japan, exports increased in volume by almost 30%. In developing countries that export mainly primary commodities, the volume of exports has been relatively stable.

It was significant during the period that oil and mineral exporters experienced significant gains. Oil prices maintained their price level, primarily because of supply insecurity related to geopolitical events. In general, geopolitical risks are expected to remain high, causing oil prices to ease only marginally during the second half of 2012. This development occurs in a period of further economic stagnation and crisis in the global economy, multiplying cyclical pressures. To compare the situation with previous years, according to the figures of the United Nations Conference on Trade and Development (UNCTAD) crude oil market prices fluctuated within a $70-$80 band during the first three quarters of 2010. They then surged in the last quarter of the year, to reach a monthly average of $116.3 during the fourth month of 2011.[14] On average, global oil demand rose by 3.2% in 2010. While the demand in non-OECD countries grew by 5.5%, OECD countries witnessed an increase of only 1.1%. The highest demand for crude oil came from China, with demand growing by 12.3% in 2010. At the same time, oil supply increased by only 2.1% in 2010, further increasing the gap between supply and demand.[15]

On the other hand, non-oil commodity prices continued their decline, thanks to improved supply conditions and a steep decline in global demand. In fact, non-oil commodity prices are projected to have fallen by 14% by the end of 2012. In the near term, prices are expected to drop even further. During the previous years, uncertainty and instability have been the major distinguishing feature of commodity markets. This is also reflected in the greater volatility of commodity prices. According to an UNCTAD report, between the two periods 2002-2005 and 2006-2011, the simple measure of volatility increased by a factor of 3.8 for food commodities and vegetable oil seeds and oils; by 2.7 for agricultural raw materials; and by 1.6 for minerals and metals and crude petroleum. In the markets for metals and minerals prices rose steeply in the second half of 2010, and peaked during the first months of 2011. Gold and silver in particular, have benefited from uncertainties about the global economy. During the second half of 2011 the prices for gold reached a historical maximum and floated between $1,690 per ounce and $1,714 per ounce. The reason for these high prices is clearly the safe haven status of gold and silver.[16]

The overall trend of stabilising or lower commodity prices would explain the relative decline of consumer price inflation during the period. In advanced economies, inflation is expected to be low, especially when compared to the effect of last year's higher commodity prices. Inflation in advanced economies is projected to fall to about 1.5% in the course of 2012, down from about 2.75% in 2011. In emerging and developing economies pressures are also expected to drop, as both growth and food price inflation slow. Overall, consumer prices in these economies are projected to decelerate, with inflation of around 6.25% during 2012, down from over 7.25% in 2011.[17]

1.2.5 Knowledge

There is no doubt that sustained education and knowledge improvement is one of the necessary conditions for successful space activities, as well as for the full exploitation of their societal benefits. In general, space technology and development, drawing on multiple scientific disciplines, is one of the most difficult and challenging fields in scientific and technical research. Therefore, coherent and sustainable strategies aiming at improving higher education and supporting technical and scientific activities are particularly relevant and necessary for space sector activities.

For Europe, as a leading actor in the field of scientific and technological R&D related to space, maintaining and expanding its large pool of highly skilled and specialised scientists and professionals should be a constant priority. Recent evidence suggests that Europe's leading position and excellence in this field could be disputed in the medium term, both by developed and emerging economies. In order for Europe to continue to be among the leaders in the global race for knowl-

[14] Id. at 14.
[15] Id. at 14.
[16] United Nations Conference on Trade and Development. Trade and Development Report, 2011. Geneva: UNCTD, 2011. 15.
[17] International Energy Agency. World Energy Outlook 2011. Paris: IAE, 2011.

edge and excellence in space R&D, the current levels of financial spending and political commitment in this area would have to be increased, and not only simply maintained. For example, today only a mere 26% of the European working age population holds a higher educational degree compared to 41% in the U.S., 44% in Japan and 50% in Canada.[18] Furthermore, this relative lack of skilled workers is most likely to be accentuated as demand for their services is expected to increase.

According to a 2010 report of the European Centre for the Development of Vocational Training, the European skills forecast indicates that by 2020 around 35% of jobs in the EU will require higher education qualifications.[19] Based on this finding, a 30% increase in higher education graduates would have to be achieved by 2020, in order for Europe to maintain its competitiveness and current position on the global scientific stage. Encouragingly, the population of university and higher education students in Europe has been constantly increasing over recent years. Today, there are approximately 4,000 universities and other kinds of higher education institutions in Europe, with more than 19 million students. Nevertheless, this quantitative increase has not been accompanied by qualitative improvements in governance structures and proposed academic curricula, or by increases in funding. Although increasing in size, Europe's higher education system has not yet achieved an academic curricula distribution that would train scientists and professionals with the right kind of skills to support economic growth and scientific excellence in new technologies. This is especially true for the space sector, which has a relatively limited human resources supply and demand chain.[20]

According to a European Commission report, the potential of European higher education institutions to fulfil their role in society and contribute to Europe's prosperity is not fully exploited. EU officials pointed out that greater capacity for research and development could fuel innovation across all sectors of the economy, improving competitiveness and fostering job creation. The same report highlights the potential technological spin offs of innovation and their capacity to revitalise more traditional economic sectors and rural areas, multiplying their broader societal impact.[21] In this context, the role of space applications should be highlighted, as for example in the case of using communications satellites to improve broadband internet connectivity in remote areas. Finally, the new strategy proposed by the European Commission indentifies priority areas where EU countries need to do more to achieve shared education objectives and describes how the EU can support the modernisation of their national higher education policies. According to the EC proposal, EU-level initiatives will include a multi-dimensional university ranking which will better inform students about university courses and support competition between universities.

Sustained and efficient investments in higher education are important prerequisites for quality improvement. For example, in 2008 the average level of direct spending on higher education in the EU, both public and private, was approximately 1.3% of the European GDP. The majority of expenditure on higher education usually comes from the public sector and it has been constantly increasing. Private expenditure on education is less pronounced in the EU, thus showcasing the traditional role of the public purse in public endeavours. By comparison, U.S. total private and public investment for the same period has amounted to 2.7% of GDP.

The EU budget dedicated to funding programmes in education and training is about €8 billion for the period 2007-2013. In addition to this, the EU will spend an additional €4.7 billion on training, mobility and career development for researchers. For the 2014-2020 budget period the European Commission emphasises the priority of "smart growth" through knowledge creation, consequently allocating substantial funds to skills and knowledge creation. According to the budget proposal, a single funding programme for education, training and youth would receive €15.2 billion, which means an increase of 73% compared to the 2007-2013 period. The Commission has also proposed a 46% rise in research funding under the planned Horizon 2020 strategy that will bring it up to €80 billion.[22]

[18] European Commission-Eurostat. Europe in Figures. Eurostat yearbook 2011. Luxembourg: Publications Office of the European Union, 2011. 212-218.
[19] European Centre for the Development of Vocational Training. Skills Supply and Demand in Europe: Medium-Term Forecast up to 2020. CEDEFOP, 2010.
[20] Id.
[21] European Commission. Communication from the Commission. Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth. COM (2010) 2020 final of 3 Mar. 2010. Brussels: European Union.
[22] "An EU Strategy for Modernising Higher Education – Questions and Answers." 20 Sept. 2011. European Commission – Press Release. 1 Mar. 2012 <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/615&format=HTML&aged=0&language=EN&guiLanguage=fr>.

Considering the aforementioned shortcomings, it was not a surprise that initiatives in the scientific research and education fields were among the 2011 Polish EU Council Presidency top priorities. For example, increasing continuous learning, as well as educational and professional mobility, and modernising higher education infrastructure and curricula have been some of the key initiatives in this respect. The implementation of these priorities followed the broad lines of the Europe 2020 Strategy and its flagship initiative "youth on the move", for the creation of new skills and new jobs. In this context, the Polish presidency launched a comprehensive debate on learning and mobility issues in the framework of EU educational programmes, taking into account its international dimension and also including EU neighbours. These actions were further supported by the European Commission, which set the goal of doubling the number of EU grant recipients for studying and training abroad at 800,000 students by 2020. In addition to this, around €72.5 billion is foreseen to be spent on education and training across Europe's regions until 2013, and this pace was expected to be maintained in the future.[23] Finally, the EC plans to emphasise quality support in teaching and scientific research, as well as improving governance practices and transparency in higher education establishments.[24]

1.2.6 Mobility

Maritime commerce accounts for the bulk of global trade, whereas air traffic carries 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. Maritime navigation and mobile communications are two of the upcoming spheres with significant financial interests in the development of new generations of satellite-based applications.

In 2011 and 2012 the transport sector continued to suffer from the effects of the global financial crisis. As the principal facilitator of global commodity flows, the transport sector continued to suffer from the steep decline of demand due to the crisis, and the subsequent slowdown in the demand for raw materials. Furthermore, the continued financial crisis and the tightening of lending it has created in the banking sector have also adversely affected transport, by restraining necessary credit flows that facilitate international commerce transactions. Indeed, the collapse of confidence that has accompanied the sovereign debt crisis in Europe has had significant repercussions in the transport sector, with several banks refusing to issue letters of credit or accepting certain forms of collateral for loans.

According to the UNCTAD 2011 maritime transport report, imports to Asia grew at a slightly slower pace than exports, an average of 15.2%. The differences between developed and emerging countries were noticeable. Imports in developing countries expanded at a faster rate of 18.7% compared to an exports rate of 16.6%. This was particularly driven by growth in import volumes of developing countries in Asia. Nevertheless, transition economies have also recorded growth in import volumes. It reached an average of 17.8%, which means a rate faster than the rate of exports. Finally, positive growth was also recorded in import volumes of developed countries. It reached an average of 16.5%, led by the positive performances of the United States and the European Union. Considering the earthquake disaster in Japan, the World Trade Organization expected Japan's export volumes to drop by 0.5–0.6% and its imports to increase by 0.4–1.3%.[25] But already in May 2011, Japan's exports began to rebound from the major disruption caused by the crisis situation in March. Nevertheless, export growth decelerated later in the year. One of the reasons was the softening global demand during this period. Finally, shortly after the earthquake disaster, imports rose notably, pushed mainly by higher demand for food. At the beginning of June 2011, exports went up to pre-crisis levels and beyond.

Maritime transport is the most commonly used form of transport for international trade, representing the bulk of global trade transport (90%). Consequently, it has suffered the greatest blow from the continued crisis. Indeed, the 2008 financial crisis and its repercussions terminated one of the longest uninterrupted growth periods in recorded maritime history. The timing of the crisis was particularly adverse, as ship owners enjoyed the most profitable financial results of all time before the crisis, and had an unprecedented number of vessels under order. As a result, during the reporting period a great number of orders continued to be cancelled. During the last 12 months, decreased maritime activity has led to a wave of ship order cancellations and an unprecedented level

[23] "Extra Funds for Education, Youth and Creativity Will Boost Jobs, says Commission." 11 June 2011. European Commission – Press Release. 29 Feb. 2012 <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/857&format=HTML&aged=0&language=EN>.
[24] Programme of the Polish Presidency of the Council of the European Union. 1 July – 31 December 2011. Warsaw: Poland Ministry of Foreign Affairs, 2010. 32.
[25] United Nations Conference on Trade and Development. Review of Maritime Transport 2011. Geneva: UNCTD, 2011. 5.

of distress demolitions (projected to have reached 15-18% of world fleet capacity in 2010). If these estimates materialise, all sectors of the maritime industry will suffer from considerable unemployment. Another medium-term consequence of the financial crisis with effects for sea trade could be the appearance of protectionist measures that would further hinder world trade.

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 the international military presence in the region has somewhat increased security, piracy incidents have persisted. This surge in piracy in the Gulf of Aden has generated considerable costs especially for Europe as 80% of shipments that pass through the area are coming from or going to this continent. Re-routing shipments around the Cape of Good Hope alone is estimated to create over $7.5 billion of additional shipping costs annually with associated increased energy consumption. Coordinated measures were undertaken by the International Maritime Organisation (IMO) to face the deteriorating security environment in the area and provide security for the ships navigating in these waters. In this context, it authorised ship owners to voluntarily arm their vessels at their own expense, notably by hiring armed guards when passing through the region.[26]

[26] White Papers of the Government of China. “China’s Space Activities in 2011.“ Beijing 29 Dec. 2011. 6 Mar. 2012 <http://www.china.org.cn/government/whitepaper/node_7145648.htm>.

2. Global Space Economy

This chapter covers the 2011 public budgets and commercial revenue that are related to space activity. There will be a brief discussion of space related public budgets and commercial revenue with a quantitative assessment of the overall market value and financial performance of space activities in the last 12 months. It should be noted that in the absence of internationally uniform standards, developing an accurate estimate of financial and market figures of global space activities is a complicated task, especially when considering that most countries and space research institutions adopt their own distinct methods of categorising and distributing funding for space activity. Likewise, the lack of transparency in certain government space programmes, e.g. military space projects, further complicates calculations. Moreover, commercial companies publish their financial figures regularly, but not in a uniform and synchronised way that would allow direct horizontal industry comparisons.

2.1 Global Space Budgets and Revenue

In general, worldwide national space budgets have continued to grow in 2011. World government expenditure for civil space programs amounted to $44.92 billion.[27] Total world governmental expenditure on space programmes amounted to $72.77 billion.[28] The rate of increase of these space budgets accelerated since 2010. Whereas the Compound Annual Growth Rate (CAGR) had dipped to 2% between 2009 and 2010, following a stronger rate of 9% during the period between 2004 and 2009, the aggregate growth rate rose to 6% between 2010 and 2011.[29] A more detailed analysis of institutional budgets is set out in the following section.

The 2012 Space Report provides a guide to the commercial revenue of space activities, listing the 2011 total revenue of commercial satellite services at about $110.53 billion including activities such as telecommunications, Earth observation and positioning services (this amount represents a 9% increase from $101.73 billion in 2010). The revenue of space-related commercial infrastructure including manufacturing of spacecraft and in-space platforms, launch services as well as ground equipment is estimated to have reached around $106.46 billion (resulting in a corresponding increase of 14% in launch capacity compared to the deficit in 2010). In conclusion, total commercial space revenue in 2011 was $216.99 billion.[30]

2.2 Overview of Institutional Space Budgets

From the Space Report, total institutional spending, including that of intergovernmental organisations, on space programs in 2011 can be estimated to be approximately $72.77 billion, a figure which shows a nominal decrease of 6% compared to 2010.[31] This space spending is comprised of $44.92 billion in civil expenditures (61.7% of the total) and $27.85 billion in defence expenditures (38.3%). On the other hand, the Euroconsult report lists 2011 civil space expenditures to amount to $40.3 billion, whereas its estimates for government expenditures for defence space programmes amount to about $30 billion.[32] Consequently, the ratio of defence expenditure relative to civil ex-

[27] The Space Report 2012. Colorado Springs: The Space Foundation, 2012: 58. The amount was calculated by subtracting the total military expenditure on space from the total world governmental expenditure on space (see infra footnote).
[28] Id. at 42.
[29] Id. at 32.
[30] Id.
[31] Cf. id. at 32 and The Space Report 2011. Colorado Springs: The Space Foundation, 2011: 32; note: Figures in this section are based on the Space Report 2012 data (USA, Russia, Japan, China, and France), while all other values in figures 2.1 & 2.2 come from the Euroconsult Report 2012 - Profiles of Government Space Programs.
[32] Euroconsult Report 2012.

penditure has gone down compared to last year, where the ratio was $37 billion in civil expenditures (or 52% of the total) and $34 billion in defence expenditures (or 48%).[33]

Based on the Space Report 2012, of the estimated $27.85 billion of defence related space expenditure worldwide, $26.46 billion was spent by the United States, representing a share of 95% and indicating a significant percentage increase compared to the previous year. These funds came from *inter alia*, the Department of Defence (DoD), the National Reconnaissance Office (NRO), and the National Geospatial-Intelligence Agency (NGA). It should be noted that a degree of uncertainty exists regarding expenditures on defence space activities as not all relevant funding is made public. However, it is clear that the activity in the United States is a driving force in worldwide space activity, particularly in the defence area.

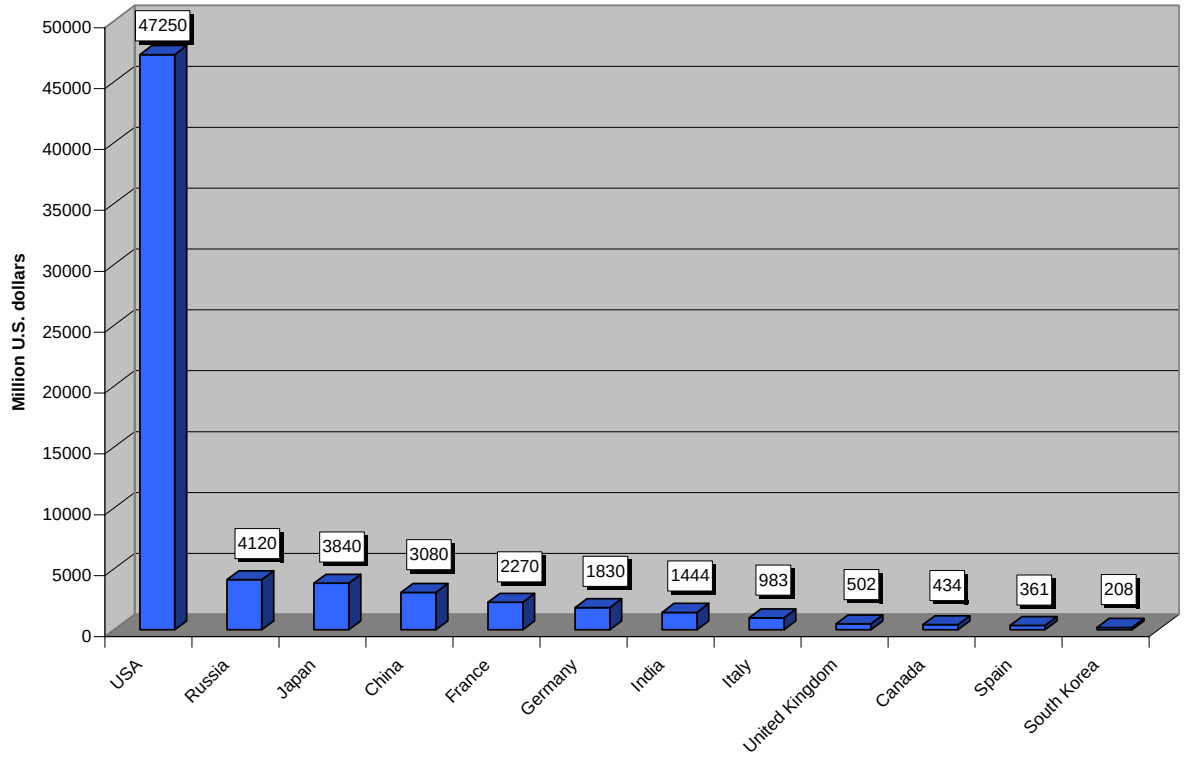

Figure 2.1: Public space budgets of major space powers in 2011 (Based on Euroconsult and the Space Report 2012 data).

The expenditure hierarchy among states has stayed roughly similar to 2010; China is the exception, having advanced its position in 2011. Maintaining its strong lead position, the U.S. has the largest budget, directing $20.79 billion toward civil expenditure, and $26.46 billion toward defence expenditure.[34] The low estimate of Russia's budget must be put into perspective, as it does not factor in the intensive military activity entailing regular classified launches or the scientific programmes. Attention should be given to China's national space budget of $3.08 billion which overtook France's budget of $2.27 billion in 2011.[35] In 2010, China was already poised to overtake France's 2010 budget of $2.5 billion with a budget of $2.4 billion.[36] India has managed to maintain its position as having the 7th largest space budget, surpassing Italy's budget by a significant margin.

The European Space Agency, as an international organization composed of 19 member states, had a 2011 budget of €3.994 billion ($5.80 billion) an increase of 6.7% above its 2010 budget of €3.745 billion ($4.60 billion).[37] As a joint investment of the 19 Member States, the five biggest contributors are France 18.8%, Germany 17.9%, Italy 9.5%, U.K. 6.6%, and Spain 5.1%. The Space Report 2012 notes a slight decrease of 8.7% in Japan's space budget amounting to ¥309.4 billion ($3.84 billion) when compared to ¥339 billion in 2010.[38] Japan's budget contributes to reduc-

[33] Pagkratis, Spyros. Space Policies, Issues and Trends in 2010/2011. Vienna: European Space Policy Institute, 2011: 12.
[34] The Space Report 2012…: 44.
[35] Cf. id. at 48, 51.
[36] Space Policies, Issues and Trends in 2010/2011…: 13.
[37] "ESA Budget for 2011." ESA 15 May 2012 <http://download.esa.int/docs/DG/ESA_2011_Budget_040111_rev2.ppt#256,1,Slide 1>.
[38] The Space Report 2012…: 55.

ing the world concentration of space expenditure among the U.S., European countries, ESA and Russia, to 80.4% in 2011 from 82% in 2010.

When measuring the concrete effort of countries in the space sector it is necessary to put the figures into perspective in regard to GDP[39] (Figure 2.2). However, considering the absolute numbers alone will paint only a partial picture since comparisons between countries with different economic conditions (e.g. price or wage levels) can be misleading.

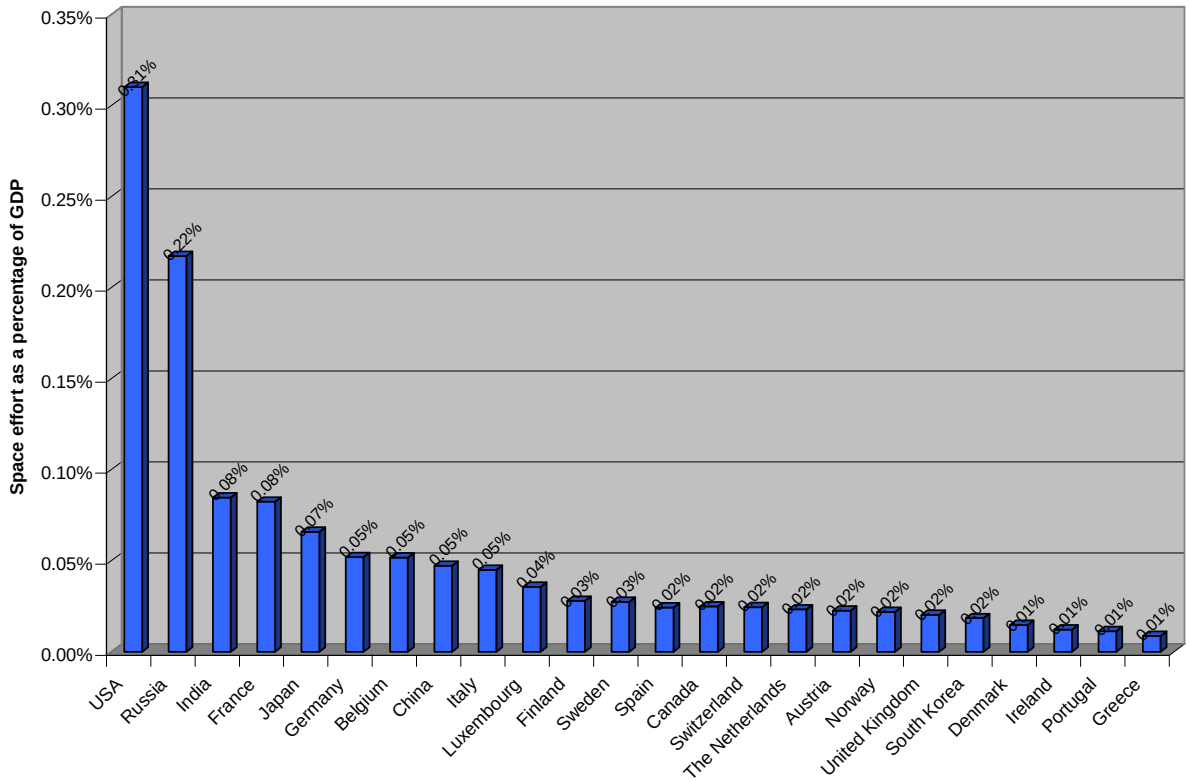

Figure 2.2: Public space budgets (selection) as a share of nom. GDP in 2011 (source: Euroconsult/IMF)

U.S. space budget figures evince its strong engagement in the space field; however, its level of investment seems to have tapered off or even diminished slightly. As explained previously, the Russian figures must be read with caution, yet Russia's space effort has increased by 0.03 to be 0.22% in 2011. France's ratio relating to space efforts as a percentage of GDP has diminished to 0.08%, with India surpassing it and Japan following behind at 0.09% and 0.07% respectively. The other leading space countries in Europe continue to invest 0.05% or less of their GDP on space activities.

The U.S. continues to dominate the amount spent on its space budget per capita at $151.59 (a decrease of 2.64% from 2010), whereas France's per capita space budget was reduced to $35.86 (a decrease of 11.24%). From the values listed in the Euroconsult Report, the per capita budget of Luxembourg has been calculated to be $44.00 (a 10.6% increase) and Belgium's is $23.55 (a 10.05% increase); these funds are heavily directed toward participation in ESA (Belgium now 4.1% and Luxembourg 0.3% listed in ESA's 2012 Space Budget). Finally, Norway has not changed significantly, its per capita space budget holding steady at $21.00, while Japan's per capita budget has decreased by 9.9%.[40] While some per capita space budgets have decreased (e.g. the U.S. France, the U.K., Canada, Japan, Spain, and South Korea) this does not necessarily indicate a trend across the board; the majority of states have experienced an uptick in per capita space funding since 2010 (including Russia, Germany, China, India, Italy, Luxembourg, Belgium). Authoritative sources conflict on the situation in India and China due in part to their socio-economic characteristics.

[39] 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.
[40] Space Report 2012...: 55.

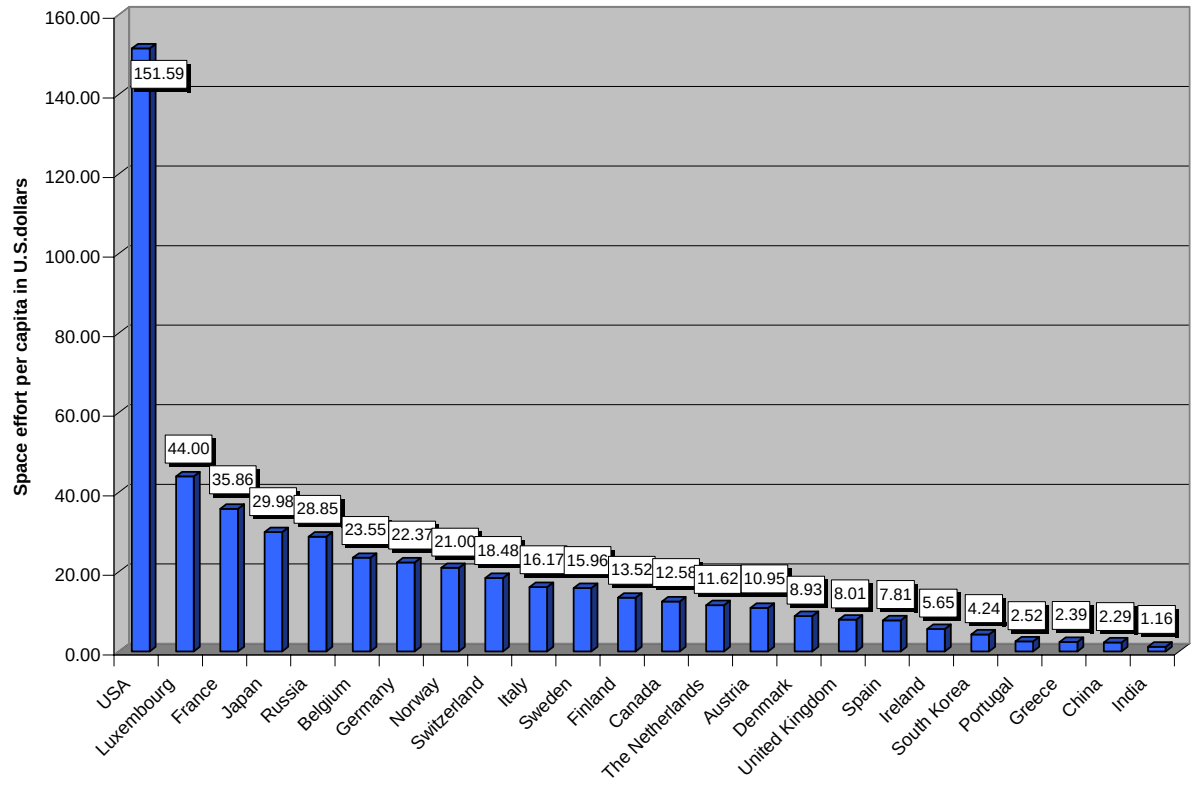

Figure 2.3: Public space budgets per capita (selection) in 2011
(Source: Space Report 2012,/Euroconsult/UN World Population Prospects)

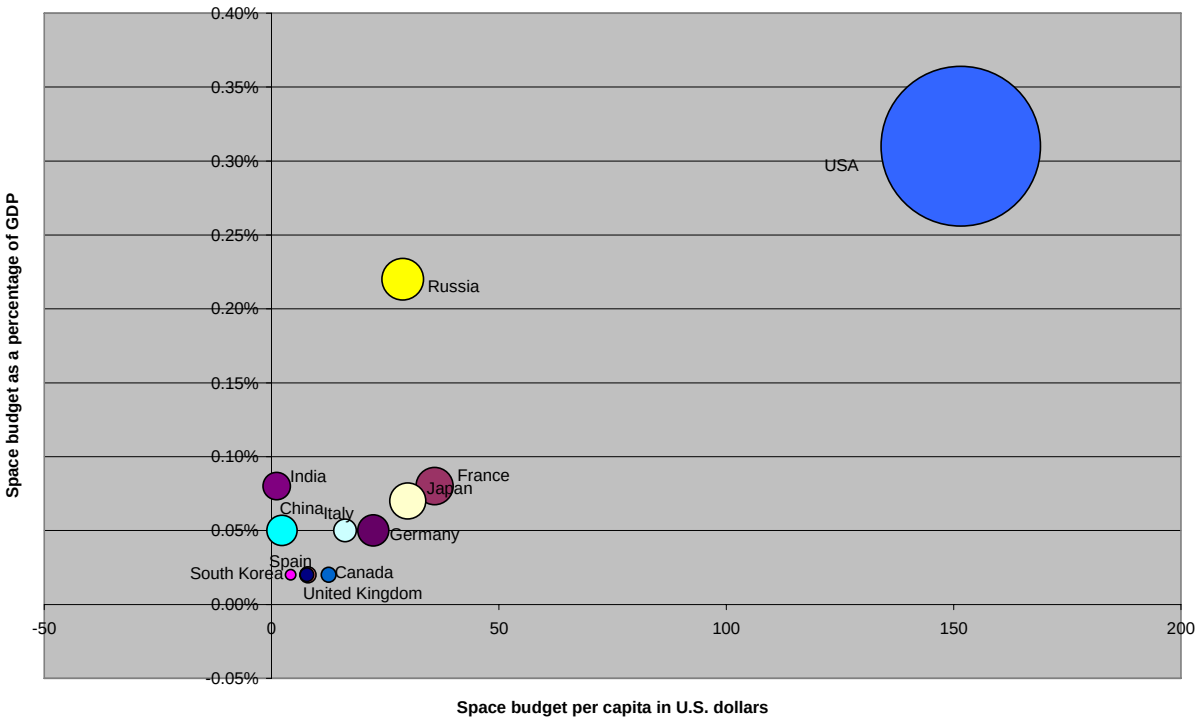

Figure 2.4: Public space budgets as share of GDP mapped against space budgets per capita in 2011. The bubble size indicates the absolute space budget (Based on Space Report 2012 and Euroconsult data)

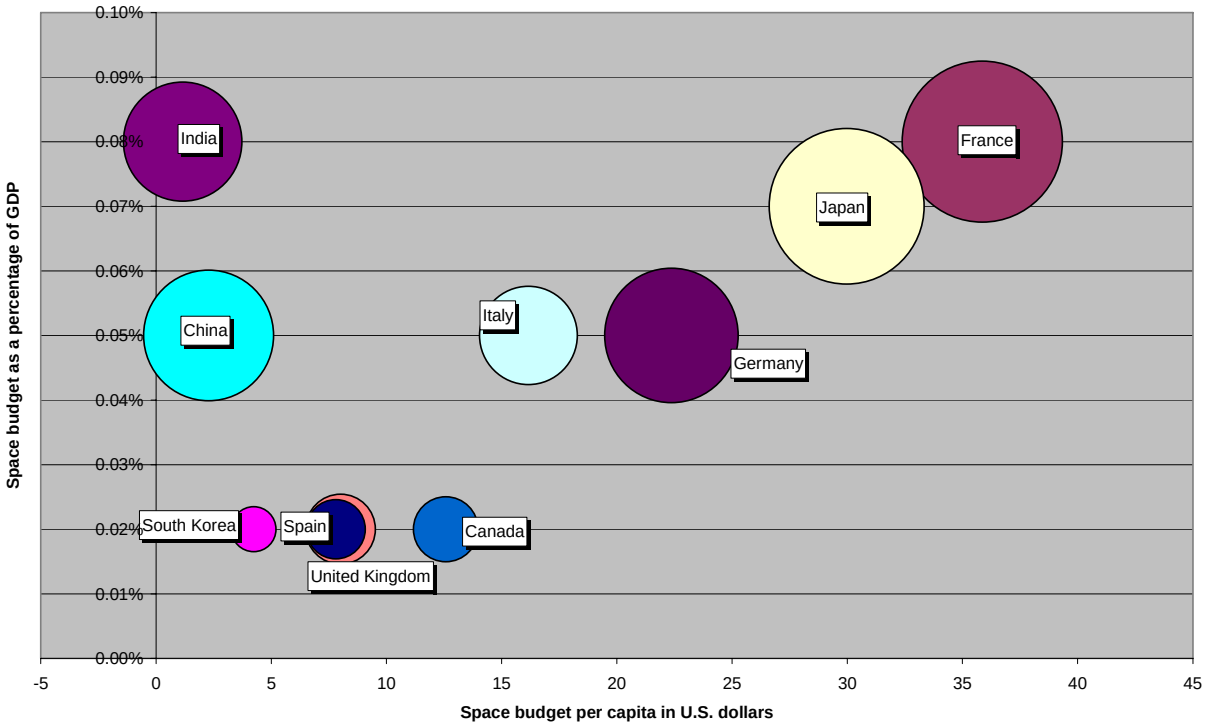

Figure 2.5: Public space budgets as a share of GDP mapped against space budgets per capita in 2011, not including the U.S. and Russia. The bubble size indicates the absolute space budget (Based on Space Report 2012 and Euroconsult data)

The GDP share of public space funds against the public space funds per capita can be compared among states involved in space funding. This is presented in figures 2.4 and 2.5, with the latter excluding the United States and Russia to display the other countries more clearly. The U.S. continues to excel by a significant margin in both the public space fund share of GDP and space budget per capita axes. France still holds second position in space budget per capita, while Russia has been surpassed by Japan for third place. It should be noted that some latitude is needed when considering the latter two due to the uncertainty of reported values. Additionally, Russia has maintained its second place position on the space budget as a percentage of GDP axis, with a large amount of its GDP directed to space activity, even if the space budget per capita falls significantly behind the United States. Germany now leads the majority of second level space powers namely Canada, Italy, UK, Spain, and South Korea which display comparable values on both axes. China and India have maintained their singular positions with a large part of their GDP spent on space activity but with space budgets per capita lagging behind the others. This situation is mainly a consequence of their large populations in comparison to the other nations included in these figures.

2.3 Overview of Commercial Space Markets

In 2011, total industry revenue, counting revenue from satellite services, satellite manufacturing, launch industry, and ground equipment are expected to have exceeded the Satellite Industry Association's (SIA) figure of $168.1 billion for 2010.[41] In fact, the Space Report 2012 reported that the total commercial space revenue amounted to $216.99 billion in 2011.[42] However, it must be clarified that these sources appear not to use the same methodology when making their assessments. In fact, revenue growth may have been low for 2011, as SIA reports that the growth of total revenue for 2010 fell short of the 2009 average of 11%, eking out 5% for 2010.[43] It is out of the question that revenue could have increased by almost $50 billion in 2011, as could be implied by a juxtaposition of the figures of the Space Report and those of SIA. The following section presents key figures and data on commercial space activities divided by field of activity, based primarily on available SIA figures in addition to Futron reports.

[41] State of the Satellite Industry Report". August 2011. Satellite Industry Association and Futron Corp 24 Apr. 2012 <http://www.sia.org/PDF/2011_State_of_Satellite_Industry_Report_(August%202011).pdf>.
[42] Space Report 2012: 32.
[43] State of the Satellite Industry Report…: 10.

2.3.1 Satellite Services

In 2011 and 2012, the satellite services industry continued to function with remarkable resilience in view of the adverse global financial conditions. The industry's upward trend is credited to its inherently global nature, allowing it to profit from the quick economic recovery of emerging markets (e.g. in South East Asia and South America regions). Continued demand from emerging economies and developing regions allowed for a sustained expansion of satellite capacity and corporate revenue. Worldwide satellite capacity rose above 900 36 MHZ transponder equivalents in 2011.[44]

The industry continues to expand its technology development programmes with further investments through the ordering or launch of larger spacecraft with enhanced signal power and transponder capacity. The industry demonstrates an acute ability to achieve the right mixture of investing in innovating technologies and new services on the one hand, while consolidating current operations on the other, which has boosted the industry's revenue for one more consecutive year.[45]

Despite the apparent slowing of growth within the satellite industry, satellite services have maintained a consistent share portion among the other segments, including satellite manufacturing, launch services, and ground equipment; balancing at 60% in 2010, the average since 2006. In 2010, satellite services exceeded $101.3 billion, due mostly to the increase in direct to home (DTH) satellite services. However, the rate of revenue growth for satellite services has slightly decreased, experiencing 9% growth in 2010, whereas it experienced 11% growth in 2009.[46]

Satellite services can further be deconstructed into component parts, including consumer services (e.g. satellite television (DTH/DBS), satellite radio (DARS), and consumer satellite broadband), fixed satellite services (e.g. transponder agreements, and managed services), as well as mobile services (voice and data), and remote sensing. The following is a breakdown of the industry's key developments and trends, according to the nature of the services provided.

Consumer Services

As mentioned above, consumer services are made up of satellite television, radio, and broadband services. Direct Broadcast Services (DBS) refer to direct-to-home satellite television. This section of the industry showed considerable development in 2010 and 2011, fuelled by the quantitative expansion in emerging markets and the qualitative increase in new technologies and services in developed ones. Demand in the latter manifested signs of recovery compared to the relatively flat revenue in 2010. In 2010 DBS revenue increased from $71.8 billion to $79.1 billion, an increase of 10.2%. This trend was expected to continue into 2011 as the number of HDTV channels has been growing exponentially (e.g. by 42% between 2009 and 2010).[47] By 2010, consumer satellite television services represented nearly 80% of total satellite services revenue, with more than 70% of the available HDTV channels servicing the Americas, and the remainder servicing Europe and Asia. Meanwhile, according to previous projections, the annual growth rate of DBS is expected to exceed that of the rest of the satellite services' sector as DBS will be replacing more traditional services such as video distribution.[48] By 2011, in the U.S. there were over 35 million satellite pay TV subscribers. Satellite radio revenue grew to 2.8 billion in 2010, from $2.5 billion the previous year (an increase of 12%), while satellite broadband revenue grew by 10%, from $1.0 billion in 2009 to $1.1 billion in 2010.[49] And the majority of worldwide broadband satellite revenue came from the U.S., generating 70% thereof. All major satellite operators have increased their investments in new technologies and products, especially in developed markets.

Fixed Satellite Services

Fixed Satellite Services (FSS) refer to the use of spacecraft that utilise land terminals in fixed positions to broadcast. They include broadband internet, communications and network televisions and radio broadcasts. In 2010 and 2011, the fixed satellite service (FSS) outlook remained buoyant, as operators continued to profit from previous investments in new capacity, as well as from the sustained demand for TV and broadband services.

While some reports anticipate a decrease in new satellite investment leading up to 2012-2013, the effect of the current boom in FSS is expected to continue throughout the decade. In 2010, industry-wide FSS revenue climbed 4.2% in 2010, to $15 billion; while an increase, that amount was

[44] Satellite Telecommunications Report – 2011 Year-End Summary. Futron: 1.
[45] See generally State of the Satellite Industry Report…
[46] Id.
[47] Id.
[48] 2010 Futron Forecast of Global Satellite Services Demand…: 3.
[49] Id.

significantly reduced from the 10.8% growth in 2009, amounting to $14.4 billion. The growth is explained by the insatiable demand for video and broadband, particularly from the Americas. Eutelsat revenue are a clear example of this upward trend with 2011 revenue that climbed to €1.168 billion ($1.558 billion) and EBITDA to €926.4 million ($1.236 billion). These were increases of 11.2% and 11.9% from the previous year's revenue of €1.05 billion and €827.8 million respectively.[50]

To handle the increase in demand, commercial operators invested in technological upgrades that let them meet the needs of consumers in the most profitable way. For that purpose, a number of Ka-band satellite projects for broadband connectivity were announced in 2010 and 2011. However, in the case of transponder agreement revenue, it expanded only slightly between 2009 to 2010, with growth in 2010 masked partly due to a stronger U.S. dollar.[51]

Eutelsat has begun providing commercial broadband service with its Ka-Sat satellite on 31 May 2011.[52] This satellite is the first of a fleet of high throughput satellites under development by Astrium Satellites; and approximately 44,000 Surfbeam 2 terminals were already sent to the Netherlands in anticipation of the demand for broadband capacity. Ka-Sat distributes its bandwidth through 82 spot beams, each carrying 900 megabits per second of capacity. These beams are evenly distributed among points in Europe, but with some points in Africa. However, the satellite lacks the onboard processing needed to maximize bandwidth and location flexibility. The coverage population is about 800 million; nearly three times that of its U.S. counterpart – ViaSat's WildBlue consumer broadband service. It is expected that European demand for Ka-Sat might be higher in suburbs than in rural areas, often the subject of government broadband stimulus programs.[53]

Remote Sensing

Remote sensing refers to commercial companies that provide optical and radar images to the open market; however, they are mostly used by government entities that have been increasingly outsourcing such capabilities over the past few years. With a considerable 37% increase in 2009, commercial remote sensing revenue managed to reach the $1 billion benchmark in that year. However, remote sensing revenue experienced little growth in 2010, staying at that $1 billion value.[54] Government demand (particularly military demand) was the dominant factor boosting remote sensing services' providers' revenue; however the sector's private clients have been on the rise and contributed to the 2009 increase.

A total of 14 civilian remote sensing satellites were launched in 2011, an increase of 55.6% compared to the 9 remote sensing satellites launched the previous year (not including government-built, university-built, or research satellites).[55] Additionally, 8 military surveillance satellites were launched in 2011, an increase of 28.6% compared to 7 the year before. While both civilian and military remote sensing satellites experienced increases last year, it appears that the civil industry is growing at twice the rate as military, indicating a shift in where government funding is directed, and suggesting that states are looking more toward Public-Private Partnerships (PPPs) in this field.

Mobile Satellite Services

Mobile satellite services offer both mobile data service and mobile voice service (including satellite phones). In 2010, mobile satellite services earned revenue of $2.3 billion, an increase of 4.5% compared to $2.2 billion in the previous year. Within its segments, mobile voice services diminished by 9%, whereas mobile data services revenue increased by 10%. The latter segment comprises around 3/4 of all mobile satellite services revenue.[56]

In the U.S., opinions on the severity of LightSquared's interference with GPS signals shifted over the 2010–2011 period. LightSquared had developed plans to provide the U.S.'s first coast-to-coast hybrid wholesale wireless network. By June 2011, a six-month study conducted by the Technical Working Group of the National Public Safety Telecommunications Council confirmed that interference to public-safety operations would occur.[57] This finding was especially damning since the U.S. Federal Communications Commission (FCC) gave conditional approval to LightSquared to deploy up

[50] Eutelsat Communications. Reverence Document 2010-2011 Including The Annual Financial Report. Paris 2011 <http://www.eutelsat.com/investors/pdf/reference-document-1011.pdf>.
[51] State of the Satellite Industry Report…: 12.
[52] De Selding, Peter B. "Ka-Sat Enters Services as European Broadband Market Heats Up." Space News 6 June 2011: 16.
[53] Id.
[54] State of the Satellite Industry Report…:13.
[55] Id. at 16.
[56] Id. at 13.
[57] De Selding, Peter B. "LightSquared Suffers Setbacks on Two Fronts." Space News 20 June 2011: 5.

to 40,000 base stations if it could demonstrate that it would not cause widespread interference with GPS. LightSquared is licensed to use two specific 10–megahertz blocks within the L-band frequency range; however GPS signals are also transmitted using the L-Band spectrum.[58] The ground-based transmissions by the former overpower the generally weak GPS signals from space. The consequence of such interference could result in aviation users losing GPS capabilities around densely populated areas with stations spaced out 400 to 800 meters apart, and aircraft below 3,040 meters in altitude could not rely on GPS in some States. Additionally, police cars could not acquire GPS signals within 182 meters of a LightSquared tower that broadcasts at 15 kilowatts.[59] Out of the various mitigation options considered, the only viable option would be for LightSquared to acquire rights to another part of the electromagnetic spectrum.[60] Of note, LightSquared closed a $586 million additional loan to help fund the $7 billion project[61].

2.3.2 Satellite Manufacturing

While satellite manufacturing revenue in 2011 are uncertain, they have not varied significantly from the previous levels in 2010 and 2009. The total revenue of satellite manufacturers that have built satellites both for governmental and commercial launches was estimated to have reached $14.5 billion in 2010; however, in fact it only reached $10.8 billion indicating a decrease of 20% (instead of the 7% increase) from the $13.5 billion in 2009.[62] Hence, Figure 2.6 depicts a trend of decreased manufacturing revenue peppered with periods of increased revenue as in 2009 and 2006. It should be noted that despite the waning trend of revenue exhibited in Figure 2.6, actual predictions forecast a regular increase of the revenue to reach $15 billion in 2013.[63]

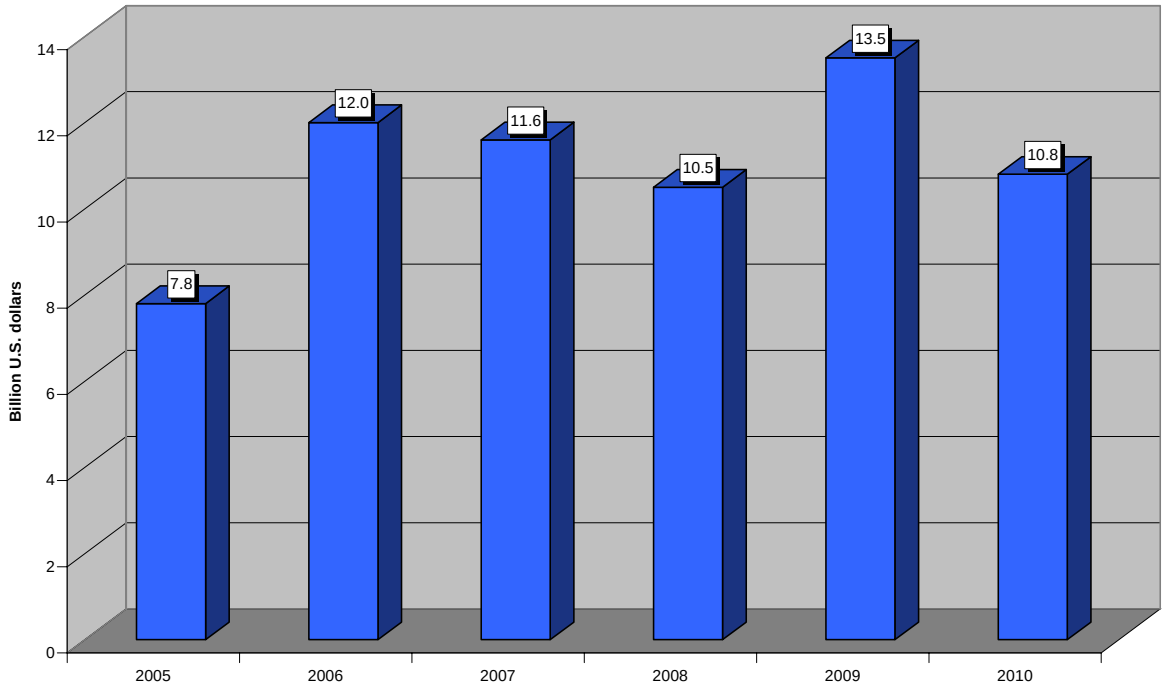

Figure 2.6: World satellite manufacturing revenue (Source: SIA/Futron/Space Foundation)

2.3.3 Launch Sector

The year 2011 ushered in a total of 18 commercial launches (one commercial launch failed), with the objective of carrying 41 payloads into orbit, out of which 35 provided commercial services. While U.S. companies did not conduct any commercial launches, Russian companies again held the lion's share with a total of 10 launches composing 55.6% of the total commercial launches. Moreover, there were 4 European launches at 22.2%, and China had 2 commercial launches at 11.1%,

[58] Leone, Dan. "LightSquared Says Altered Plan Would Limit GPS Disruption." Space News 27 June 2011: 14.
[59] Brinton, Turner. "Reports: LightSquared Plan Poses Unacceptable Risk to GPS Service." Space News 13 June 2011: 1.
[60] Id. at 4.
[61] Warwick, Graham and Taverna, Michael A. "Tests Planned On Cell-Phone Jamming Of GPS." Aviation Week & Space Technology 28 Feb 2011: 48.
[62] State of the Satellite Industry Report…: 15.
[63] 2010 Futron Forecast of Global Satellite Services Demand: Executive Summary…

as did the multinational Sea Launch AG. The revenue from the 18 launches amounted to an estimated $1.9 billion, a decrease of 21.7% or $526 million from the previous year, and below 2009 revenue by $483 million. Due to the absence of U.S. commercial launches, where $307 million was generated in 2010, no U.S. commercial revenue was generated in 2011. European revenue was once again the highest reaching $880 million (a 33.3% decrease from last year), followed by Russian commercial launch revenue at approximately $707 million (a decrease of 14.4%). Multinational revenue took the next position, generating approximately $200 million, and Chinese revenue amounted to around $140 million. The 21.7% drop in the industry revenue was a result of the decrease in net profits by all commercial launch service providers (not including Chinese or multinational commercial launches in 2011). However, these figures should only be considered as indicative of the sector as they do not depict current commercial launch contracts because contracts are typically prepaid one to two years prior to launch; instead they take into account the value of the past year's activity.[64]

Looking at European Launch activities in total, i.e. commercial and non-commercial, Arianespace expected a 10% increase in revenue for 2011 compared with 2010, marking a slight profit after two years of losses.[65] In 2010, Arianespace earned €897 million ($1.197 billion), resulting in a loss of €83 million ($110.7 million) in revenue. Thanks in part to the introduction of the Soyuz 2 in Kourou, Arianespace was able to avert loss for the third year in a row, making a small profit on revenue of €985 million ($1.275 billion). Four European launches were carried out by Arianespace onboard the Ariane 5 ECA launcher. Europe's Ariane 5 ES-ATV launcher made its second flight in February 2011, the maiden flight having been conducted in March 2008. This past launch carried the second ATV, Johannes Kepler, to the international space station, with three more missions planned in the coming years. The ATV-3, Edoardo Amaldi, launched on 23 March 2012,[66] with upcoming ATV missions including the Albert Einstein in 2013, with the final ATV-5 scheduled in 2014.[67] Europe's spaceport in Kourou was outfitted to launch the Soyuz spacecraft in 2011. In that year, Arianespace launched 2 Soyuz 2 spacecraft, designated as Soyuz-ST. While marking a milestone in cooperation between Europe and Russia, this decision to develop the spaceport's launch infrastructure to launch the Soyuz benefitted both Europe and Russia, enhancing the competitiveness and flexibility of the launch systems available at the spaceport. Moreover, the Soyuz-ST launched the first pair of satellites for Europe's Galileo global navigation satellite system in October 2011; another hallmark of European and Russian commercial cooperation.[68] Europe's Vega Launcher made its debut launch on 13 February 2012. Vega can carry a 1,500 kg satellite into a 700-kilometer orbit, This small satellite launcher will be priced commercially at around €32 million ($42 million) per launch, and is expected to be price-competitive with converted Russian ballistic missiles; and if sufficient market demand exists, the price may drop to €22 million ($28.5 million).[69]

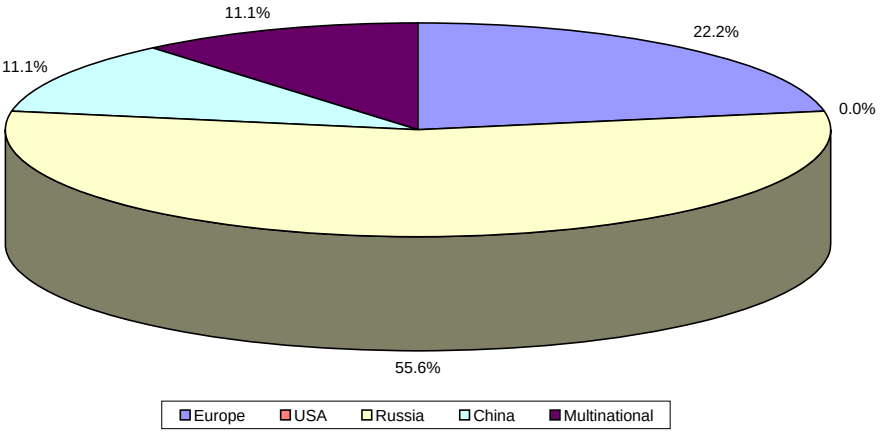

Figure 2.7: Commercial Launch Activity by Country in 2011 (Source: FAA)

[64] Federal Aviation Administration. Commercial Space transportation: 2011 Year in Review. Washington DC: FAA, Jan. 2012: 5.
[65] De Selding, Peter B. "Arianespace Expects To Post 2011 Profit After 2 Years of Losses." 5 Jan. 2012. Space News 24 Apr. 2012 <http://www.spacenews.com/launch/120105-arianespace-expects-profit.html>.
[66] "ATV-3 launch." 23 Mar. 2012. ESA News 22 May 2012 <http://www.esa.int/esaCP/SEM9UR2T00H_index_0.html>.
[67] "Ariane 5 ES." ESA Launch Vehicles. 24 Apr. 2012 <http://www.esa.int/esaMI/Launchers_Access_to_Space/SEM20W67ESD_0.html>.
[68] "One Soyuz Launcher, Two Galileo Satellites, Three Successes for Europe." 21 Oct. 2011. ESA - News. 24 Apr. 2012 <http://www.esa.int/esaCP/SEM167GURTG_index_0.html>
[69] De Selding, Peter B. "Vega Expected to be Price-competitive With Russian Rockets." 23 Jan. 2012. Space News 23 May 2012 <http://www.spacenews.com/launch/012312-vega-expected-price-competitive-with-russian-rockets.html>.

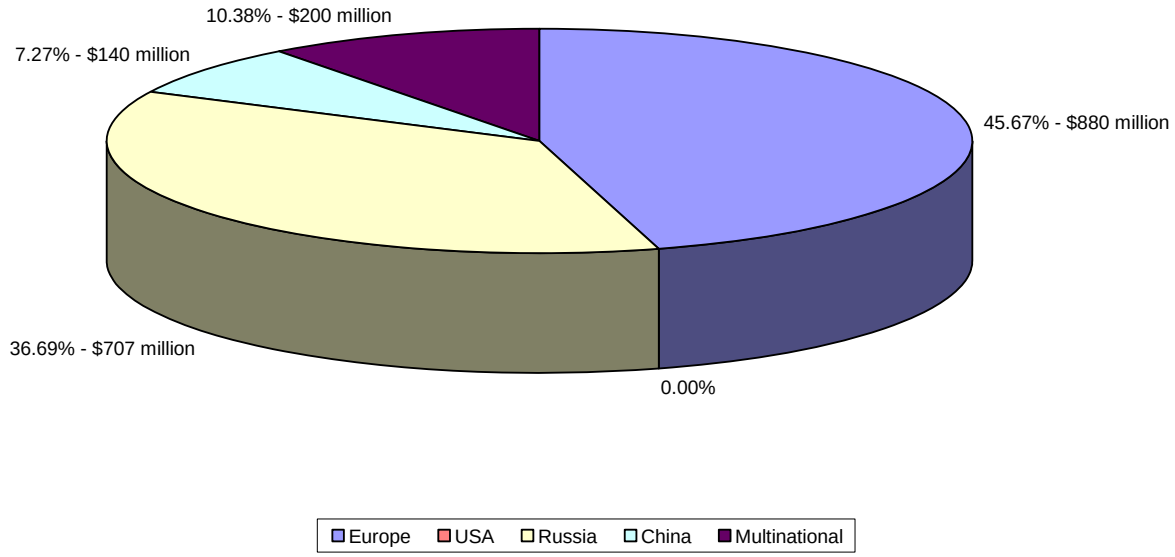

Figure 2.8: Commercial Launch Revenues by Country in 2011 (Source: FAA)

2.3.4 Ground Equipment

Ground equipment revenue 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.

The PND market continued its expansion while still slowing down in comparison to 2008. The sharp increase of 34% experienced in 2008 continued to fall below the 8% growth reached in 2009 to the rate of 3% in 2010 with a consolidated global turnover of $51.6 billion.[70] In 2010, ground equipment represented 31% of world space business revenue maintaining its 3% rate of growth in the global distribution of the past year; it experienced slower growth in consumer equipment, while also experiencing accelerated growth in network equipment.[71]

The 2011 revenue profiles for the two companies leading the market parted ways. In 2010, TomTom announced its total revenue to be €1.521 billion ($2.016 billion), which decreased in 2011 to €1.273 billion ($1.648 billion);[72] with total revenue diminishing by 16.3%. On the other hand, Garmin has moderately rebounded from its 9.6% drop in total revenue to $2.69 billion in 2010, rising to a total revenue of $2.76 billion (an increase of 2.6%) in 2011.[73]

To better understand these figures, they can be divided into types of product and sale areas. Revenue in Garmin's automotive/mobile products in 2011 continued to decline to $1.591 billion from $1.669 billion in 2010; however, its 2011 segments related to marine, aviation and outdoor fitness either grew or stayed on par with 2010 resulting in steady growth. Meanwhile, TomTom increased its revenue in automotive systems by 31.3% during the same period with global revenue of €235 million ($304.3 million) from €179 million ($237.20 million) in 2010. Geographically speaking, the growth of Garmin's sales in Asia have slowed down compared to the 47% increase in 2010; in 2011, the revenue in Asia increased by only 12.5% to $248.06 million from $220.49 million in 2010. Moreover, Garmin continued to lose revenue in the Americas, losing an additional 7.2% in 2011, after losing an additional 16.52% in the year prior; i.e. 2011 revenue amounted to $1.527 billion in 2011 whereas it was at $1.646 billion in 2010, and $1.972 billion in 2009. On the other hand, revenue in Europe increased by 19.5% to $983 million in 2011, after holding steady at

[70] State of Satellite Industry Report…: 8.
[71] Id. at 9.
[72] "TomTom Annual Report and Accounts 2011." TomTom 24 Apr. 2012. <http://files.shareholder.com/downloads/TOMTOM/1821069808x0x552704/24dcadbf-4781-4f88-81cc-84172c34e85e/Tomtom_JV2011.pdf>.
[73] "Garmin Annual Report 2011." 24 Apr. 2011. <http://www8.garmin.com/aboutGarmin/invRelations/reports/2011_Annual_Report.pdf>.

around $823 million in the two previous years.[74] TomTom was even less successful than its counterpart in North America with a decrease of 32.6% in 2011, following the 7.54% decrease in sales in 2010. Earning €256.6 million ($332.26 million) in 2011, down from €380.5 million ($504.22 million) in 2010, TomTom has experienced a loss in revenue of €123.9 million. TomTom's revenue in Europe also decreased 12.4%, from €1.07 billion ($1.42 billion) to €937.5 million ($1.21 billion). This loss in revenue followed an increase of 6.26% in 2010. The rest of the world was the only sector that appeared to experience an increase in revenue at a growth rate of 12.3%, earning €79.1 million ($102.42 million), up from €70.5 million ($93.42 million) in 2010; this increase in revenue is in addition to the 12.9% increase experienced in 2010.[75] While revenue growth in the Americas seems to be tapering off, Europe is in a state of flux between PND providers, with the most growth occurring in the Asia Pacific market.

	Total Revenue	**2010**	**2011**
TomTom		€1.521 billion ($2.016 billion)	€1.273 billion ($1.648 billion)
Garmin		$2.69 billion	$2.76 billion
	Products		
TomTom	Automotive Systems	€179 million ($237.20 million)	€235 million ($304.3 million)
Garmin	Automotive / Mobile	$1.669 billion	$1.591 billion
	Geographical Sales		
TomTom	Europe	€1.07 billion ($1.42 billion)	€937.5 million ($1.21 billion)
	North America	€380.5 million ($504.22 million)	€256.6 million ($332.26 million)
	Rest of World	€70.5 million ($93.42 million)	€79.1 million ($102.42 million)
Garmin	Europe	$822.84 million *($824.07 million in 2009)*	$983.00 million
	Americas	$1.646 billion *($1.972 billion in 2009)*	$1.527 billion
	Asia	$220.49 million *($149.92 million in 2009)*	$248.06 million

Table 2.1 Understanding TomTom & Garmin variables

2.3.5 Insurance Sector

Insurance costs have steadily decreased as the space industry has continued to demonstrate increased hardware reliability, low accident rates and promising growth in recent years.[76] More competition results from a safer market, which results in a change in consumer behaviour as well. Insurance is now procured two or three years before the launch of a spacecraft for the purpose of reducing the price. The coverage rates for space insurance have continued to decrease throughout the 2000's resulting in the withdrawal of actors from this market. This has led some insurers to be alarmed as to the fragile market that results from the lower premiums and fewer market actors. With annual premiums for satellite insurance policies averaging between $800 to $900 million for the past several years, the double payload capacity of the Ariane 5 ECA has insurers nervous. In 2011, an Ariane 5 carried two satellites in a single launch, whose combined insurance was more than $700 million, over 80% of the total premium revenue for the year. Had that launch failed, it

[74] "Garmin Ltd. Form 10-K for Period Ending 12/31/2011." 24 Apr. 2012 <http://www8.garmin.com/aboutGarmin/invRelations/reports/xbrl/Fourth_Qtr_2011_view/index.htm>.
[75] TomTom Annual Report and Accounts 2011…: 54.
[76] De Selding, Peter B. "Insurance Premiums Stay Flat Despite W3B Satellite Failure." 20 May 2011. Space News 24 Apr. 2012 <http://www.spacenews.com/satellite_telecom/110520-insurance-premiums-flat.html>.

would have taken 80% of total premium revenue with one stroke.[77] Despite the risk, new underwriters keep entering the space insurance market expecting to make money on satellite coverage based on the recent track record. However, the decline in premiums, in addition to the potential fragility of the market has led some larger insurance brokers, e.g. London's Liberty Syndicate 4472 (associated with Lloyd's), to avoid launch coverage completely, focusing only on the less risky in-orbit policies. With very narrow profit margins based on the low rates, a loss of more than $1 billion in a single year will be very likely to drive up rates.[78] While the low rates experienced in the past decade are appealing and are expected to fall further, the consequences of a future launch failure would create an inverse response.

2.4 Sectoral Overview

2.4.1 Launch Sector

Despite its crucial importance for the satellite industry, the launch sector is an enabler rather than a primary economic activity. The revenue it generates is far less significant than that originating from the satellite manufacturing and satellite services business.

The year 2011 experienced increased activity for the launch sector, with a total of 84 launches conducted by launch providers from Russia, the United States, Europe, China, India, Japan, Iran and the multinational Sea Launch AG (see Table 2.2). There were some important events, such as the 5 non-commercial launch failures, a Rockot launch carrying the Russian GEO IK-2 No.II payload in February; a Taurus XL launch carrying the Glory, Kysat I, Hermes and Explorer I (Prime) payloads in March; a Long March 2C carrying the Shijian II-04 in August; a Soyuz carrying the Progress M-12M also in August; a Zenit 2M carrying the Phobos-Grunt and Yinghuo payloads missions, failing after launch, in November; and a Soyuz-2 carrying the Meridian 5 payload in December. There was also one commercial launch failure, i.e. a Proton M carrying the Express AM4 payload in August. Four of these six launch failures resulted from Russian launches on three different launch vehicles.

When looking into specific countries, Russia was again the world leader in the number of launches, accounting for approximately 36.9% of the total number. It was followed by China at 22.6%, the United States at 21.4%, Europe at 8.3%, India at 3.6%, Japan at 3.6%, Iran with one launch at 1.2%, and the Multinational Sea Launch AG at 2.4% of the total launch figure (see Figure 2.8).[79]

Russia launched 31 vehicles using eight different launch system configurations. The U.S. used a set of 11 different launch configurations for a total of 18 launches, China conducted 19 launches using 7 configurations, and India used 1 launcher for its 3 launches. Europe used its Ariane 5 ECA and ES-ATV launchers in addition to its newly acquired Soyuz 2 launcher for its 7 launches (4 Ariane 5 ECA, 1 Ariane 5 ES-ATV, and 2 Soyuz 2 ST). Japan had 3 launches using its 2 launchers, while Iran used its one launcher for its single launch, and the multinational provider used 2 launch configurations for 2 launches. The total of different launch system configurations is now 35 for 2011, marking an increase of three compared to 2010.

The launch market has expanded from being shared between three actors in 2010, i.e. Russia, Europe, and U.S., to now include China, Japan, India, Iran and the Multinational participants (see Figure 2.9). However, it should be recalled that Europe's launcher Ariane 5 has the ability to carry two standard-size payloads.

[77] De Selding, Peter B. "Falling Satellite Insurance Premiums Put Market at Risk of Major Upheaval." 2 Mar. 2012. Space News 24 Apr. 2012 <http://spacenews.com/satellite_telecom/120302-falling-sat-insurance-premiums-market-risk.html>.
[78] Id.
[79] Commercial Space Transportation: 2011 Year in Review...: 3.

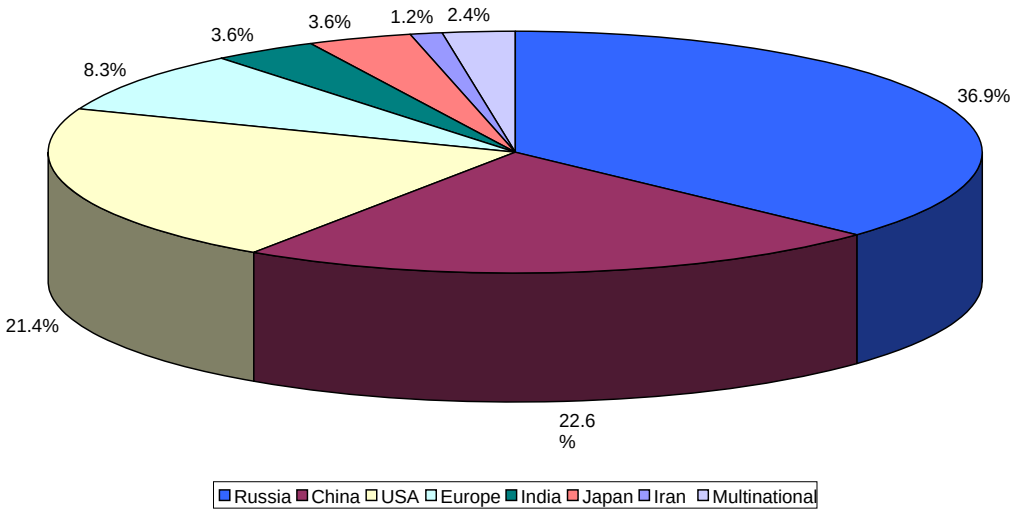

Figure 2.9: Worldwide launches by country in 2011 (Source: FAA)

Launchers	Number of launch systems	Total number of launches	Commercial launches	Non-Commercial launches
Russia	8	31	10	21
China	7	19	2	17
USA	11	18	0	18
Europe	3	7	4	3
India	1	3	0	3
Japan	2	3	0	3
Iran	1	1	0	1
Multinational	2	2	2	0
Total	**35**	**84**	**18**	**66**

Table 2.2: Worldwide launches in 2011 per country, number of launched systems, and commercial status (Source: FAA)

With the above payload consideration in mind, the activity of the two leaders of commercial launches (Europe and Russia) should be considered as nearly equivalent. When considering non-commercial launches, Russia's dominance is not quite apparent as it beats the U.S. by only 3 launches, and China by 4 launches. While Russia conducted 31.8% of non-commercial launches, the U.S. followed closely behind with a 27.3% share, along with China's 25.8% share.

The distribution between commercial and non-commercial payloads launched seems largely to have maintained equilibrium with the past year. The majority of non-commercial activity came from Russia, the U.S., and China. This is particularly true for China with its 17 non-commercial launches, a country that is rapidly developing its national programmes in remote sensing and navigation systems, as well as its own space station. Similarly, many of Russia's 53 payloads had non-commercial functions with 32 payloads destined to programmes such as the GLONASS system, ELISA, etc. U.S. commercial payloads are non-existent with zero launches in 2011 compared to its 28 non-commercial payloads, and also compared to the 3 commercial payload launches in 2010.

Regarding the global share of payloads launched in 2011 (see Figure 2.10), Russia takes first place once again, increasing its stake by 20.5% since 2010, with 53 payloads launched; representing 39.8% on the worldwide scale, virtually equal to its 40% share in 2010. The U.S. position was unchanged with 28 payloads and 21.1%, while China fortified its 3rd place position with 21 payloads amounting to 15.8%. Europe launched 17 payloads with a share of 12.8%, and India followed with 8 payloads, at a share of 6.0%. Next, Japan's 3 payloads amounted to 2.3%; the 2 Multinational payloads took a 1.5% share; and finally, Iran's 1 payload resulted in a 0.8% share. Thus, the hier-

archy of satellites launched between space powers has stayed roughly similar to 2010, with Iran and the Multinational payloads replacing Israel and South Korea.

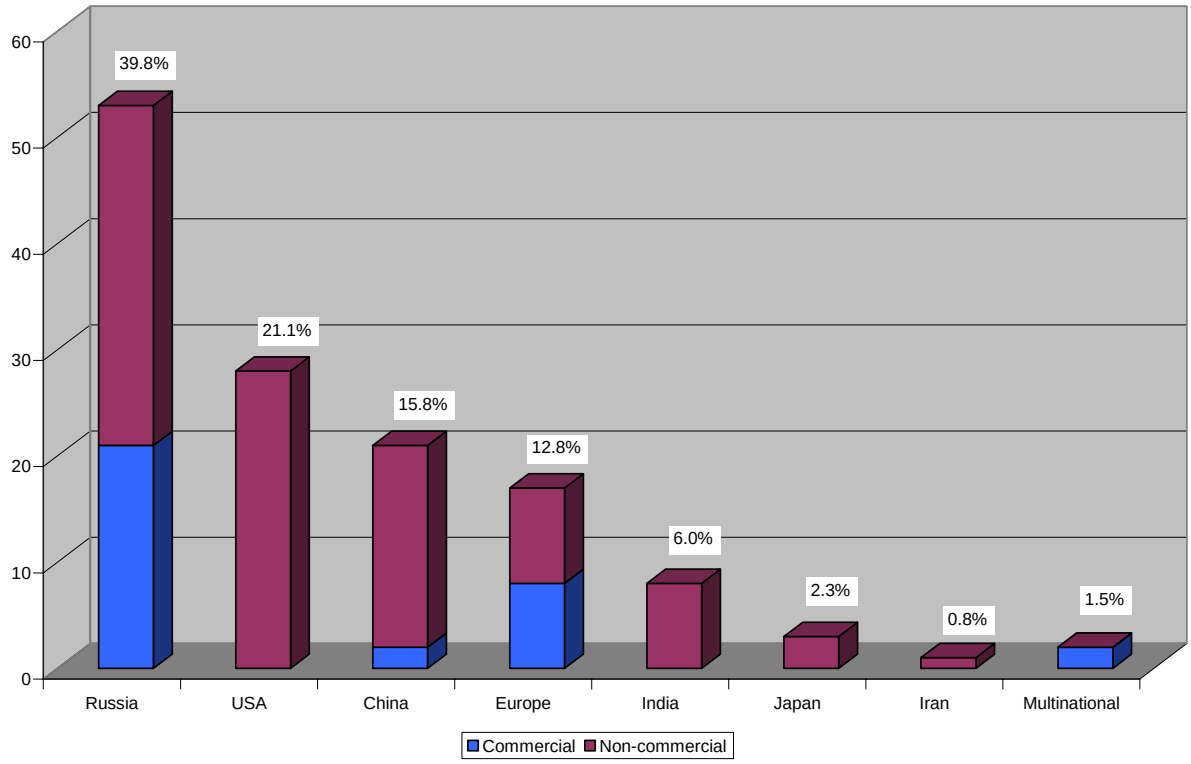

Figure 2.10: Total payloads launched in 2011 by country, share and commercial status (Source: FAA)

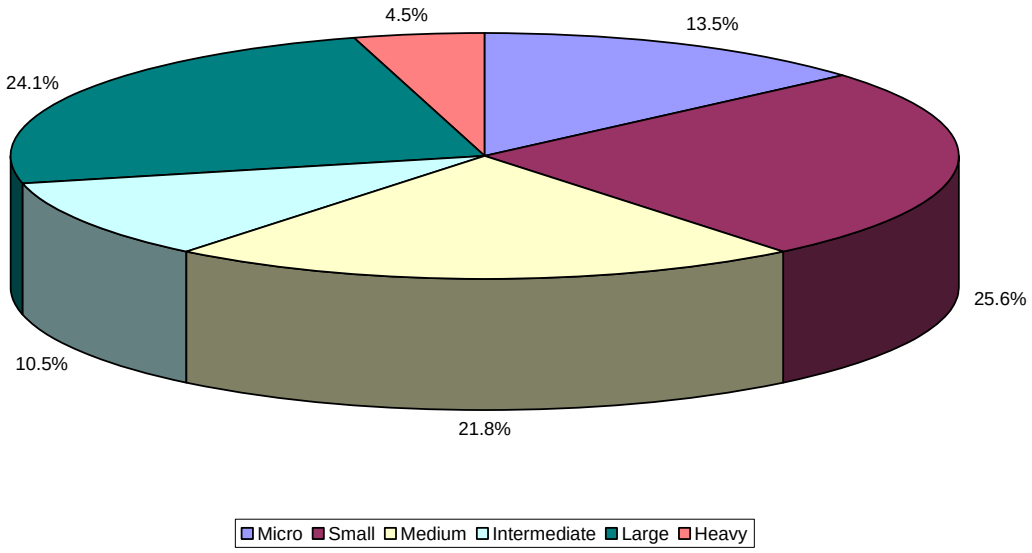

Figure 2.11: Distribution of the payloads launched in 2011 by mass class (Source: FAA)

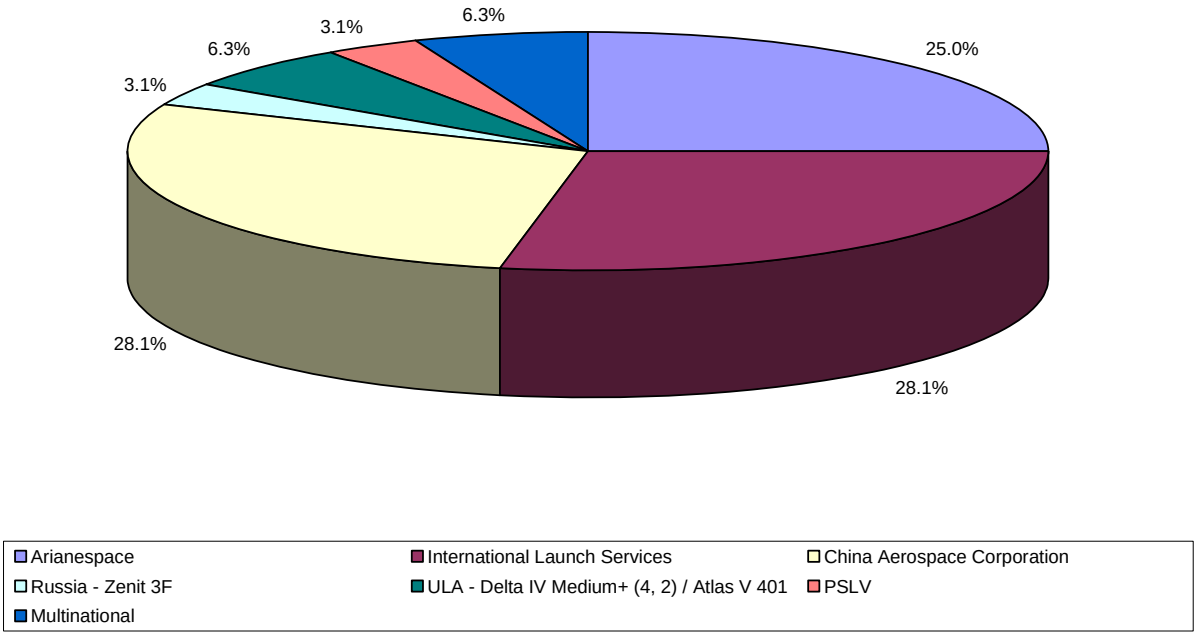

Figure 2.12: Share of launch contracts for GEO satellites in 2011 by launch service provider

Concerning the distribution of payload sizes, there were some noticeable changes compared to 2010. "Small" was the mode with 34 payloads at 25.6% (an increase of 7.5 percentage points relative to 2010), followed by 32 Large payloads at 24.1% (down 3.5 points), 29 Medium at 21.8% (up 7.1 points), 18 Micro at 13.5% (down 7.2 points), 14 Intermediate at 10.5% (down 3.3 points), and lastly, 6 Heavy payloads at 4.5% (down 0.7 points). Micro payloads have a mass of 91 kg or less, and are mainly science satellites, technological demonstrators or small communications satellites. Small payloads weigh between 92 and 907 kg and are very often Earth Observation satellites, similar to the Jason or the RapidEye series. Medium payloads weigh between 908 and 2268 kg, and 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, weighing between 2269 and 4536 kg, encompass medium satcoms and big scientific satellites. Large payloads, between 4537 and 9072 kg, refer to big satcoms, as well as to the Soyuz and Progress spacecrafts flying to the ISS. Finally, heavy payloads, exceeding 9072 kg, are linked to ISS activity, such as the cargo spacecrafts, ATV, etc.[80] In 2011, while there were 13 missions to the ISS, there was a decrease in the Heavy mass class payloads destined for the station.

In 2011, the number of actors in the market of launchers for GEO satellites increased significantly with the return of the China Aerospace Corporation, Sea Launch, and the addition of India's PSLV (see Figure 2.12). China Aerospace Corporation and the International Launch Services shared the top position, both obtaining 28.1% market share, followed by Arianespace with a 25.0% market share.[81]

Of Russia's commercial launches, International Launch Service launched a total of 9 satellites using seven Proton M vehicles. The International Space Company Kosmostras launched 8 satellites on one Dnepr into LEO and 12 Globalstar 2 satellites were deployed on two Soyuz 2 launchers. Europe launched 8 GEO communications satellites on four Ariane 5 ECA launchers. China carried 2 commercial payloads (Eutelsat 1R and NigComSat 1R) on two Long March launchers. And Sea Launch AG, the Multinational launch provider, commercially launched Atlantic Bird 7 and Intelsat 18 from two Zenit 3SL model launchers.

2.4.2 Manufacturing Sector

Looking at the market share of satellites launched and ordered in a given year provides a good indication of the vitality of domestic space industries, while also providing clues to global trends in the space industry.

[80] Commercial Space Transportation: 2011 Year in Review...: 32.
[81] Figure 2.12.

In 2011, 133 payloads were launched (including *inter alia* an estimate of 116 satellites, and 14 crewed or cargo missions to the ISS). Russia manufactured 39.8% of the launched payloads, while the U.S. made 21.1%, and China produced 15.8%. Europe accounted for 12.8% of the payloads launched, while India produced 6.0%, and Japan accounted for 2.3%. Iran and Multinational replaced Israel and South Korea producing 0.8% and 1.5% respectively.[82]

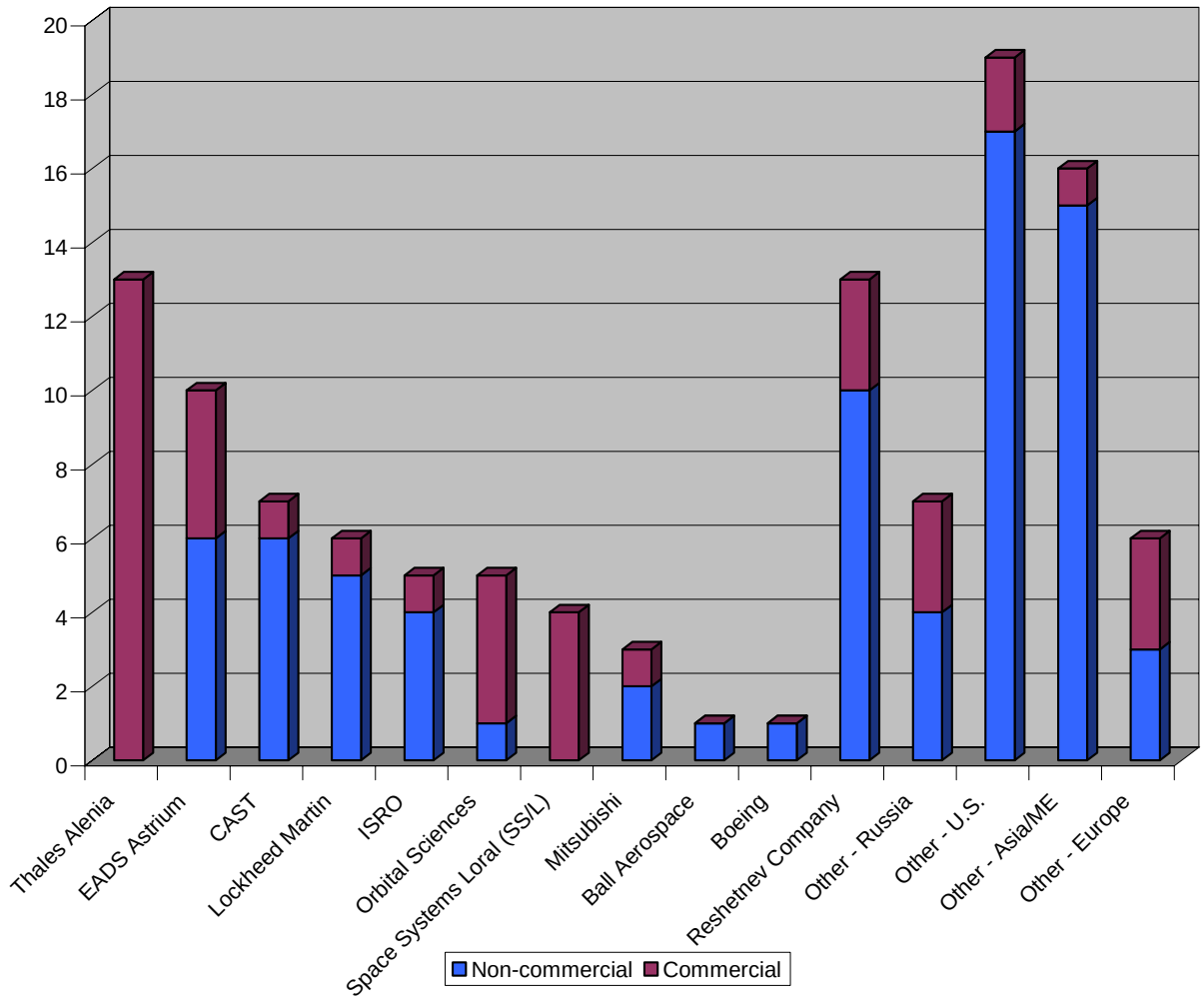

Figure 2.13: Satellites launched in 2011 by manufacturer and commercial status (Source: Futron)

To summarize (Figure 2.13), of the 116 satellites launched in 2011, 75 were non-commercial. The European satellite manufacturers Thales Alenia and EADS Astrium took the lead in manufacturing irrespective of whether the satellites were commercial or non-commercial with, respectively, 13 and 10 satellites launched confirming their strong share in this market. These figures result from the commercial orders these manufacturers receive unlike satellites developed by CAST (7 satellites launched), Lockheed Martin (6), ISRO (5), Mitsubishi (3), and Reshetnev Company (13), whose satellites have mainly non-commercial origins. The majority of satellites developed by Orbital Sciences (5) and Space Systems Loral (4) were commercial in nature. Finally, 6 of the 20 Russian satellites were designated for commercial activities, along with 1 commercial CAST satellite. [83]

Next, 27.6% of the 116 satellites launched in 2011 were GEO-stationary satellites (Figure 2.14).[84] In this field, 34.4% of the satellites came from the U.S. (4 by SS/L, 2 by Lockheed Martin, 4 by Orbital Sciences, and an additional satellite classified under Other – U.S.); while 15.6% were from Europe (1 by Thales Alenia Space and 4 by EADS Astrium); 18.8% from China (6 by CAST); 6.2% from India (2 by ISRO); 3.1% from both Japan (1 Mitsubishi) and Other – Asia/ME; and, 18.8% for Russia (4 Reshetnev Company, and 2 Other – Russia). In contrast, concerning the non-GEO orbit-

[82] Id. at 6. Payloads are assigned to the nation that commissioned them, not according to the nationality of the manufacturer.
[83] Id. at 22.
[84] Id.

ing satellites, Europe held a 28.6% share (12 Thales Alenia Space, 6 EADS Astrium, and 6 Other – Europe); Russia held 16.7% (9 Reshetnev Company, and 5 Other – Russia); China held 1.2% (1 CAST); India held 3.6% (3 by ISRO); Japan held 2.4% (2 Mitsubishi), while Other – Asia/ME held a 17.9% share with 15 non-geo satellites. Yet, the U.S. developed the majority of non-GEO-stationary satellites in 2011 with a share of 29.8% (4 by Lockheed Martin, 1 by Orbital Sciences, 1 by Ball Aerospace, 1 by Boeing, and 18 additional satellites classified under Other – U.S.). The strong influence of national programmes remained in 2011, considering the GLONASS constellation completion in MEO or Beidou navigation system in GEO.

Lacklustre demand for commercial GEO-stationary satellites continued in 2011, with 23 orders, even less than the 26 contracts awarded in 2010. Eleven manufacturers were represented in this market, an increase from the 8 in 2010. The U.S. company, Boeing had no contracts, while Lockheed Martin won 1, and SS/L was awarded 6 GEO satellites contracts. Thales Alenia and EADS Astrium garnered respectively 1 and 5 contracts (Figure 2.15).

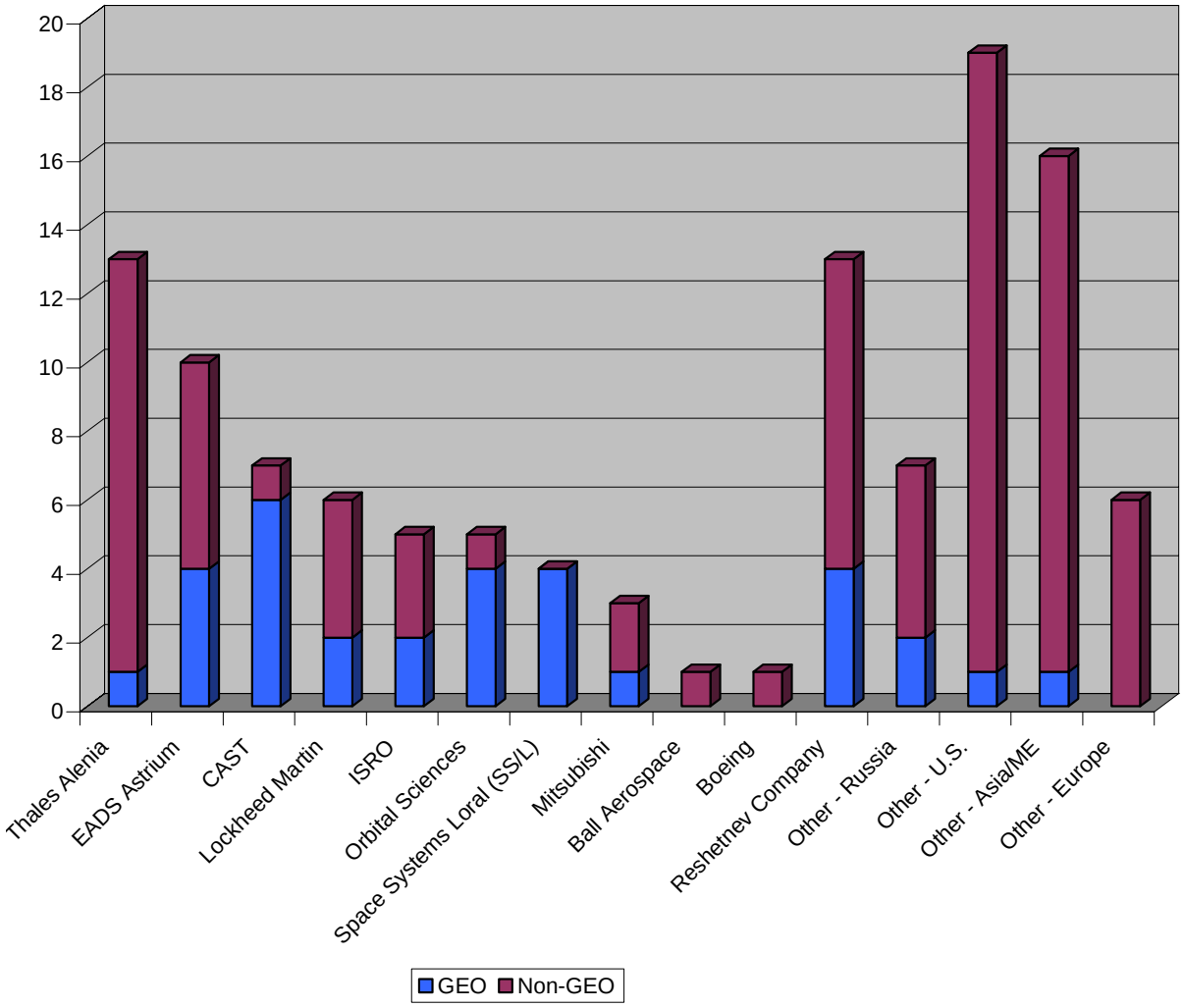

Figure 2.14: Satellites launched in 2011 by manufacturer and orbit type (Source: Futron)

The ISS-Reshetnev took 1 satellite order (KazSat 3), whereas its U.S. counterpart Orbital Sciences took 2 satellite orders (SES 8, Thaicom 6); Mitsubishi took 2 satellite orders as well (Türksat 4A, 4B). ISRO is still in the market with 1 satellite ordered (GSAT 14). The core of the competition is thus between U.S. companies with a total of 39.1% of the contracts awarded (9 contracts total) against 26.1% for European ones (6 contracts total). China trails is in third place with 3 satellite orders (Belarus Sat 1; Chinasat 11, Chinasat 13), a share of 13.4%.[85]

[85] "Satellite Orders Report - 2011 Year-End Summary." Futron 15 May 2012 <http://www.futron.com/upload/wysiwyg/Resources/FoF/2011/FutronSM2011-EOY.pdf>.

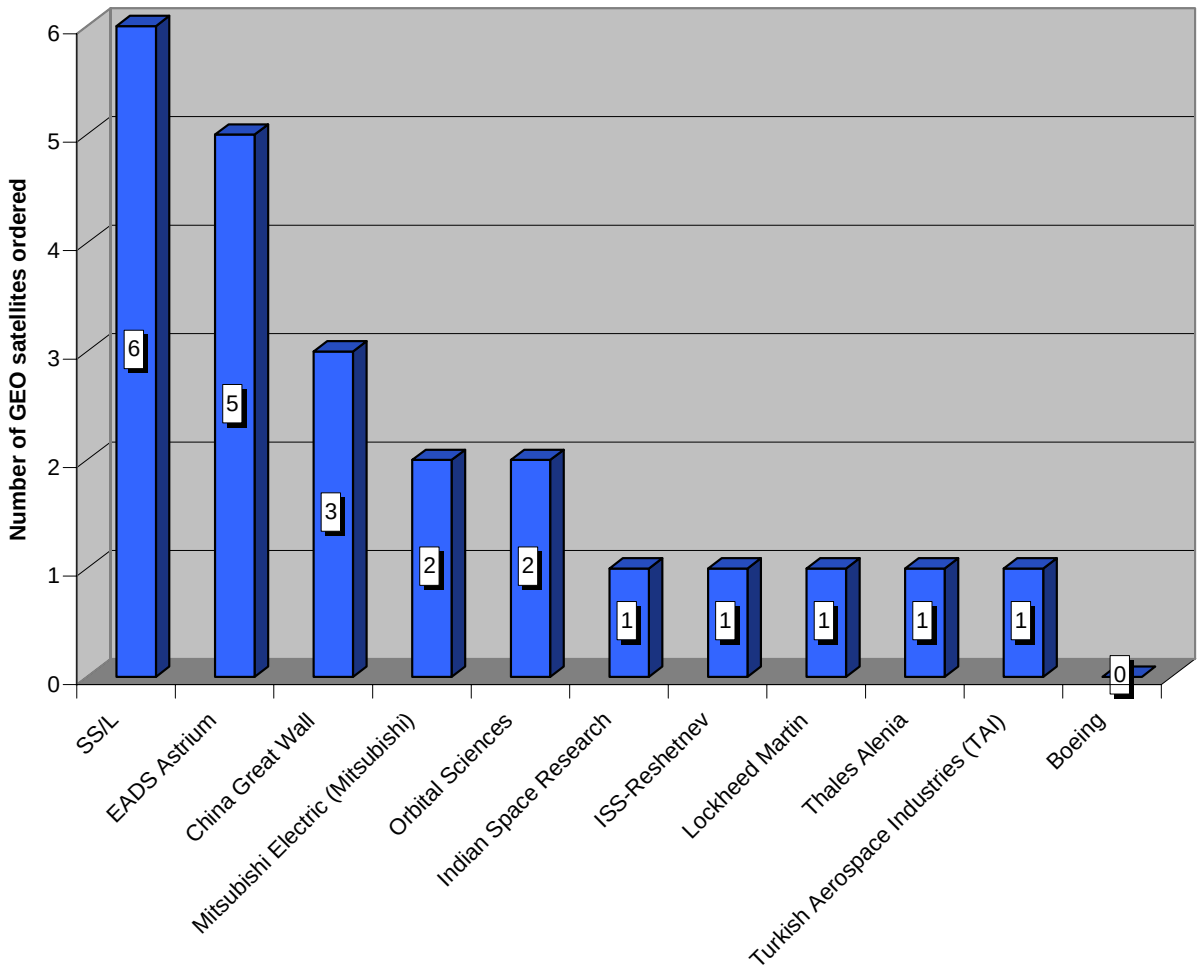

Figure 2.15: GEO satellite orders in 2011 by manufacturer

2.5 International Sectoral Comparison

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

2.5.1 Launch Sector

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

Whereas a total of 84 orbital launches was carried out by eight countries in 2011 (Figure 2.16), there was a total of 74 orbital launches in 2010. The rank order is similar to 2010, with Russia taking the lead again with 31 launches. China edged ahead of the U.S. for the second position with 19 launches; the U.S. conducted 18 launches; and Europe held the fourth position with 7 launches.

Indeed China had a busy year concerning space activities with the development of its national programmes e.g. Beidou for navigation and Yaogan for remote sensing.[86] India and Japan both conducted 3 launches, while Iran successfully launched its own payload, and Multinational had 2 launches. The trend remained consistent with the previous year, especially between China and the

[86] SpaceRef. “China Accelerates Military Space Program.” 9 Mar. 2011. Space News 24 Apr. 2012 <http://www.spacenews.com/commentaries/110309-fromwires-china-accelerates-military-space.html>.

U.S., where Chinese activity continued to grow while the U.S. launches stagnated for the second year, with a rate significantly lower than its 24 launches in 2009.[87]

The number of missions provides a perspective that is particularly interesting and useful for a complete picture of the launches in 2011 (Figure 2.17). The number of missions increased in 2011 from 110 payloads to 133. The range and hierarchy of the number of missions launched was similar to previous cycles. The U.S. undertook a total of 43 missions (a share of 32.3% of the total missions launched), followed by Russia with 28 (21.1%), and China with 21 (15.8%). France and India moved past Japan in missions in 2011, with values of 8 (6.0%) and 5 (3.8%); while Japan at 4 (3.0%) appears to have lost steam, conducting just half the amount of missions of 2010. ESA conducted 3 (2.3%) missions in 2011. The U.S., Russia, and China were well ahead compared to the other states involved, and they made up 69.2% of the total amount of missions for 2011.

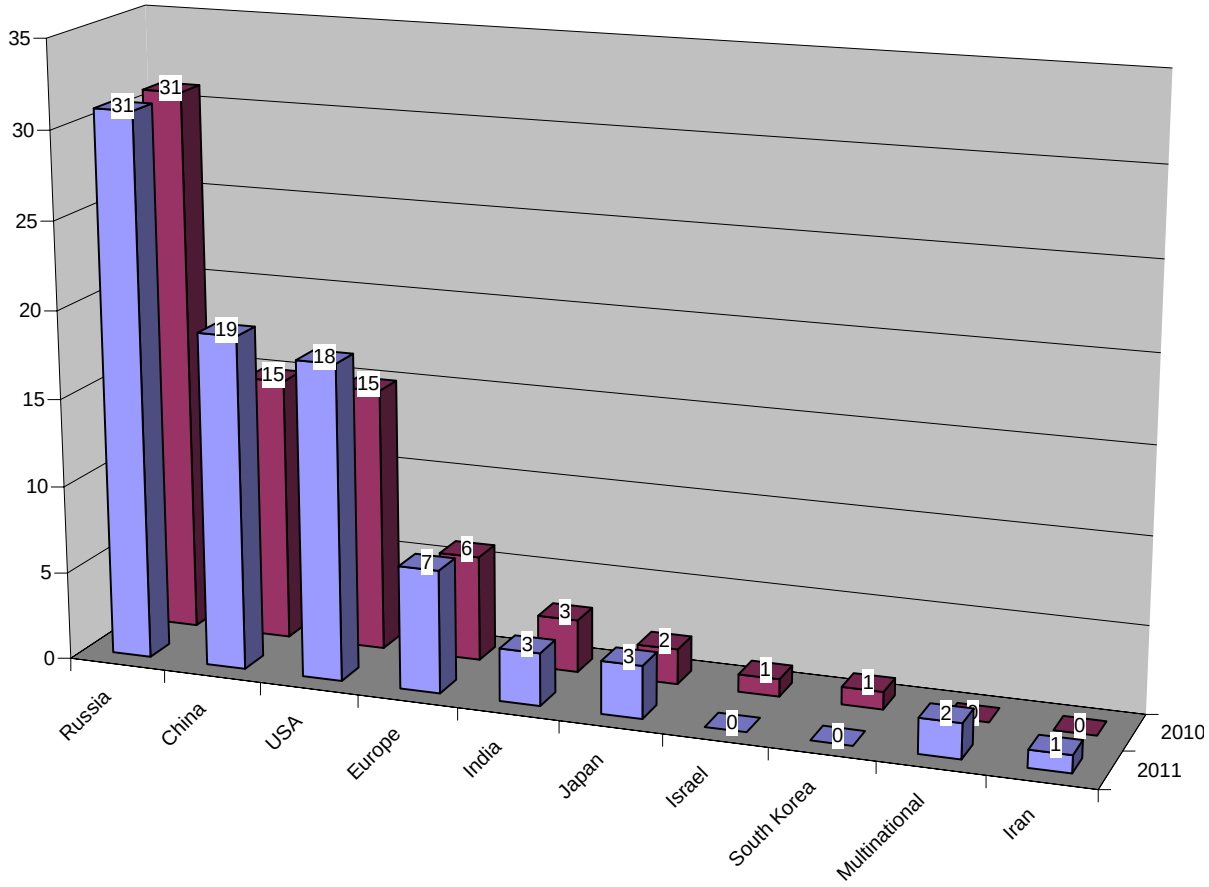

Figure 2.16: Total worldwide orbital launches per country/institution 2011/2010 (Source: FAA)

Europe taken as a whole (including ESA) barely reached 13.5% again, remaining behind China for a second year; European missions in 2009 constituted 19.8% before falling to 13.4% in 2010, in the opposite direction of Chinese missions. France continued to conduct the highest number of missions among European countries, with 8 missions for 2011. It is clear that the hierarchy differs when comparing the number of missions to launches, especially with respect to the U.S. and Russia. As with the U.S., China, France, and India were better represented in this category than in launch activity. Internal European activity is also more discernable through this perspective, with France leading followed by ESA and other European countries.

[87] Space News Staff. "2010: The Year in Review." 13 Dec. 2010. Space News 24 Apr. 2012 <http://www.spacenews.com/civil/2010-year-review.html>.

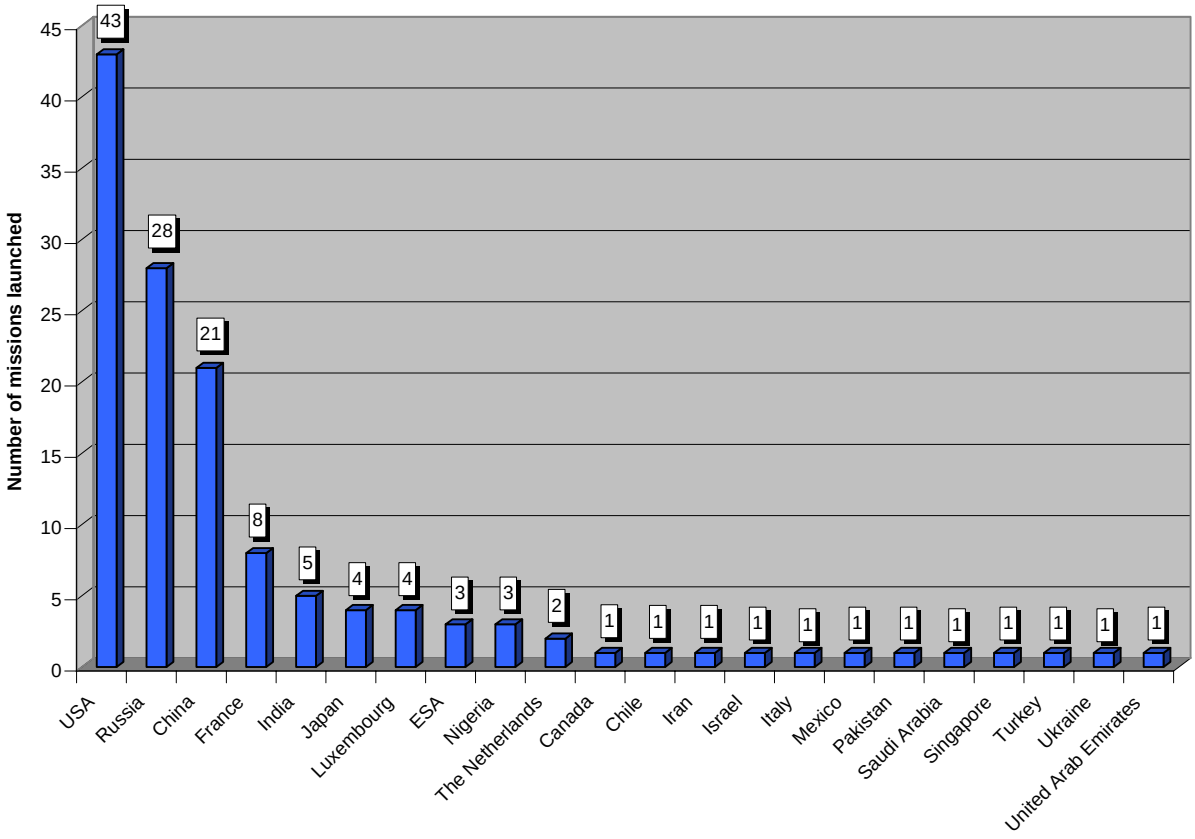

Figure 2.17: Number of missions launched into space by country/institution in 2011 (Source: FAA)

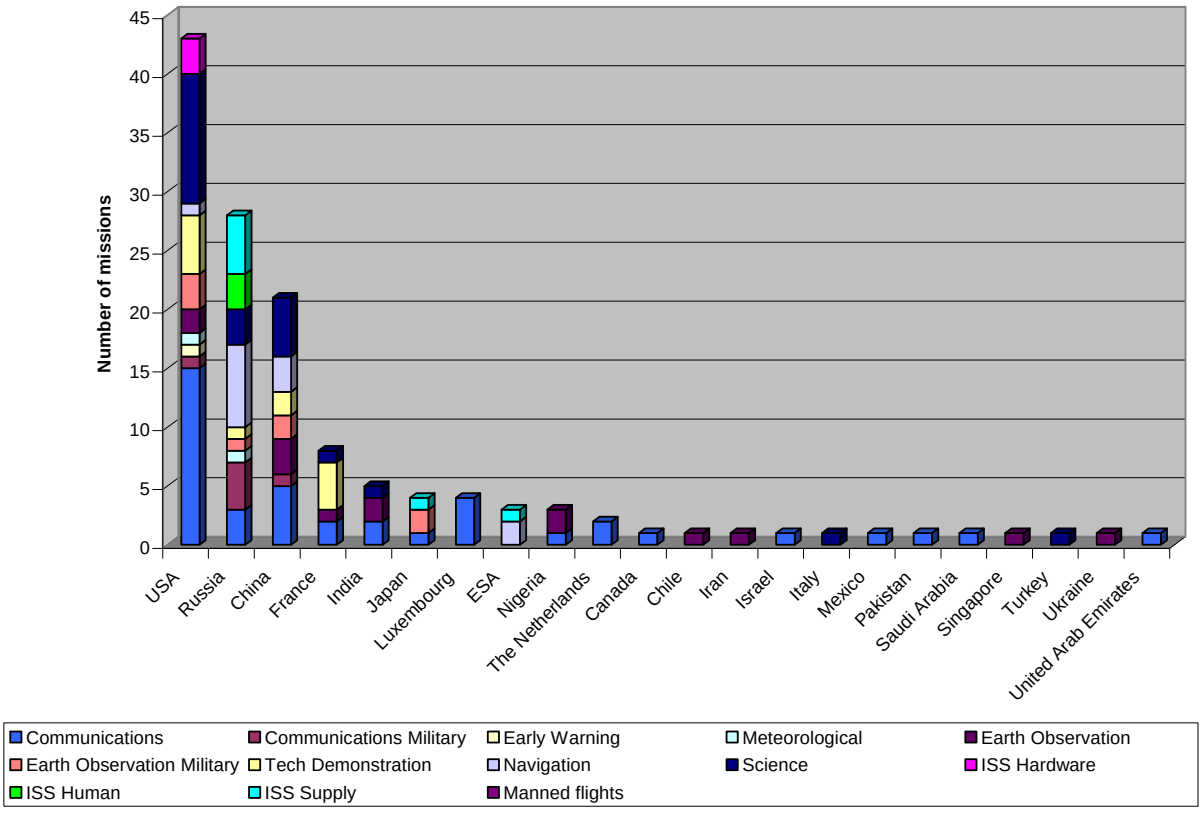

Figure 2.18: Types of missions launched into orbit in 2011 (Source: FAA)

Once again, U.S. missions were particularly focused on communication activities, in addition to science and tech demonstrations (Figure 2.18). In addition to Russia's own communications activity, Russia concentrated its efforts on navigation and resupplying the ISS. Russia also conducted a significant number of dual-purpose payload launches, suggesting that military purposes continued to play an important role in its space activity. France, India, and Japan focused on non-military communication and remote sensing, in addition to France's classified ELISA tech demonstrations. When tracing activity from previous years, it is clear that China was aggressively pursuing its space ambitions.

Regarding the areas of activity, communications (both civil and military) made up a large share of the missions launched (35.3%); followed by science activities at 17.3%, remote sensing (civil and military) at 16.5%, navigation and ISS (supply and hardware) had an equal share at 9.8%, while tech demonstrations amounted to 9.0%, and finally, meteorological and early warning activities made up 1.5% and 0.8% respectively.

An overall hierarchy in space activities existed among the top actors, i.e. the U.S. and Russia. While the United States dominated in the number of conducted missions, Russia was the world leader in the launch sector in 2011.

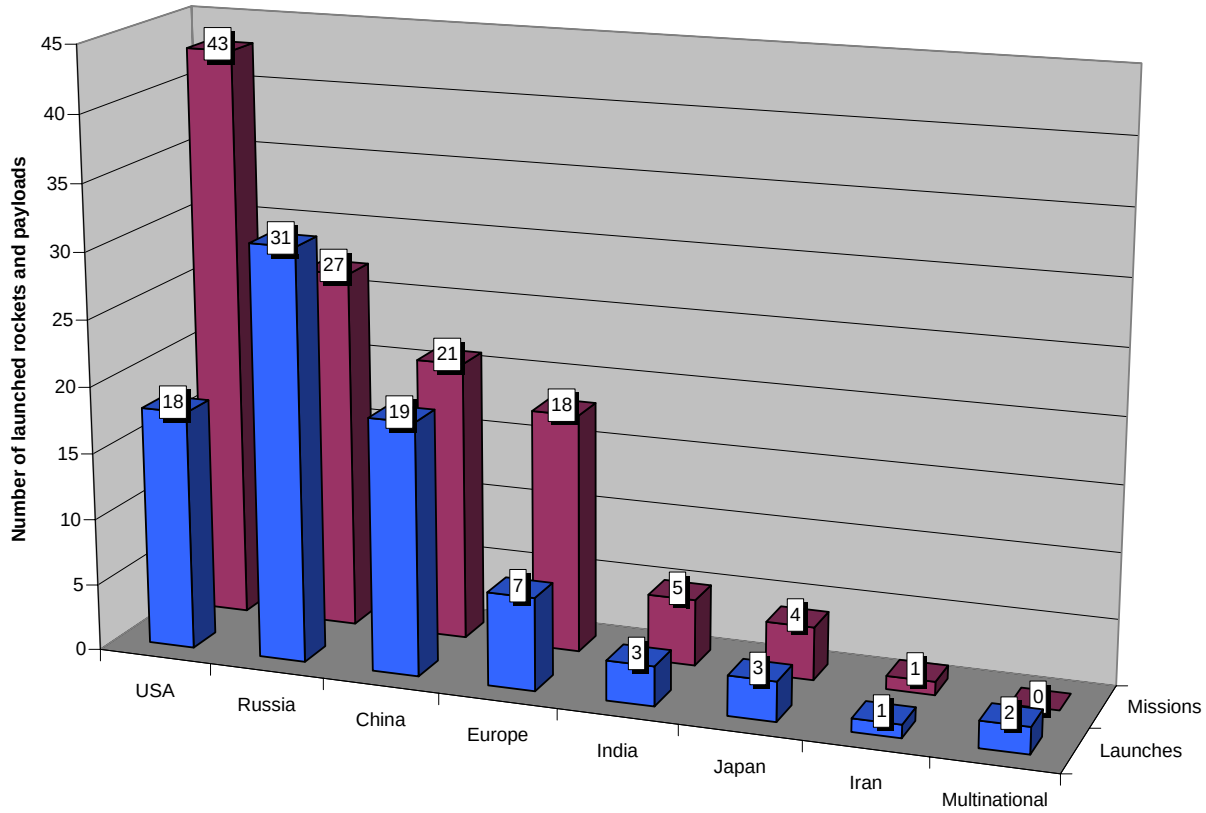

Figure 2.19: Assessment of major space powers' activities in 2011 (Source: FAA)

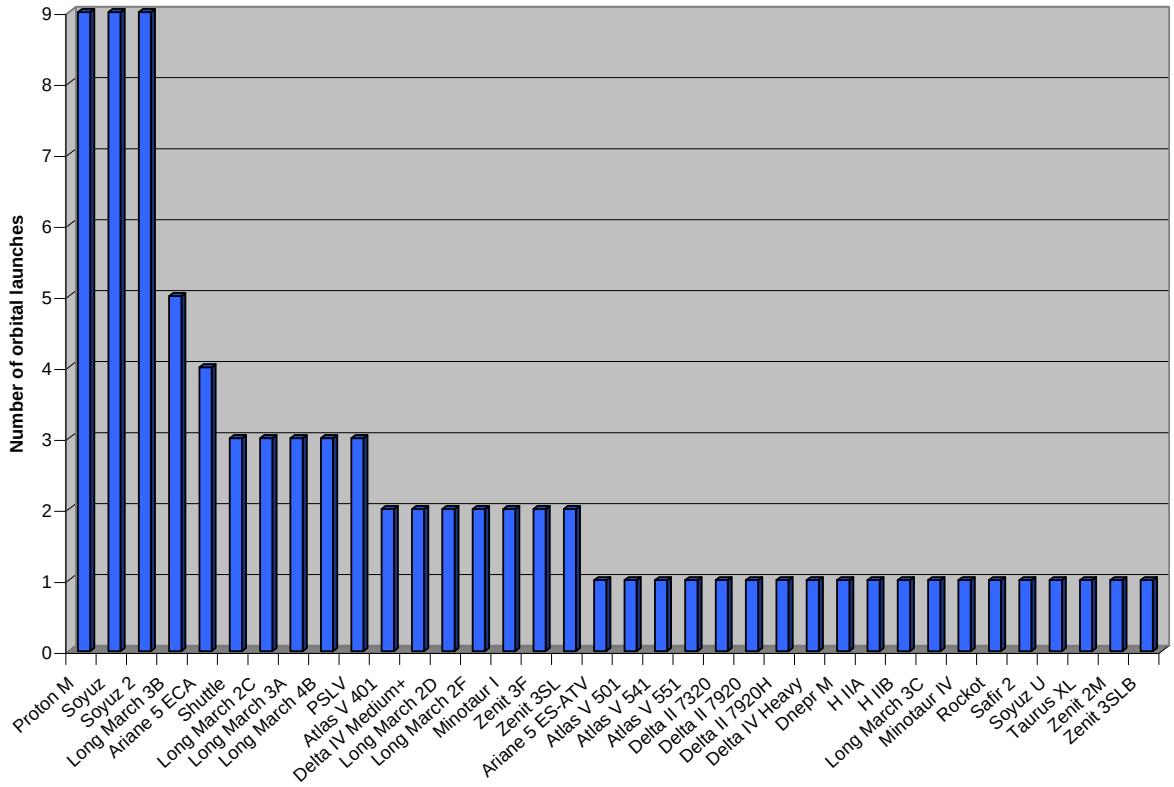

Figure 2.20: Worldwide orbital launches per launch system in 2011 (Source: FAA)

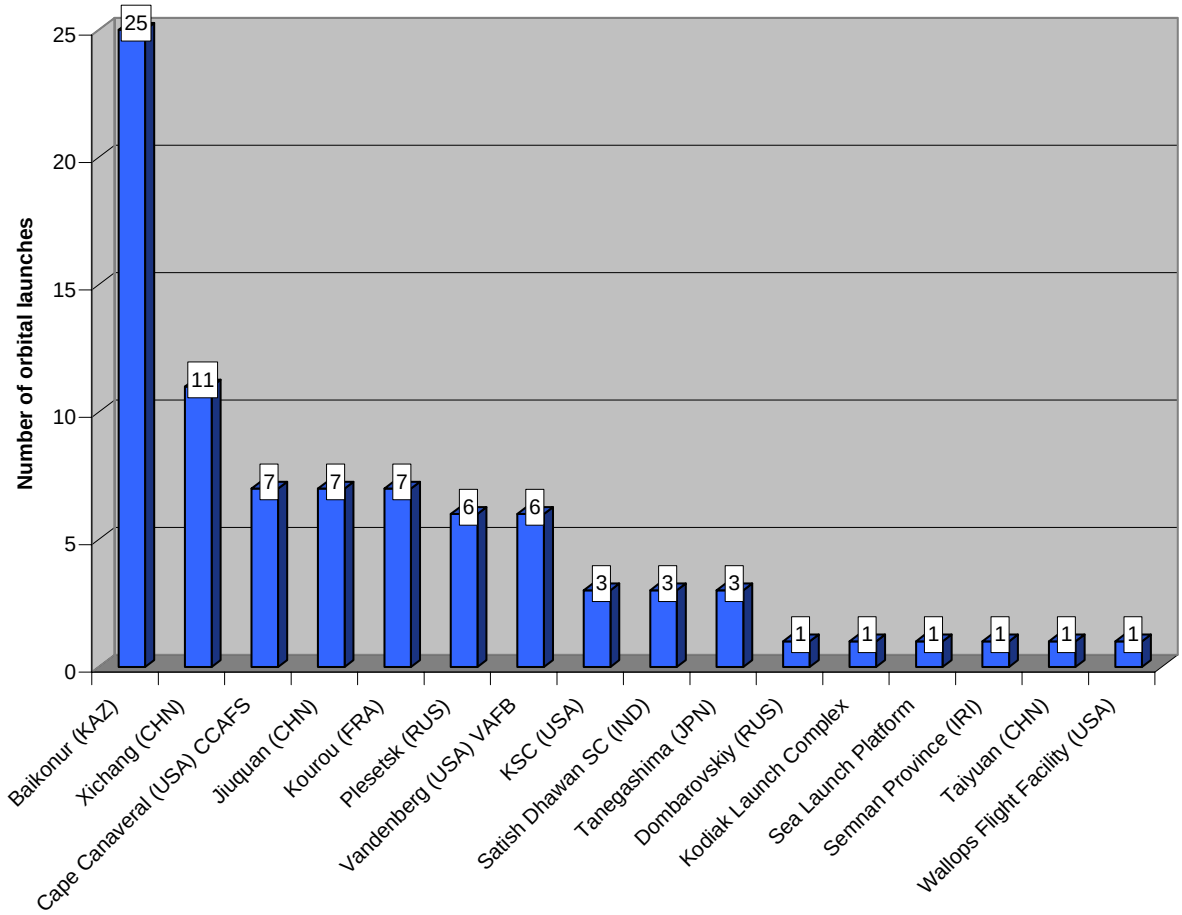

Figure 2.21: Worldwide orbital launches per launch site in 2011 (Source: FAA)

China has now surpassed Europe in the number of missions and launches combined, having moved even closer to its goal of becoming a key actor in the space domain (Figure 2.19). More growth is required from Europe if it is to reclaim its previously held position, or hold its current stake in activities against other state actors.

In terms of the number of launchers per launch system (Figure 2.20) Russia maintained its lead with 9 Proton M, 9 Soyuz, and 9 Soyuz 2 launches, while China's Long March 3B took fourth position with 5 launches, and the Ariane 5 ECA moved to fifth place with 4 launches. Next, there were 3 launches for the Shuttle, Long March 2C, 3A, and 4B, in addition to India's PSLV. The Atlas V and the Delta IV appeared next, with 2 launches apiece.

Russian launchers spread across 8 configurations (mainly Proton M, Soyuz and Dnepr M) and amounted to 36.9% of the launches (31 launches) in 2011, while U.S. rockets distributed in 11 configurations (Falcon 9, Minotaur IV and various Atlas V and Delta IV) amounting to 21.4% (18 launches). Chinese launchers (7 models of the Long March) amounted to 22.6% of the launches (19 launches), and finally Europe with the Ariane 5 ECA and ES-ATV along with its own Soyuz 2 amounted to 8.3% (7 launches). The Ariane 5 has the advantage of the ability to carry two payloads, which sheds some light on the European figures. The major changes from 2011 were the additional launch variants and Europe's first time use of the Soyuz 2 ST launcher from Kourou.

The total number of launch configurations rose in 2011 from 31 to 35. However, this is less significant when the multiple versions used in each launch system are taken into account, e.g. the U.S. divided both the Delta IV and Atlas V into three different versions.

Space transportation infrastructure is another factor that helps assess space capacity, as spaceports are integral for independent access to space (Figure 2.21). The number of spaceports used by a country, as well as the frequency of launches conducted from them, are important indicators of the dynamism of a country's space activities.

Once again, Baikonur was the busiest place with 25 launches during 2011, representing 29.8% of total launches. Xichang was next with 11 launches (13.1%), followed by Cape Canaveral, Jiuquan, and Kourou with 7 launches (8.3%). Pletsek and Vanderberg had 6 launches (7.1%), while KSC, Satish Dhawan, and Tanegashima each had 3 launches (3.6%). Finally, Dombarovskiy, the Kodiak Launch Complex, the Sea Launch Platform, Iran's Semnan Province, Taiyuan, and Wallops Flight Facility each had 1 launch (1.2%). While China operates from fewer launch sites than the U.S., it surpassed the U.S. in terms of activity. Europe is stable with the spaceport in Kourou, yet it runs the risk of being outdistanced by its competitors. This risk was counterbalanced by the introduction of the launcher Ariane 5 ES-ATV and the launch of the Soyuz 2 from Kourou. Russian sites hosted 38.1% of total launches followed by 22.6% in China, 21.4% for the U.S., 8.3% for Europe. The situation could change in the next years due to Russian plans to invest more than $800 million in a new launch facility that will be ready by 2015 and be capable of supporting cosmonaut launches by 2018.[88]

2.6 Transatlantic Industrial Comparison

Europe (all actors) and the United States are the two major space actors that invest the most in space activities (cf. Figure 2.1). They also have the most diverse and competitive industrial bases. An overview of their respective structures and capabilities is therefore necessary to assess the health and competitiveness of their industrial bases. This follows in the next two subsections, beginning with Europe.

2.6.1 State of the European Industry

Unfortunately, data on the financial results of Europe's space industry for 2011 is not expected until the summer of 2012, which does not allow for final data to be included in this report. Nevertheless, by using long-term overviews this section attempts to give a basic insight into European space industry developments and character. The trends reviewed in this section are mainly based on a report of the European Space Industry issued by ASD-Eurospace.[89]

[88] Katia, Moskvitch. "Russia to Kick Off Construction of a New Spaceport.." 21 July 2010. BBC 24 Apr. 2012 <http://www.bbc.co.uk/news/science-environment-10698433>.
[89] ASD-Eurospace. "Facts & figures – The European Space Industry for 2010." 15th edition. June 2011.

From Figure 2.22, while the trend of regular increases in turnover was reversed in 2009 (from €5.885 billion to €5.471 billion), it recovered in 2010 with a turnover of €6.146 billion ($8.198 billion). While this estimate rebounded from the previous year, a sluggish atmosphere still prevails with a further decrease of 11.5% GEO satellite orders in 2011; this reduction occurred in the wake of the exceptional 35% decrease in 2010.[90]

Employment levels are another way to gauge the strategy of the main companies in the space sector (Figure 2.23). Nearly 3000 jobs (approx. 2965) were created in 2010; a significant boost in light of the stagnation of previous years. It appears that while 2010 was a sluggish year in term of sales, the result did not have a direct adverse affect on employment levels.

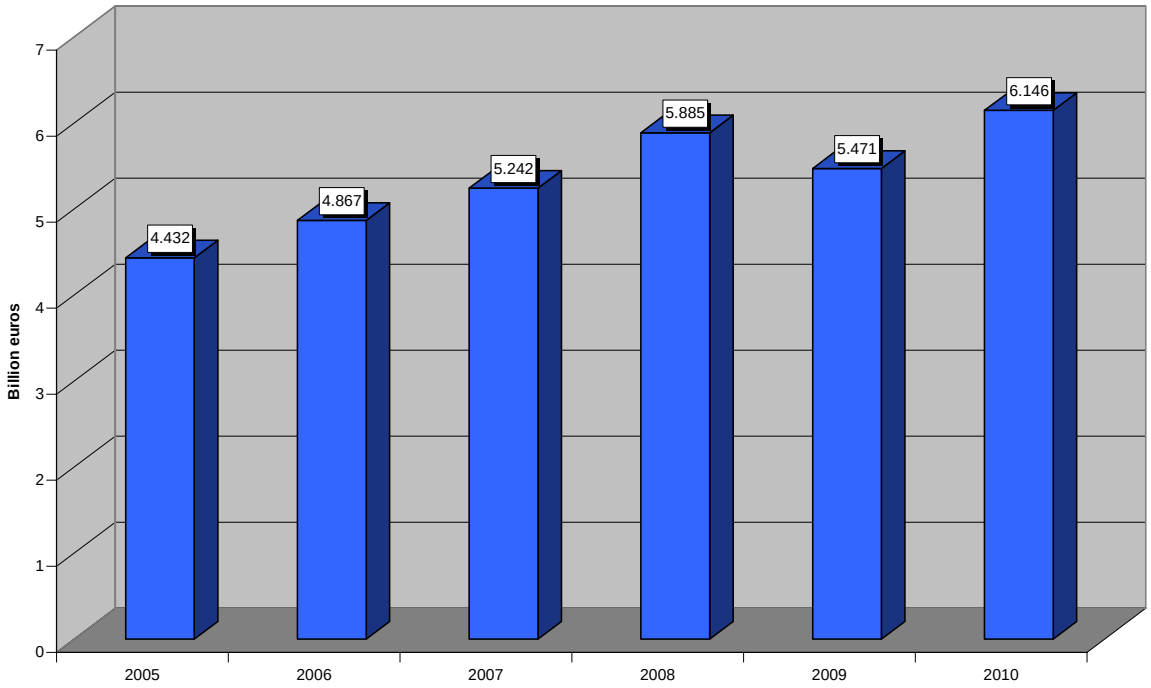

Figure 2.22: Estimated consolidated turnover of the European space sector in Euros (Source: ASD Eurospace)

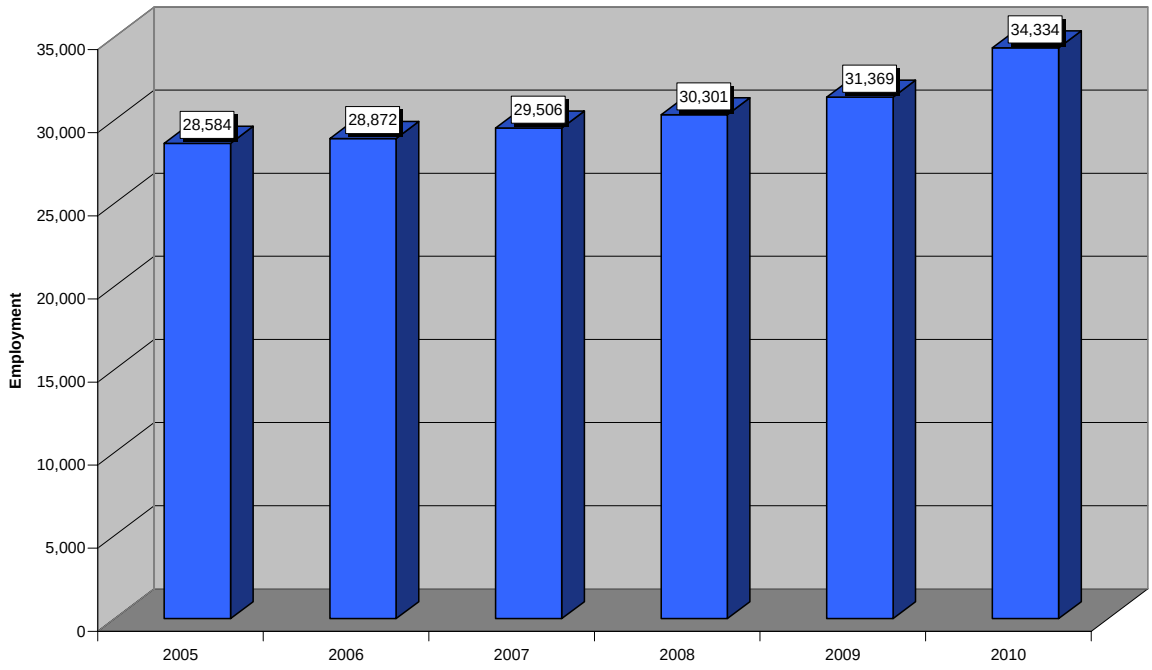

Figure 2.23: European space industry employment (Source: ASD Eurospace)

[90] Satellite Orders Report - 2011 Year-End Summary…: 2.

In Europe, there has been a shift in priorities toward funding institutional civil programmes at the expense of military ones. ESA's role has grown steadily since 2004, while other public entities have maintained their positions after a sharp decrease in 2009; this may be explained by the reduced presence of the military as a customer. Similar to the values in 2009, sales to European customers were 77.5% of final sales, while exports represented 22.5% of final sales.[91] Institutional programmes (both civil and military) were the main source of revenue for the European industry at 68.2%, while commercial programmes generated 31.8% of final sales.[92] Next, while operational launchers held a larger share than commercial satellites in 2009, those roles were switched in 2010.

Some interesting developments arose in the European space industry by sector (Figure 2.25). While there was a slight overall increase in turnover, that increase had the greatest impact in scientific programmes, and the support and test sectors. Satellite applications (e.g. navigation systems and telecommunications systems) only marginally increased in this cycle, while the launcher development and production sector experienced a small decrease.

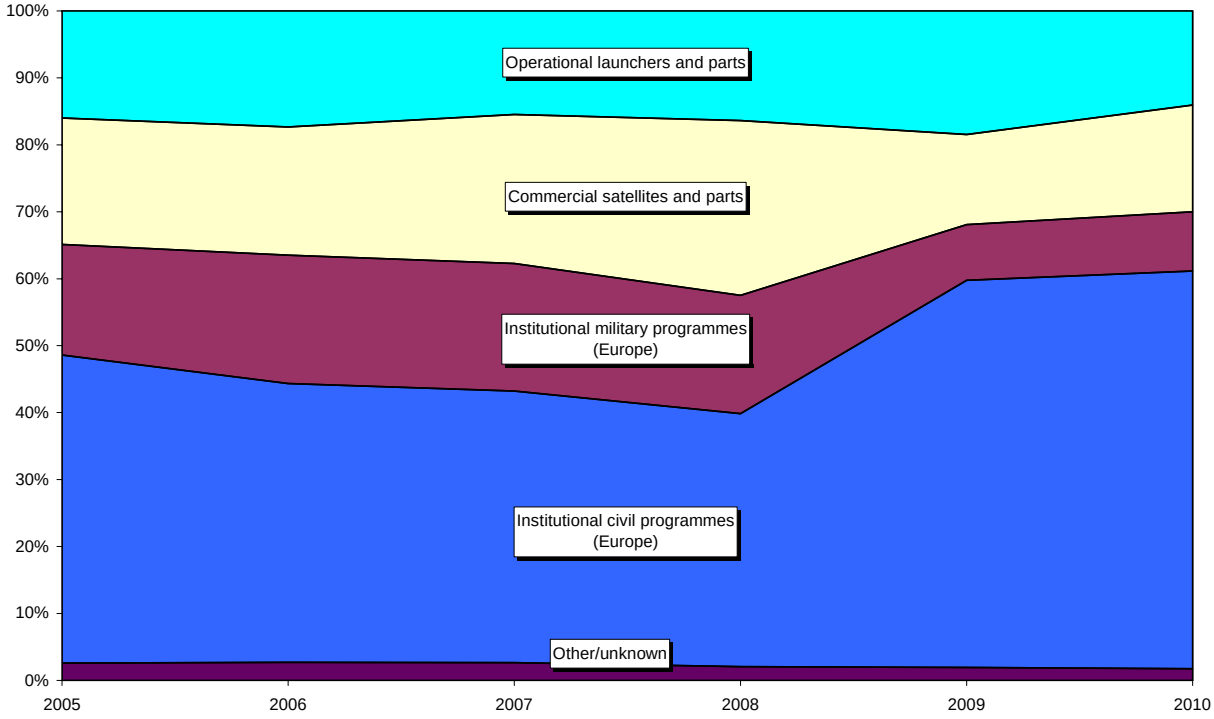

Figure 2.24: Estimated share of European space industry consolidated turnover per institutional customer (Source: ASD Eurospace)

While Figure 2.25 displays the impact of the turnover per sector, and provides a historical timeline, it is possible to drill down further into each category to assess the impact of the increase in turnover. The effect varied among the three parts of the satellite applications sector (i.e., telecommunication, earth observation, and navigation/localisation systems). In 2010, Telecommunications systems in the European sector earned revenue of €897.02 million ($1196.80 million), earth observation systems raised €736.94 million ($983.03 million), and navigation systems earned €322.48 million ($430.17 million).

When looking at the launcher development and production section, it should be noted that launcher developments in Europe are funded almost exclusively by ESA. In 2010, the expenditure on launcher development amounted to about €300 million per year ($400 million); and there is no expected growth in the next few years due to the absence of development plans for new launchers in Europe. Operational launcher systems earned an estimated €700 million ($934 million) in 2010.[93] The situation of scientific programmes appears to have been unchanged from 2009, as these programs are strongly supported by ESA, which is by far the main customer with 81.4%, while civil public entities represent barely 10.8% and exports 6.5%.

[91] Facts & figures – The European Space Industry in 2010...: 8.
[92] Id.
[93] De Selding, Peter B. "Arianespace Needs aid to avoid loss in 2010." 4 Jan. 2010. Space News 24 Apr. 2012 <http://www.spacenews.com/civil/110104-arianespace-needs-aid.html>.

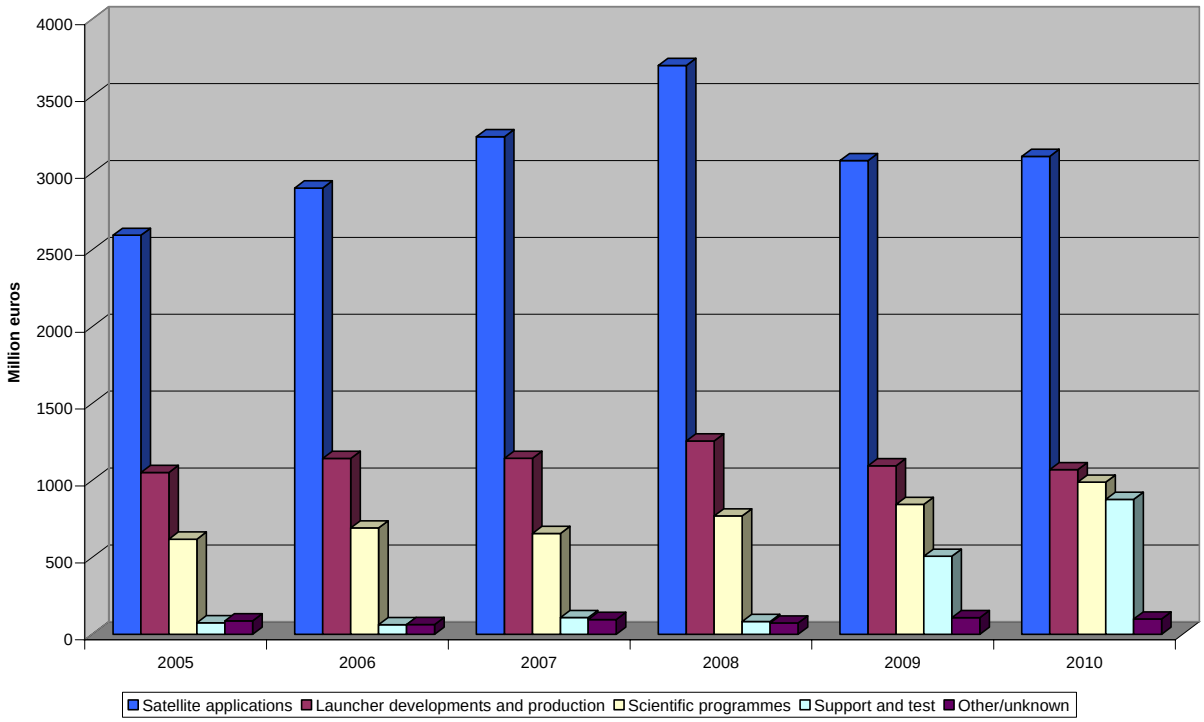

Figure 2.25: Estimated share of European space industry consolidated turnover per sector (Source: ASD Eurospace)

2.6.2 State of the United States Space Industry

The trends reviewed in this section are mainly based on the 2011 Year-End Review and Forecast report issued by the Aerospace Industry Association (AIA).[94] The U.S. aerospace industry operated with a constant increase in sales especially between 2008 and 2009, when sales grew from $43.2 billion to $45 billion. This growth was expected to slow down from 2009 to 2010, increasing sales by a modest $300 million, a significant drop from the rate of increase experienced in the prior year.

Preliminary assessments of 2011 point to an increase in sales by over 1 billion, at $46.4 billion, however sales are forecast to decrease substantially in 2012.

In 2011, an estimated 71,000 people were employed in the U.S. space industry. That number is less than the previous year, and this flow is in the opposite direction to the European counterpart which experienced a significant increase in employment in 2010.

This current economic situation may be the result of two factors. The first deals with the state of exports, and the second concerns the domestic market. Deciphering the situation of U.S. exports is difficult because the figures are only available for aerospace taken as a whole. However it can be noticed that while there is an increase of total civil exports to $76.69 billion in the 2011 preliminary assessment, there has been a constant reduction of sales in this field, from $82.26 billion in 2008 to $67.13 billion in 2010. With this lack of consistency, it is difficult to determine which part the space sector has been or will likely be affected by the shifting tides. The military figures are more accurate, allowing a better assessment of the trends in sales. The sales of spacecraft, satellites & parts continued to fall from $189 million to $133 million between 2009 and 2010, to $107 million in 2011; however, this declining rate is also apparent in the total of military exports (e.g. complete aircraft, aircraft engines, missiles/rockets and parts, and spacecraft satellites and parts, etc.), where the 2011 total military exports amount to $10.293 billion (lower than the $10.375 billion in 2010, and $10.666 billion in 2009).[95]

This worrying situation has made U.S. officials consider modification of the ITAR regulation to encourage the export of high technology material. Additionally, in 2009, the Obama Administration reaffirmed its support for ITAR reform, calling for a review of the current regime.[96] Recently, a

[94] Aerospace Industry Association. “2011 Year-End Review and Forecast.” 2012 <http://www.aia-aerospace.org/economics/year_end_review_and_forecast>.
[95] Id. at 17.
[96] Klamper, Amy. “Official Reaffirms White House Support for ITAR Reform.” 14 Sept. 2009. Space News 24 Apr. 2012 <http://www.spacenews.com/policy/official-reaffirms-itar-reform.html>.

report from the U.S. State and Defence Departments concluded that many satellites and their components could be transferred to the Commerce Department's Commerce Control List. While these satellites and their components are currently listed under the U.S. Munitions List, administered by the Department of State, the "1248 report" (invoked by Section 1248 of the National Defense Authorization Act for 2010) recommends giving the U.S. President the authority to determine export jurisdiction. The move would aid national security by allowing the government to focus its controls on technologies and capabilities that are the most sensitive; however, the report still recommends strengthening the U.S. ban on shipping U.S. satellite technology to China for launch on Chinese rockets. Meanwhile, if the 1248 report recommendations are applied, most communications satellites and some low-performing remote sensing satellites could be treated as non-military technology for export purposes, without affecting national security.[97]

As confirmed by the figures in the AIA report, U.S. manufacturers have a natural tendency of dependence on the domestic market.[98] In 2010, 72.2% of the sales in the U.S. aerospace sector were to the domestic market, in 2011 that figure increased by a small margin to 72.8%. To summarize, these figures are a reminder that the domestic market plays a crucial role in the U.S. space industry, clearly showing that public expenditure must increase at a constant pace to cover the weaknesses in the export market and ensure increased sales on a yearly basis. This tendency is even more pronounced if one looks at the space domain only. Employment figures strongly support this observation, as the decreasing numbers of employees mirrors the small changes in sales.

The U.S. is still at its turning point after recent political decisions; the outcome will depend on whether the U.S. space industry has the will to reform the ITAR export control rules, and whether the decision to privatize a significant portion of U.S. space activity will positively affect the sector.[99]

[97] Leone, Dan. "U.S. Report Supports Sweeping Reform of Satellite Export Rules." 18 Apr. 2012. Space News 23 May 2012 <http://www.spacenews.com/policy/120418-report-backs-reform-sat-export.html>.
[98] Aerospace industry association, "Aerospace Industry Sales by Customer 1997-2011.", 2011 <http://www.aia-aerospace.org/economics/year_end_review_and_forecast>.
[99] Boessenkool, Antonie. "DoD: U.S. Space Industry May Lose Edge." 25 May 2010. Defense News 24 Apr. 2012 <http://www.defensenews.com/story.php?i=4641686>.

3. Space Industry Evolutions

3.1 Europe

The Arianespace commercial launch company expects to post a 10% revenue increase in 2011 and to report a slight profit after two years of losses. The company's backlog now stands at an unprecedented combined amount of €4.5 billion ($5.9 billion) for its heavy-lift Ariane 5 series and medium-lift Soyuz 2 ST vehicles. This is composed as follows: €2.5 billion ($3.25 billion) towards commercial launches aboard the Ariane 5, €1 billion ($1.3 billion) for government launches aboard the Ariane 5, and €1 billion ($1.3 billion) in backorders for Soyuz launches. Where in 2011, the Soyuz 2 ST conducted 2 launches, 2012 will have three Soyuz launches from French Guiana, with two additional commercial launches conducted from its original Baikonur location. Meanwhile, Arianespace has scheduled seven launches of the Ariane 5 series launch vehicle, and conducted the inaugural launch of the Vega small-satellite launcher in 2012. While Arianespace earned €897 million ($1.16 billion) in 2010, amounting to a fall of €83 million ($107.9 million) in its revenue; with the introduction of the Soyuz 2 in Kourou, Arianespace was able to avert a loss for the third year in a row, making a small net profit on its €985 million ($1.28 billion) in revenue. Last year, following an audit of Arianespace and its contractors (a condition for injecting about €240 million ($312 million) into Arianespace over two years), ESA determined that additional savings related to the Ariane series would not be possible without wholesale restructuring. ESA has released €217 million ($282 million) allocating half to Arianespace's 2011 accounts, with the remaining funds to be made available in 2012.[100]

Eutelsat expects its total revenue to grow by more than 7% per year on average through 2014, mainly from selling short-term capacity to the U.S. Defence Department. But the company's government business is not expected to continue its accelerated pace. Additionally, Eutelsat's video business in the Balkans and its data-transmission business in parts of Africa will also face increased competition in both regions. In the second half of 2011, Eutelsat's multi-usage revenue increased by 29.9%, to €74.4 million ($97 million), that amount accounts for 12.5% of Eutelsat's total revenue for the period. The operator reported revenue for the six months of €602.4 million ($780 million), up 4.6% over the same period a year ago, while its earnings before interest, taxes, depreciation and amortization (EBITDA) were 79.4% of revenue. About 68% of Eutelsat's revenue came from video broadcasting, where the number of television channels carried on Eutelsat's fleet rose by 10%, to 4,173 in 2011. Eutelsat's 7% annual growth rate through 2014 will be accomplished at an EBITDA margin that averages 77% of revenue.[101]

On 12 January 2012, the Spanish telecommunications infrastructure provider Abertis Telecom announced it would sell half its stake in Eutelsat for a price of about €1 billion ($1.3 billion). Abertis Telecom, Eutelsat's biggest shareholder, had a 31.4% equity stake in Eutelsat. Credit Suisse, Morgan Stanley and Society General would manage the accelerated placement sale of 16% of Eutelsat's share capital, valued at €29.75 ($37.88) per share. While no explanation was given for the expedited disposal of such a large stake, some suspect Abertis sought to raise its cash liquidity to avoid becoming an acquisition target for its competitors.[102]

Hispasat reported a 7% increase in EBITDA over 2010. In 2011, the company reported revenue of €187.5 million ($246.7 million), an increase of 3.4% over 2010. Its EBITDA increased to 82.5% of revenue (up 2.8 points from 79.7% a year earlier), and its consolidated operating profit was €70.6 million ($92.9 million), an increase of 2.2% from 2010. As observed by the Hispasat CEO, "the results obtained in 2011 confirm the validity and strength of the business model established by HISPASAT, which is capable of increasing operating revenue even in such a complex context like the one we experienced last year, marked by the economic crisis." Of the total earned revenue in 2011, €182.4 million ($240 million) was derived from revenue from leasing space capacity, with

[100] De Selding, Peter B. "Arianespace Expects to Post 2011 Profit After 2 Years of Losses." Space News 9 Jan. 2012: 10.
[101] De Selding, Peter B. "Eutelsat Forecasts Slower Pentagon Sales Growth." Space News 20 Feb. 2012: 12.
[102] "Abertis Telecom To Sell Half of its Eutelsat Stake." Space News 16 Jan. 2012: 3.

50% generated from clients located in Europe and 49.1% from clients in the Americas, where HISPASAT has consolidated a strong presence in the region, holding a significant market share. The remaining 0.9% came from other regions. Hispasat´s growth is mainly due to the commercialization of capacity from the Amazonas 2 and Hispasat 1E satellites.[103]

Telenor Satellite Broadcasting of Norway reported a 7.6% decrease in revenue for the year-ending 2011; much of the drop was said to be caused by the increased strength of the Norwegian krone. Another cause for this depressed revenue was Oslo-based Telenor's renegotiation of its contracts with its biggest customer, Canal Digital. Their agreement consolidated multiple fixed price contracts into a single contract that featured volume discounts. Telenor reported revenue of 998 million kroner ($165.7 million) for the 12-month period, down 7.6% from the same period in 2010. Its EBITDA was 66% of revenue, down from 70% in 2010. In addition to serving the Nordic market, Telenor is seeking to broaden its customer base by operating in Central and Eastern Europe as a cheaper alternative to Eutelsat and SES, while also marketing to maritime consumers by adding a Ka-band payload to its Thor 7 satellite.[104]

Despite filing for bankruptcy protection after breaching several of its loan covenants, RapidEye AG remained confident in the continued support of its three main financiers, which have already expressed willingness to renegotiate the terms of the current loans. A leader in privatized satellite imagery, RapidEye has elected this procedure to place itself on a firmer financial footing and pursue its long-term business goals. With few creditors financing the company, the debt reorganisation procedure is less complex than with multiple creditors. RapidEye's main creditors KfW and Commerzbank from Germany, and Canada's Export Development Corp, provided about half of the €160_million ($232 million) that RapidEye raised to start its business. An additional €15 million ($21.6 million) came to RapidEye in the form of a grant from the Germany Space Agency (DLR); repayable over five years in the form of imagery. A second more substantial grant, totalling €137 million ($181.5 million), came from the Brandenburg region of Germany in return for RapidEye creating 130 jobs there for at least five years.[105]

Europe's Astrium space hardware and services provider reported flat revenue and lower pre-tax profit for 2011, along with lower services revenue which offset increases in satellite manufacturing and launch-vehicle sales. Astrium's revenue for 2011 totalled €4.96 billion ($6.4 billion), decreasing slightly from 2010. Pre-tax profit was 5.4% of revenue, down from 5.7% in 2010. The reduction in pre-tax profit is partly related to its acquisition of mobile satellite services provider Vizada; a €745 million ($965 million) transaction which closed in December 2011. Astrium has three principal divisions that contribute to revenue: Astrium Services, which sells Earth observation imagery and satellite communication services to government customers; Astrium Satellites, a major satellite builder; and Astrium Space Transportation, Europe's biggest contractor for the international space station, and the prime contractor for Europe's Ariane 5 heavy-lift rocket and French ballistic missiles. Astrium Services revenue totalled €861.8 million ($1.13 billion), down 12.7% from 2010; however, revenue is expected to increase by 60% with the acquisition of Vizada. Astrium Satellites revenue totalled €2.15 billion ($2.8 billion), up 12.2%, following the delivery of 13 satellites, including Pleiades 1A and two Galileo navigation spacecraft. And Astrium Space Transportation reported revenue of €2.18 billion ($2.86 billion), up by about 4% from 2010, after delivering the second Automated Transfer Vehicle and five Ariane 5 rockets during the year. Additionally, these divisions booked a combined total of €3.5 billion ($4.59 billion) in new orders in 2011.[106]

The Astrium space hardware and services division plans to eliminate 1,000 Astrium positions and 1,000 subcontracting positions from its pool of 17,000 employees. Described as a part of Astrium's streamlining effort, the 2015 goal is to create a company that is leaner in middle management and bureaucracy, eliminating jobs that do not directly contribute to Astrium's product and service portfolio. The company will reinvest the €400 million ($560 million) in annual savings resulting from the employment streamlining into self-financed research and offering better prices to its customers. Astrium's Agile programme, an internal transformation programme designed to prepare the company to adapt to the competitive market, has been operating in an environment where, for instance, the currency exchange rate between the Euro and the Dollar has made it very hard for Europe's Ariane 5 rocket to make a profit, despite 44 consecutive launches without failure. With the Euro strong, streamlining is Astrium's best option if it is to make a profit and win business in the coming years. Astrium's workforce is dispersed among several European states with the following

[103] "HISPASAT reaches a new maximum for revenue in 2011 of 187.5 million euros." Noticias hispasat acercando culturas 3 May 2012 <http://www.hispasat.com/media//395-Resultados%202011_EN.pdf>.
[104] "Telenor: Exchange Rates Contribute to Revenue Drop." Space News 13 Feb. 2012: 8.
[105] De Selding, Peter B. "Earth Imagery Firm RapidEye Seeking Bankrupcy Protection." Space News 6 June 2011: 6.
[106] De Selding, Peter B. "Drop in Services Business Keeps Astrium Revenue Flat." 8 Mar. 2012 Space News 3 May 2012 <http://spacenews.com/satellite_telecom/120308-astrium-revenue-flat.html>.

distribution: 43% of Astrium's workforce is in France, 27% in Germany, 21% in Britain, 5% in Spain, 1% in Netherlands, with the final 3% dispersed within other countries.[107]

Astrium Geo-Information Services will increase the competition for its two U.S. competitors, GeoEye and DigitalGlobe in early 2012 when its Pleiades 1A high-resolution optical Earth observation satellite enters service. Launched on 17 December 2011, this lone satellite has a twin, Pleiades 1B, that is expected to join it in orbit before March 2013. In the meantime, the French government is testing Pleiades 1A's performance and capabilities. Built by Astrium Satellites and Thales Alenia Space under contract to the French Space Agency (CNES), the 1A was ready to launch aboard the Soyuz 2 ST in June 2011 at the European launch base in Kourou, but the owners decided against launching the 1A on the Soyuz 2 ST's first mission, resulting in a 6-month delay before the next launch opportunity arose. GeoEye and DigitalGlobe had jumped ahead in mid-2010 after securing a joint 10-year, $7.3 billion contract with the U.S. National Geospatial-Intelligence Agency (NGA). However, at a cost of more than €760 million ($1 billion), covered 90% by CNES, the French government soon will have access to an output of 900 images per day once both satellites are in near-polar low Earth orbit position. Of that share, the French Ministry of Defence has priority access to 50 images per day, while civil agencies have access to 40% of the remaining output; Astrium Geo-Information Services gets the remaining 60% of CNES's share. As the rest of the bill was covered by Belgium, Spain, Sweden, and Austria; these states get access to a pro rata share of the remaining 10% of imagery and work for their respective national industries.[108]

Thales Alenia Space, owned 67% by Thales and 33% by Finmeccanica, has 7,500 employees in France, Italy, Spain, Belgium, Germany and the United States. It posted total revenue of €2.1 billion ($2.72 billion) in 2011.[109] Thales, the 67% share holder of Thales Alenia Space, reported a slight decrease in revenue, earning €13.028 billion ($16.869 billion) in 2011 compared to €13.081 billion ($16.938 billion) in the previous year. Registered in both France (Thales Alenia Space SAS) and Italy (Thales Alenia Space Italia SpA),[110] Thales Alenia Space is a key supplier of satellite and orbital infrastructure solutions. Thales Alenia Space is thus a global market leader in telecommunications, navigation, space exploration and Earth observation.[111] In telecommunications, it competes in the commercial satellite market, producing its own satellites from its Spacebus platform dedicated to geostationary satellites, while supplying additional payloads for all the major contractors in the sector, and providing satellites for the low-orbit civilian constellation market. In the defence and security segment, it offers space segments and ground telecommunications systems (Syracuse, Sicral, COMSAT-BW), military observation systems (Helios, Pleiades, CSO – rest of Helios, SAR-LUPE), and also dual civilian and military systems (COSMO-SkyMed, Athena-Fidus, Yahsat). Thales Alenia Space is also a major player in Earth observation and scientific missions. For the last 3 decades, it has been prime contractor for weather satellite programmes in Europe (METEOSAT) and for environmental missions in the context of GMES (Sentinel programmes) or space altimetry. And for scientific missions, it developed Proteus, a multi-mission platform (class 500-700 kg), used in the SMOS, Jason, COROT and Calipso missions. Thales Alenia Space also plays a major role in the Galileo programme, participating in the In-Orbit Validation (IOV) phase, .as well as providing system support and the Mission Ground Segment for the full constellation. In manned space flight, Thales Alenia Space is a major contributor to the ISS, supplying more than 50% of its pressurised volume (Nodes 2 and 3, MPLM, Cupola, PMM) and is significantly involved in the ATV vehicles for ESA.[112] On the transaction side, in October 2010 Thales Alenia Space sold its stake in Indra Espacio to Indra Sistemas for €39.2 million, resulting in a €13.8 million gain on disposal.[113]

OHB Technology of Germany expected its total revenue to rise to over €600 million ($780.8 million) for fiscal year 2011. According to Reuters I/B/E/S estimates, OHB is expected to report EBITDA of €41.77 million ($54.3 million) and EBIT of €29.25 million ($38 million) for the 2011 fiscal year.[114] During the period OHB Technology purchased the Space System division of the Swedish Space Corporation (SSC); yet again branching into another market after signing an agreement with China last year in order to develop a small constellation to measure atmospheric

[107] De Selding, Peter B. "Astrium Efficiency Initiative to Eliminate 2,000 Positions by 2015." Space News 27 June 2011: 12.
[108] De Selding, Peter B. "With Pleiades in Orbit, Astrium Sets Sights on DigitalGlobe, GeoEye." Space News 9 Jan. 2012: 7.
[109] Thales Alenia Space 17 May 2012 <http://www.thalesgroup.com/Markets/Space/Related_Activities/Thales_Alenia_Space/>.
[110] 2011 Registration Document. Thales. 23 May 2012 <http://www.thalesgroup.com/Group/Investors/Documents/Releases_and_Publications/2012/2011_Registration_Document/>.
[111] 2010 Registration Document. Thales 23 May 2012 <http://www.thalesgroup.com/Workarea/DownloadAsset.aspx?id=15726&LangType=2057>.
[112] See generally 2011 Registration Document…: 132.
[113] 2010 Registration Document…: 41.
[114] "Financials: Ohb AG (OHBG.DE)." Reuters 3 May 2012 <http://www.reuters.com/finance/stocks/financialHighlights?rpc=66&symbol=OHBG.D>.

levels of methane and carbon dioxide.[115] The transaction, concluded for 1 Swedish krona, is an asset deal whereby OHB has agreed to assume the risk associated with the Swedish division's future performance. SSC is a for-profit government enterprise that will act as a subcontractor for its previously held Space System division on the OHB-led Small-Geo satellite platform. In recent years, the Space Systems division has returned revenue of about €10 million ($14 million) per year, while employing around 53 employees that will be designated under the organisational title of OHB Sweden. As this transaction occurred with another ESA member state, by virtue of ESA's geographic return rule, the German-owned OHB Sweden will be entitled to benefit from ESA opportunities arising from Swedish space spending.[116]

RUAG Space, the largest independent supplier of space technology in Europe developing subsystems and equipment for satellites and launch vehicles, reported a 2.8% decrease in net sales for 2011, earning CHF 275 million ($292.6 million) compared to CHF 283 million ($300.8 million) in 2010. Nevertheless, RUAG Space increased its EBIT by 46%, from CHF 9 million ($9.6 million) in 2010 to CHF 13 million ($13.8 million) in 2011; and its EBITDA in 2011 amounting to CHF 33 million ($35.1 million), an increase of 10% from CHF 30 million ($31.9 million) in 2010.[117] Based in Switzerland, Sweden, and Austria, the company employs 1,113 personnel.[118] Structures and separation systems for launch vehicles again had the highest sales volume during the past year, with RUAG Space's payload fairings being used in 8 launches of Ariane 5 and Atlas V launch vehicles.[119] The company is also involved in the "Pleiades" Earth observation satellite programme; the first satellite having been launched in December 2011.[120]

3.2 United States

Following a lack of commitment from the U.S. and other prospective government and commercial customers, Intelsat and MDA Corp. rescinded their agreement to collaborate on a satellite in-orbit refuelling system. Intelsat, the largest commercial satellite fleet operator, had agreed to invest $280 million in MDA's first mission for its proposed Space Infrastructure Service (SIS) business. Yet, even with the credibility gained from Intelsat backing, it was insufficient to coax in additional customers. Bad timing seemed partially to blame – while U.S. Air Force officials indicated interest in the idea, their current satellite fleets were undergoing replacements that had already been financed, leaving little funding for a program such as in-orbit fuelling. MDA is not wholly abandoning the SIS idea, but will also bid for an upcoming U.S. government contract calling for proposals on satellite-repair missions.[121]

With controversy swirling around LightSquared, and the potential interference its wholesale broadband service may have on highly sensitive GPS receivers, LightSquared is seeking to shift the burden of resolving the matter to others. Instead of switching from operating on the L-band to another frequency, LightSquared has urged stakeholders in the GPS industry to build better receivers that do not receive signals beyond their intended function. This debate has made officials hope that technical standards can be established that will allow companies developing broadband networks to tailor their systems so as to avoid disrupting GPS applications. Thus the U.S. Deputy Transportation Secretary will work with the Commerce Department's National Telecommunications and Information Administration (NTIA) to develop GPS spectrum standards in consultation with stakeholders in industry. However, those standards would be crafted so as not to affect emerging GPS applications that are vital for the economy, public safety and national security.[122]

The Stratolaunch project, seeking to develop the largest air-launch system in the world, has confused the industry with regard to its prospects and purpose. Unveiled on 13 December 2011 by billionaire Microsoft co-founder Paul Allen, the company's aim is to bring airport-like operations to the launch of commercial and government payloads and eventually conduct human missions. The carrier aircraft, operating from a large airport or spaceport, will be able to boost up to 6,100 kilograms of payload to low Earth orbit by the flying launch of a booster weighing up to 222,000 kg. However, with the large number of start-up commercial launch providers, some question whether

[115] De Selding, Peter B. "OHB Purchases SSC's Space System Division." Space News 27 June 2011: 11.
[116] De Selding, Peter B. "Astrium Efficiency Initiative to Eliminate 2,000 Positions by 2015." Space News 27 June 2011: 12.
[117] RUAG Annual Report 2011. RUAG 9 May 2012: 98 <http://www.ruag.com/de/Konzern/Media/Geschaeftsberichte/2011/2011_e/RUAG_GFB_2011_E.pdf>.
[118] Id. at 26.
[119] Id. at 24.
[120] Id.
[121] De Selding, Peter B. "Lack of Interest Dooms MDA, Intelsat In-Orbit Servicing Deal." Space News 23 Jan. 2012: 7.
[122] Ledbetter III, Titus. "U.S. Officials Mull Standards in Wake of LightSquared Controversy." Space News 13 Feb. 2012: 6.

the venture will be able to capture sufficient business to turn a profit, while recouping the costs associated with the air-carrier and re-useable mother-ship payloads. While the company would not go into detail regarding its target customers, the prospective payloads were said to include small commercial satellites currently hitching rides to orbit as secondary payloads.[123]

GeoEye signed a multimillion-dollar deal with ScanEx, a Russian company, to complete a national map of Russian land properties. In the first stage of the agreement, GeoEye will provide ScanEx with previously acquired imagery from its GeoEye-1 high-resolution optical Earth observation satellite. In the next stage, starting in 2012, GeoEye will provide ScanEx with new imagery to supplement the creation of the nationwide map. ScanEx has participated in a series of similar contracts signed with GeoEye and with Europe's Astrium Services, working under contract for the Russian Federal Service for State Registration, Cadastre and Cartography to provide maps of all Russian localities. The company has already mapped 49 million land parcels and placed them in a Web-based system for use by local government agencies and the public; averaging 12,000 visits per day.[124]

Space Exploration Technologies (SpaceX) will launch commercial telecommunications satellites, AsiaSat 6 and AsiaSat 8, in 2014. AsiaSat of Hong Kong ordered the development of the two satellites from Space Systems/Loral of Palo Alto, California, to increase the capacity of the current AsiaSat fleet in orbit. Meanwhile, SpaceX is currently retooling its Falcon 9 rocket for missions to the geostationary orbit used by most telecommunications satellites. SpaceX now has two customers in Asia following its additional 2011 contract with Thaicom of Thailand. Interestingly, Thaicom is also paying AsiaSat $171 million over 15 years for half of the capacity of AsiaSat 6. That satellite, located at 120 degrees east longitude and carrying 28 C-band transponders, permits Thaicom to retain its rights to the 120-degree slot that otherwise would have expired under International Telecommunication Union rules. Its share will be rebranded as Thaicom 7 for marketing purposes. Commercial launches now represent over 60% of SpaceX's upcoming missions. The company has contracted with SES of Luxembourg for the launch of a single commercial telecommunications satellite in 2013 pending upgrade tests of the Falcon 9. And SpaceX will also launch the Iridium NEXT constellation of LEO communications satellites starting in 2014.[125]

SpaceX is developing a new launch pad at Vandenberg U.S. Air Force Base, in California. It plans to use that facility to launch the standard Falcon 9 rocket and its upcoming heavy-lift variant. SpaceX currently launches its Falcon 9 only from Canaveral Air Force Station, whereas the new pad will be built to also accommodate the developmental Falcon 9 Heavy launch vehicle, to debut in 2013 at the earliest.[126] The company will spend between $20 million and $30 million to renovate the site, unused since 2005; the Titan 4 was the last rocket launched from there. SpaceX will also update its launch facility in Cape Canaveral, allowing the heavy-lift rocket to launch from both coasts. Using the Falcon 9 Heavy Launcher will cost between $80 million and $125 million; [127] whereas launching low-end versions of the Delta 4 generally costs around $200 million.[128]

SpaceX is also expanding its Florida base in other respects, building additional hangars to prepare its Falcon 9 rockets and customer payloads for launch. Of the more than 40 flights on its manifest, valued at $3.5 billion, from the U.S. government, commercial and international customers, 40% is for NASA, flying cargo to the ISS beginning in 2012. With an expected flight rate of 10 to 12 launches per year, the current facility (Space Launch Complex 40) will receive a 16,000 square-meter addition, including an unused Delta 2 processing building. SpaceX will receive $7.3 million from Space Florida, a state-funded agency, toward the upgrades. These upgrades include, *inter alia*, a clean room, a hazardous hypergolic fuelling facility and enough volumetric space to encapsulate a payload in a fairing in a vertical position.[129]

SpaceX had its first Falcon 9 rocket launch to the International Space Station (ISS) on 22 May 2012.[130] The date allowed NASA to check SpaceX's flight software, while also avoiding any conflict with the launch of three new crew members, launched from Baikonur, Kazakhstan on 14 May 2012.

[123] Leone, Dan. "Stratolaunch Charts Course for a Tough Market." Space News 16 Jan. 2012: 6.
[124] "GeoEye Wins Contract for Mapping Russian Properties." Space News 9 Jan. 2012: 8.
[125] De Selding, Peter B. "SpaceX To Launch Pair of Satellites for AsiaSat." 8 Feb. 2012. Space News 3 May 2012 <http://www.spacenews.com/contracts/120208-spacex-launch-asiasat-sats.html>.
[126] "SpaceX Breaks Ground on West Coast Launch Pad." Space News 25 July 2011: 8.
[127] Associated Press. "SpaceX Breaks Ground on California Launch Pad." 13 July 2011. ABC News 3 May 2012 <http://abcnews.go.com/Technology/wireStory?id=14059673>.
[128] De Selding, Peter B. "Boeing, ULA Wrangle with Air Force Over Delta 4 Launch Contract Prices." 29 Apr. 2011. Space News 9 May 2012 <http://www.spacenews.com/military/110429-boeing-ula-wrangle-af-delta-prices.html>.
[129] Klotz, Irene. "SpaceX Expanding Florida Facilities to Meet Launch Demand." Space News 28 Nov. 2011: 5.
[130] Space News Staff. "SpaceX Delivers Falcon 9 to Orbit." 22 May 2012. Space News 23 May 2012 <http://spacenews.com/launch/120522-spacex-falcon-delivers-dragon-orbit.html>.

A successful demonstration would mark the first commercial flight to ISS. Prior to latching and berthing onto the station, the launcher's Dragon capsule must successfully conduct a series of manoeuvres; if the capsule is unable to hook up with the station, another demonstration test flight would be scheduled. Once successful, the supplies would be unloaded and afterwards the capsule would detach, re-enter Earth's atmosphere, and land in the Pacific. If successful, SpaceX may then start conducting commercial resupply missions to the ISS under the terms of a $1.6 billion contract with NASA.[131]

Virgin Galactic plans to conduct its first rocket-powered test flight of SpaceShipTwo (SST) by the end of 2012. The spacecraft has already performed 16 unpowered flight tests, involving drop tests where SST would glide back to a runway after being dropped in midair from its mother ship, WhiteKnightTwo, and performing a set of manoeuvres along with ballast checks. Designed to be released from its carrier at an altitude of 15km, its SSTs rocket engine will ignite to propel the craft at an apex altitude of about 100km. Should this flight proceed as expected, Virgin Galactic may be able to start flying customers sometime between 2013 to 2014. Nearly 500 passengers have already signed up, each willing to spend $200,000 for the flight. Among these customers are scientists along with their experiments and space tourists. Soon, other companies might also be able to provide similar suborbital space travel products, including *inter alia* XCOR Aerospace, Blue Origin and Armadillo Aerospace.[132]

Despite experiencing weakness in the mobile satellite services market for usage of its hand-held satellite telephone, Inmarsat is expected to have record revenue growth in 2011 thanks to cash coming in from the struggling U.S. wireless-broadband start-up, LightSquared. LightSquared secured a broad portion of the L-band spectrum to provide its service by paying Inmarsat to modify its use of the same spectrum and to retrofit certain Inmarsat hardware to avoid future interference. Receiving over $268.1 million in 2011 (total funds received amount to $420.6 million), $152.8 million will be recognized as revenue for 2011. Inmarsat's FleetBroadband maritime product has been successful beyond Inmarsat's forecasts, adopted by 23,500 ships worldwide, and its hand-held satellite telephone has met company forecasts for new subscribers with at least 10% of the market. Yet with slowly developing usage and revenue rates, the company is investing in additional capacity, i.e. $1.2 billion in a next-generation, Ka-band service called Global Xpress, and also spending $113 million to purchase Ship Equip of Norway.[133]

3.3 Russia

Sea Launch AG is back in operation after coming out of U.S. Chapter 11 bankruptcy, gaining a Russian owner, and moving its registered headquarters from California to Switzerland. Coming out of a 30-month break, Sea Launch has returned to the market debt-free, while remaining a private international venture without privileged access to any government satellite markets. With total operating and financing costs of no more than around $50 million per year, the company will break even at 3 launches annually, and it aims to reach its target launch rate of 5 launches per year by 2014. It conducted a successful launch of Eutelsat's Atlantic Bird 7 Satellite in September 2011, followed by a subsequent land launch of the Intelsat-18 satellite on a modified version of the Sea Launch vehicle in October.[134] After having secured the backing of both Intelsat and Eutelsat (the world's 1st and 3rd largest commercial satellite fleet owners), with additional satellites scheduled to be launched in the upcoming years, Sea Launch is looking to provide launch services to SES (the 2nd largest fleet owner) as well.[135]

3.4 Japan

NEC Corp. of Tokyo will design and build hardware for Japan's Hayabusa-2 asteroid sample-return mission, which JAXA plans to launch in 2014. The probe will be similar in design to the original Hayabusa spacecraft, weighing 600 kilograms when fully fuelled and it will be fitted on a larger

[131] Boyle, Alan. "SpaceX station launch set for May 19." 4 May 2012. Cosmic Log on MSNBC.com 3 May 2012 <http://cosmiclog.msnbc.msn.com/_news/2012/05/04/11543790-spacex-station-launch-set-for-may-19?lite>.
[132] Wall, Mike. "Virgin Galactic Aims for 1st Rocket-Powered Flight This Year." 28 Feb. 2012. SPACE.com 3 May 2012 <http://www.space.com/14706-virgin-galactic-spaceshiptwo-powered-flight.html>.
[133] De Selding, Peter B. "LightSquared Deal a Boon To Inmarsat's Otherwise Flat Business." Space News 7 Nov. 2011: 16.
[134] Bergin, Chris. "Zenit 3SLB launches successfully with Intelsat-18 satellite." 5 Oct. 2011. NASAspaceflight.com 2 May 2012 < http://www.nasaspaceflight.com/2011/10/live-zenit-2slb-launch-intelsat-18/>.
[135] De Selding, Peter B. "Sea Launch Back in Business with Successful Eutelsat Launch." Space News 3 Oct. 2011: 5.

satellite platform than its predecessor. The Hayabusa-2 will hold a more powerful sample collection system that will attempt to dig a crater in the asteroid to bring a bigger cache of samples back to Earth. Moreover, the Hayabusa-2 will be equipped with a Ka-band communications subsystem that will be faster than the original Hayabusa's X-band system, and it will carry a sophisticated camera to better capture the shape and the geography of the asteroid. The ¥16 billion ($204 million) spacecraft will be designed to visit 1999 JU3, a 920-meter-diameter carbonaceous asteroid in a similar orbit to Itokawa. Carbonaceous asteroids are plentiful, rocky, and thought to contain water and organic materials, whereas asteroids like Itokawa are stony, and are thought to lack the same organic materials.[136]

Mitsubishi Electric Co. of Japan plans to double its annual satellite-related revenue to ¥152.4 billion ($1.9 billion) by 2021. The company is investing in new satellite production and test facilities as part of its strategy, already launching its first non-Japanese funded ST-2 commercial satellite on 20 May 2011; the ST-2 was funded as part of a joint venture between Singapore Telecommunications Ltd. and Chunghwa Telecom of Taiwan. The Türksat 4A and 4B telecommunications satellites will soon join the group of Japanese commercial satellites in 2013 and 2014. With its DS2000 satellite frame proven in orbit on Japanese commercial and technology-demonstration missions, Mitsubishi will be more aggressive in the commercial market, planning to spend ¥3 billion ($37 million) on the new plant and equipment to enlarge total facilities (satellite production, integration and test floor space) to 7,700 square meters. Through this pursuit, Mitsubishi hopes to realise its doubled satellite revenue goal by 2021.[137]

3.5 China

The Chinese launcher, Long March 3B successfully placed Eutelsat's W3C Commercial Telecom Satellite into geo-orbit on October 7, 2011. Twelve years had passed since the U.S.'s ITAR ban on satellite technology exports to China. At that time, the U.S. Congress passed a law reclassifying commercial satellites as weapons systems for export purposes, making them subject to ITAR. The impetus for such action was based on fear that China was using commercial satellite launches to perfect its missile technology. In fact, while the newly released U.S. government "1248 report" recommends allowing the government to focus its ITAR controls on technologies and capabilities that are only the most sensitive; it still recommends strengthening the U.S. ban on shipping U.S. satellite technology to China for launch on Chinese rockets.[138] Despite the export ban, Thales Alenia Space wanted access to the Chinese market, and developed an "ITAR-free" product line. Eutelsat was the first to contract for a launch, making it China's first launch for a Western satellite owner in more than 12 years. Intelsat, SES, and Telesat (the 4th largest fleet operator based in Canada) have yet to order an ITAR-free satellite, however, they have all expressed an interest in doing so. One reason for these companies' hesitation in using the Chinese vehicle is that they have U.S. government-licensed orbital slots, subjecting them to the risk of regulatory backlash that may compromise these assets.[139]

AsiaSat of Hong Kong reported an 18% increase in revenue and a 26% increase in operating profit for 2011. Total revenue amounted to 1.72 billion Hong Kong dollars ($221 million), while operating profit was 1.05 billion Hong Kong dollars ($135 million). SpeedCast, an AsiaSat subsidiary providing two-way broadband links to corporate and government customers, increased its revenue by 16% during the same period and accounted for 14% of AsiaSat's revenue. The company has agreed to sell to an undisclosed third party its 50% stake in the money-losing Dish-HD Asia Satellite venture with EchoStar of Englewood, Colo.; a venture which never realized its promise to provide 36 enhanced standard-definition and high-definition television channels in Taiwan, and widened its losses in 2011. The sale of AsiaSat's share should close within a year upon gaining regulatory approval. Besides the four satellites operated by AsiaSat, the newest being AsiaSat 7 which entered into service in February, two more satellites have already been ordered from Space Systems/Loral, i.e. AsiaSat 6 and AsiaSat 8, which should be ready for launch in the first half of 2014.[140]

[136] Kallender-Umezu, Paul. "NEC Tapped to Build Second Asteroid-bound Hayabusa Probe." Space News 30 Jan. 2012: 10.
[137] "Melco Expansion Aimed at Doubling Satellite Revenue." Space News 13 June 2011: 9.
[138] Leone, Dan. "U.S. Report Supports Sweeping Reform of Satellite Export Rules." 18 Apr. 2012. Space News 23 May 2012 <http://www.spacenews.com/policy/120418-report-backs-reform-sat-export.html>.
[139] De Selding, Peter B. "Chinese Rocket Launches Eutelsat's W3C Satellite." Space News 10 Oct. 2011: 4.
[140] De Selding, Peter B. "AsiaSat Reports Rising Profit, Remains Bullish on Satellite TV Market." 22 Mar. 2012. Space News 3 May 2012 <http://www.spacenews.com/satellite_telecom/120322-asiasat-rising-profit.html>.

3.6 India

Very high regulatory barriers in India make access to its satellite telecommunications market an unusually difficult pursuit. Nevertheless, SES of Luxemburg is investing heavily there in the hope of capturing 40% of the Indian satellite television market within the next few years. Capacity will be increasing as part of a major capital spending program, as SES's total in-orbit transponder supply will be increased by 23%, i.e. 293 transponders on 12 satellites will be launched between 2011 and 2014; 85% of that capacity will be directed toward emerging markets, mostly television markets. India is by far the biggest emerging market; its six pay-TV and one free-to-air DTH satellite television providers have a combined total of 32 million subscribers, with that number growing at a rate of nearly 1 million per month toward 60 million. With over 300 television channels awaiting regulatory approval, the sheer demand partly explains why India has been forced to allow SES and other non-Indian satellite providers into the market. It is likely that India will remain a growing market for non-Indian providers for the long term, as the regulations will necessarily be relaxed since India will never launch enough bandwidth on its own to meet demand.[141]

Legislators in India have not come to this same conclusion, where in April 2012 the Indian government proposed a new tax that would impose a 10% royalty fee on foreign satellite communications services that would be retroactive covering the past 36 years. The government is looking for ways to reduce its deficit without regard to the crippling effect this tax will have on broadcast and communications, when there is already a shortage of domestic satellite bandwidth. Such a move would put India in breach of its international tax treaties, where compliance with the royalty tax would amount to double taxation. The matter is now on appeal before the Supreme Court of India; however, if the tax is enforced and foreign satellite providers are unable to obtain a tax credit in their own tax homes, they will be forced to pass on the royalty withholding to their customers in India. The 130-member Cable and Satellite Broadcasting Association of Asia (Casbaa), including many of the world's biggest commercial satellite fleet operators, is attempting to persuade the Indian government that retroactivity violates basic international rules and principles of fair play.[142]

3.7 World

Global orders for commercial GEO telecommunications satellites fell by about 35% in 2011, from 26 to 17 in 2011; beginning the long-anticipated decline of spending by the biggest satellite fleet operators. The effect of this reduction in spending on affected markets remains unclear, and will depend on spending patterns of the four largest satellite fleet operators, Intelsat of Luxemburg and Washington, SES of Luxemburg, Eutelsat of Paris and Canada's Telesat. Yet the drop in satellite manufacturing orders in 2011 will likely not be felt by the global commercial launch industry until 2014 since the launcher sector lags behind the trend in the satellite manufacturing industry by 2 to 4 years. Moreover, as the number of launch contracts for geostationary-orbiting commercial satellites increases yearly, satellites that are not ready for launch in a previous year are pushed up to the next available launch opportunity, further swelling already saturated launch years.[143]

On 12 January 2012, the Canadian satellite component manufacturer Com Dev International reported a decrease in revenue, but higher profitability for the fiscal year ending 2011. Moreover, its new maritime surveillance subsidiary is expected to double its revenue in 2012. The company is seeking to return to its previous levels of profitability, 25% or higher gross margin, rather than grow revenue. Twenty-six satellites were ordered in 2011, whereas 32 were ordered in 2010. Moreover, the number of transponders on the satellites that were ordered in 2011 decreased by 11% from 2010. Despite the downturn, the company is not greatly concerned, explaining that it is the type of customer that is changing. As larger satellite fleet operators are beyond the peak of their replacement-and-expansion cycle, demand is increasing among smaller satellite manufacturers whose products can be tailored to better fit the needs of the region in which they operate.

[141] De Selding, Peter B. "Despite Barriers, SES Invests Heavily in Indian Satellite Market." Space News 6 June 2011: 6.
[142] De Selding, Peter B. "Satellite Fleet Operators Protest Indian Tax Proposal." 5 Apr. 2012. Space News 9 May 2012 <http://www.spacenews.com/policy/120405-sat-operators-protest-indian-tax.html>.
[143] De Selding, Peter B. "Satellite Orders Drop but Near-Term Launch Manifests Are Full." Space News 9 Jan. 2012: 11 and 12.

4. European Institutional Market

This chapter will analyse institutional space spending in Europe along distinct internal categories. The contributions are explained and contrasted with each other, exhibiting significant ratios and proportions regarding European space activities, and establishing a basis for comparison with space actors outside Europe.

4.1 European Institutional Features

Space programmes in Europe develop simultaneously on three distinct levels, i.e. national, intergovernmental (e.g. ESA, EUMETSAT) and supranational (European Union). Figure 4.1 displays the structure that results from the overlapping complementary budgetary lines.

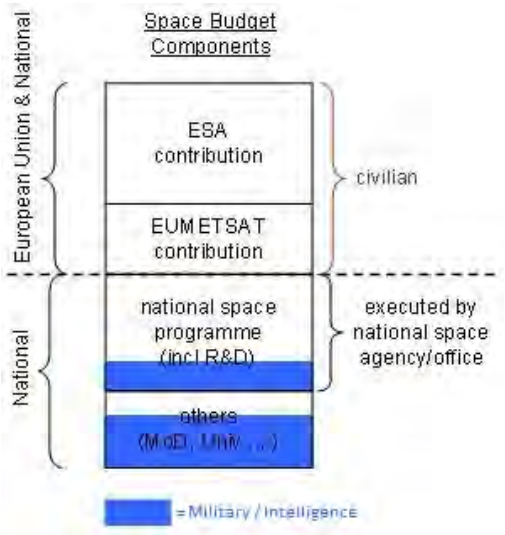

Figure 4.1: General structure of space budgets

4.2 Civilian Space Expenditure

A consequence of the aforementioned structure is that, in terms of utilisation, national space budgets in Europe usually have both European and national components. The former usually consist of contributions to European Space Agency (ESA) and EUMETSAT and is regarded as civilian for the purposes of this report, as both organisations are broadly labelled as civilian despite the presence of dual-use products and services. While direct member state contributions to the European Union do not officially have a space related designation, EU funds have been increasingly used to finance space activities. In this section they are only visible through the ESA budget or are wrapped into the budgets of other actors.

National space budgets usually have three tiers: civilian, military and space related academic research. Countries with national space agencies essentially fund the first and third tiers through the agencies, while funding for the second tier remains under defence ministry control. In countries that prefer less centralised approaches, e.g. the United Kingdom until recently, budgetary lines are dispersed throughout government agencies, making them more difficult to account for.

In addition to vertical delineation, space related budgets are also dispersed horizontally among national, bilateral and multilateral space cooperation agreements. While some European countries are engaged in multinational cooperation through participation in ESA, they may also have bilateral agreements on space activities between them. Through this cooperation, certain security related space projects are funded simultaneously by European institutions (notably the European Commission and the European Defence Agency) and by other sources. The share of funding for military and intelligence gathering activities is represented in the blue area of Figure 4.1. However, academic research and development projects may in a similar way be channelled both through ESA and bilateral scientific cooperation agreements.

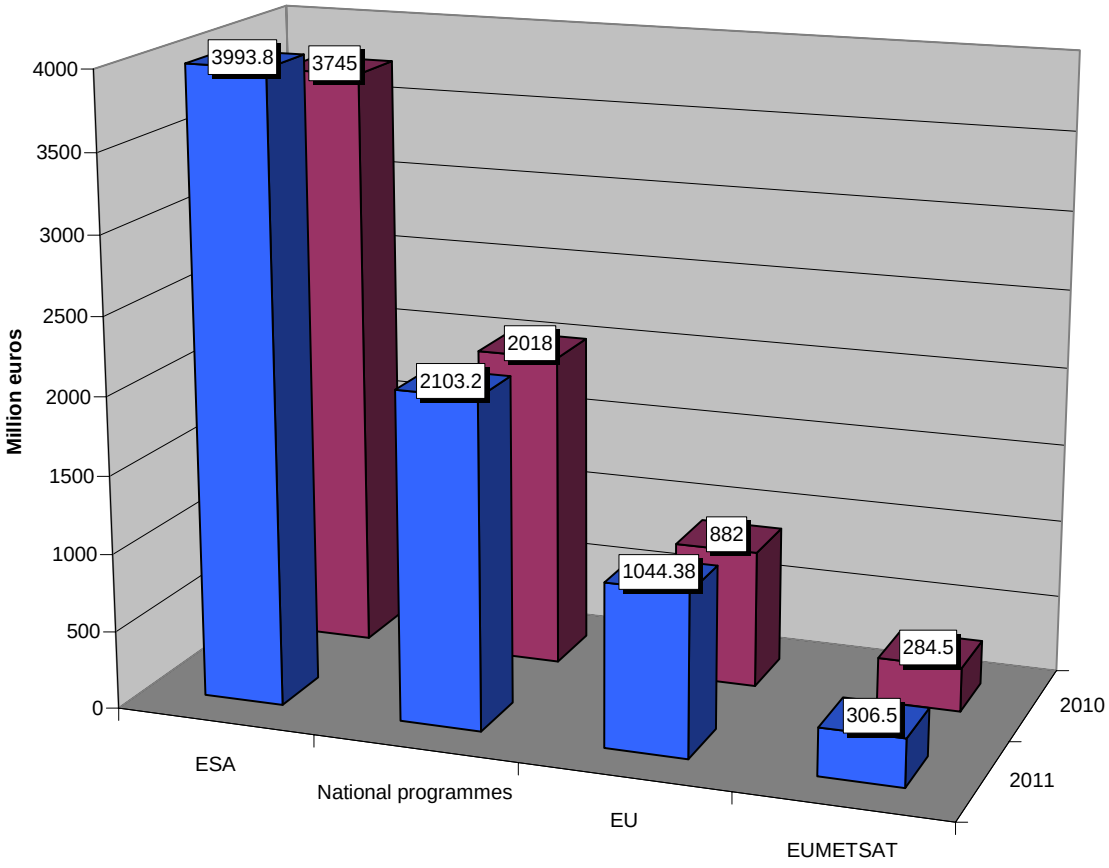

Figure 4.2: Estimated European civil public expenditures in 2011.

Investment in military and intelligence gathering space activities is not obligatory among all European states; additionally, most institutional spending is directed toward civilian activity. The total sum of European institutional spending on space in 2011 was around €7.45 billion, amounting to an increase of €518 million compared to about €6.932 billion in 2010. The investment share between civilian and military funding is not readily available, but can be estimated to be similar to 2010 and 2009 (i.e. around 90% civilian and 10% military). The U.S. overshadows Europe's investment in security-related space activities in both its share-size and amounts invested; i.e., 56% and $26.46 billion (€20.43 billion) on security-related space activities. Europe's investment in security-related space activities is a mere fraction of the Space Report 2012's estimate of $1.39 billion (€1.07 billion) in combined military spending by the rest of world.[144]

4.3 European Space Agency (ESA)

The European Space Agency's budget rose again in 2011 to €3.994 billion from €3.745 billion in the previous year. The 2011 budget reflects changes in allocations due to ESA's involvement in the Galileo and GMES programmes. Earth observation received the highest priority, accounting for 21.1% (€843.9 million) of ESA's budget for programmes and mandatory activities. Navigation is the second largest area where ESA directs its funding, i.e. 16.7% (€665.7 million). And the third largest outflow involves launcher related expenditures, i.e. 15.3% (€612.5 million). The funding for the rest of ESA's programmes is overshadowed by these programmes, with space science receiving 11.6% (€464.8 million), human spaceflight receiving 10.3% (€410.9 million), and telecommunications receiving 8.5% (€341.3 million).[145] The rest of the budget is directed toward activities where the share percentages are between 5.4% and 0.2%.

[144] Cf. The Space Report 2012…: 58.
[145] "ESA Budget by Programme (2011). ESA 21 Mar. 2011 <http://download.esa.int/docs/DG/ESA_2011_Budget_040111_rev2.ppt>.

The utilization of the ISS has been extended from 2015 to 2020; thereafter the ISS partners plan to have the spacecraft enter Earth's atmosphere and plunge into an ocean to avoid creating a massive piece of space debris.[146] Europe, through ESA, contributes to the development of the ISS, as does NASA, the Russian Federal Space Agency, JAXA, and CSA. Germany is Europe's largest contributor to the ISS with a funding commitment share of 41%; France has a 27.6% share, while Italy's share is 18.9%. These three states represent the body of ISS funding coming from ESA, amounting to a combined 87.5% share of the total sent from ESA. The other European ISS contributors include Belgium (3%), Switzerland (2.5%), Spain (2%), Denmark (1.17%), The Netherlands (0.94%), Norway (0.46%), and Sweden (0.4%) with the final 2.03% contributed from Other areas.[147]

ESA has picked EADS Astrium to manage the operation and exploitation of the European components on the International Space Station (ISS). This contract, for operational services at a fixed cost of €240 million and covering 2011 to 2012, is the first phase in a long-term ISS service agreement between ESA and Astrium to run through to 2020. Astrium will facilitate contracts for services related to the operation of these components, including *inter alia*: mission preparation and delivery, astronaut training, developments for new experiments and research facilities, maintenance and logistics for components and ground stations, communications and data transfer. As prime contractor, Astrium will lead a consortium consisting of 40 industrial partners in the 10 European countries participating in the ISS.[148]

While the life-cycle of the ISS has been extended by another 5 years, ESA has cancelled the development of Automated Transfer Vehicles (ATVs) from Thales Alenia Space after 2015. Instead, the space agency has directed Thales to look for ways to supply a service module for the Multi-Purpose Crew Vehicle (MPCV) that Lockheed Martin started building under the old Constellation program.[149] Three ATVs have resupplied the ISS by 2012, with the ATV-1 Jules Verne launched in 2008, the ATV-2 Johannes Kepler launched in February 2011, and the ATV-3 Edoardo Amaldi launched on 23 March 2012. With a mass over 20 tonnes, the ATV-3 is the heaviest payload the Ariane 5 rocket has ever launched into space.[150]

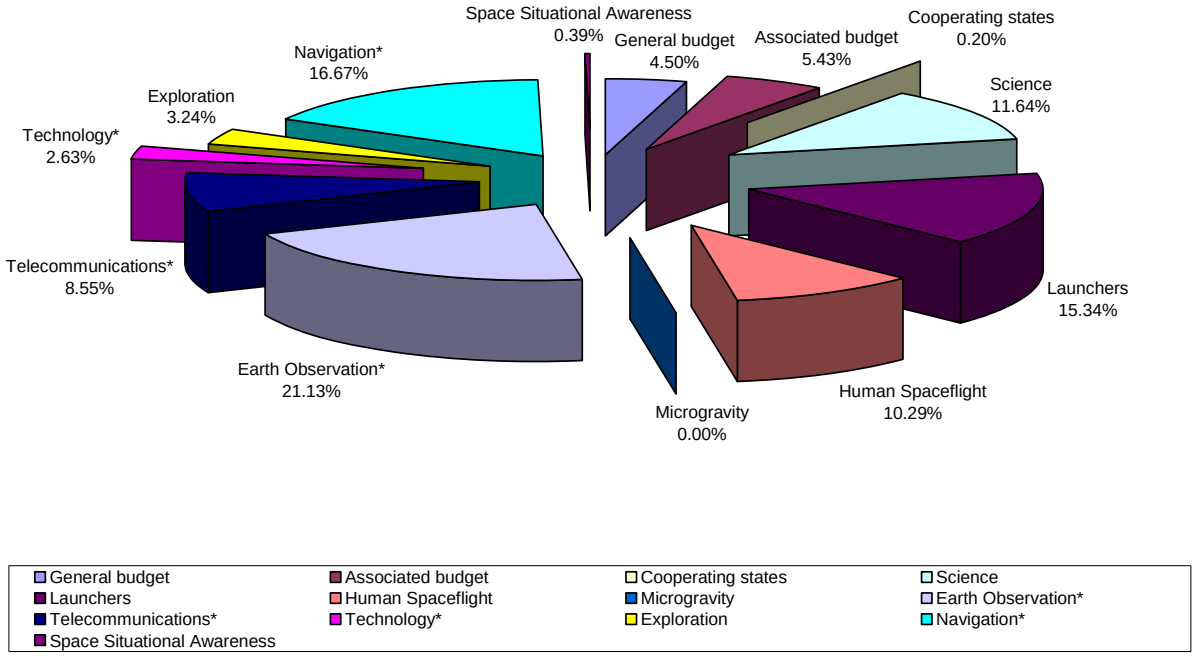

Figure 4.3: ESA Programmatic Budget Allocations for 2011 (Source: ESA)

[146] AFP. "Space Station to Be Sunk After 2020." 27 July 2011. Discovery News 7 May 2012 <http://news.discovery.com/space/space-station-end-ocean-110727.html>.
[147] "European Participation – Participating States." ESA – International Space Station 7 May 2012 <http://www.esa.int/esaHS/partstates.html>.
[148] Press Centre. "Astrium will continue to manage the ISS on behalf of ESA" 13 Dec. 2011. Astrium – An EADS Company 8 May 2012 <http://www.astrium.eads.net/node.php?articleid=8068>.
[149] Morring, Jr., Frank. "Spacefaring Nations Regroup For Push Beyond LEO." Aviation Week & Space Technology 10 Oct. 2011: 46.
[150] Botta, Oliver. "Factsheet - ATV-3 Edoardo Amaldi begins its journey to the ISS." 19 Mar. 2012. Swiss Space Office 6 May 2012 <http://www.sbf.admin.ch/htm/dokumentation/publikationen/raumfahrt/FactSheet_ATV3-e.pdf>.

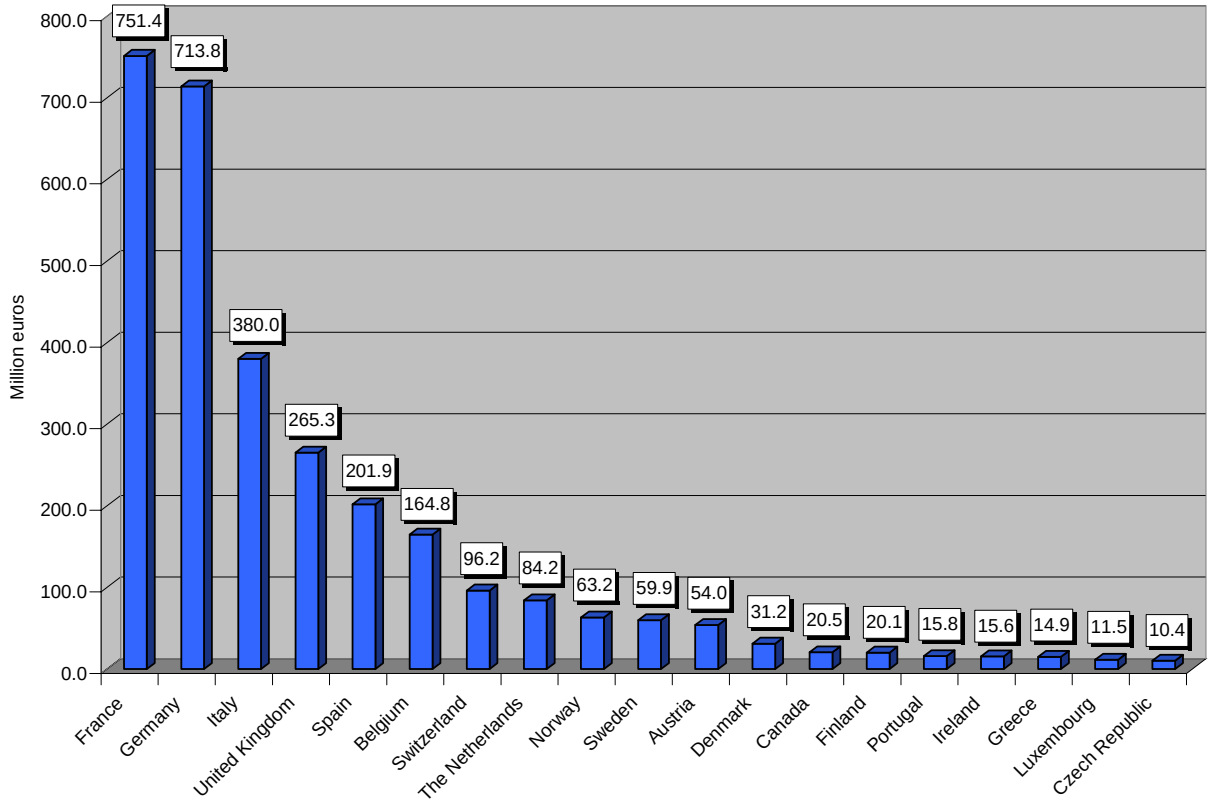

Figure 4.4: Member States' Contributions to ESA Budget for 2011 (Source: ESA)

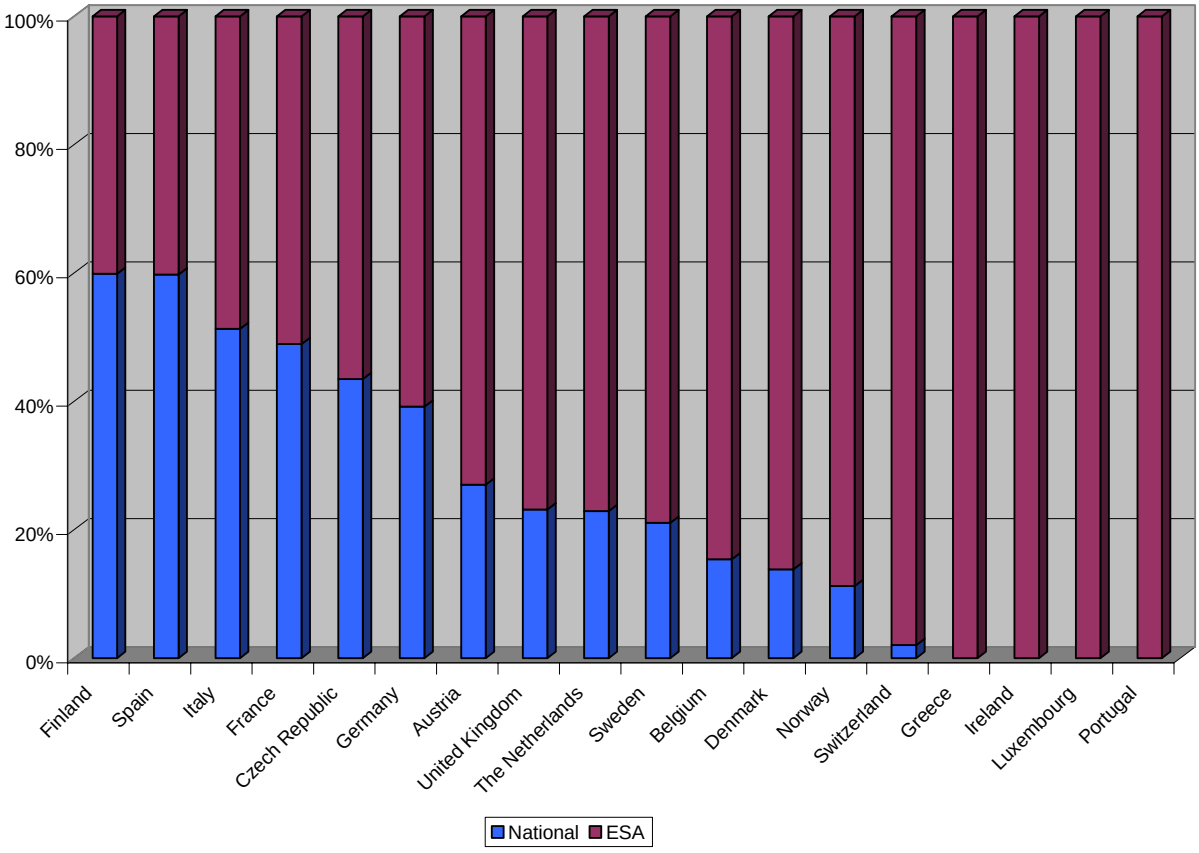

Figure 4.5: Estimated Shares of European National Institutional Investment in Civilian Space of ESA Members in 2011

The European Space Agency has financially backed EADS Astrium to build a new high-speed data relay service for Europe while also creating the market for it. The Public-Private Partnership (PPP) agreement signed on 4 October 2011 will provide Astrium with €275 million toward establishing a European Data Relay Satellite (EDRS) system. Two payloads are being developed for the service at an estimated cost of about €400 million, and they are scheduled to be operational by 2014. The development of such a system would eliminate Europe's dependence on non-European ground stations for the reception of Earth-observation satellite data, i.e. a potential threat to European independence. While demand for the EDRS system is currently unknown, it will have at least one core customer for data relay services in the European Commission's GMES project. The EDRS system is the 4th and most complicated PPP agreement established with ESA; other ESA PPPs include the Hylas-1 telecommunications satellite, Alphasat, and Germany's Small GEO platform.[151]

4.4 EUMETSAT

Last year, EUMETSAT gave approval for the METEOSAT Third Generation System (MTG). The six-satellite, €3.3 billion MTG system will be funded by all EUMETSAT Member States and by the 14 ESA Member States that approved and signed the resolution authorising the ESA part of the programme. The MTG system will succeed the currently orbiting METEOSAT geostationary system in 2016.[152]

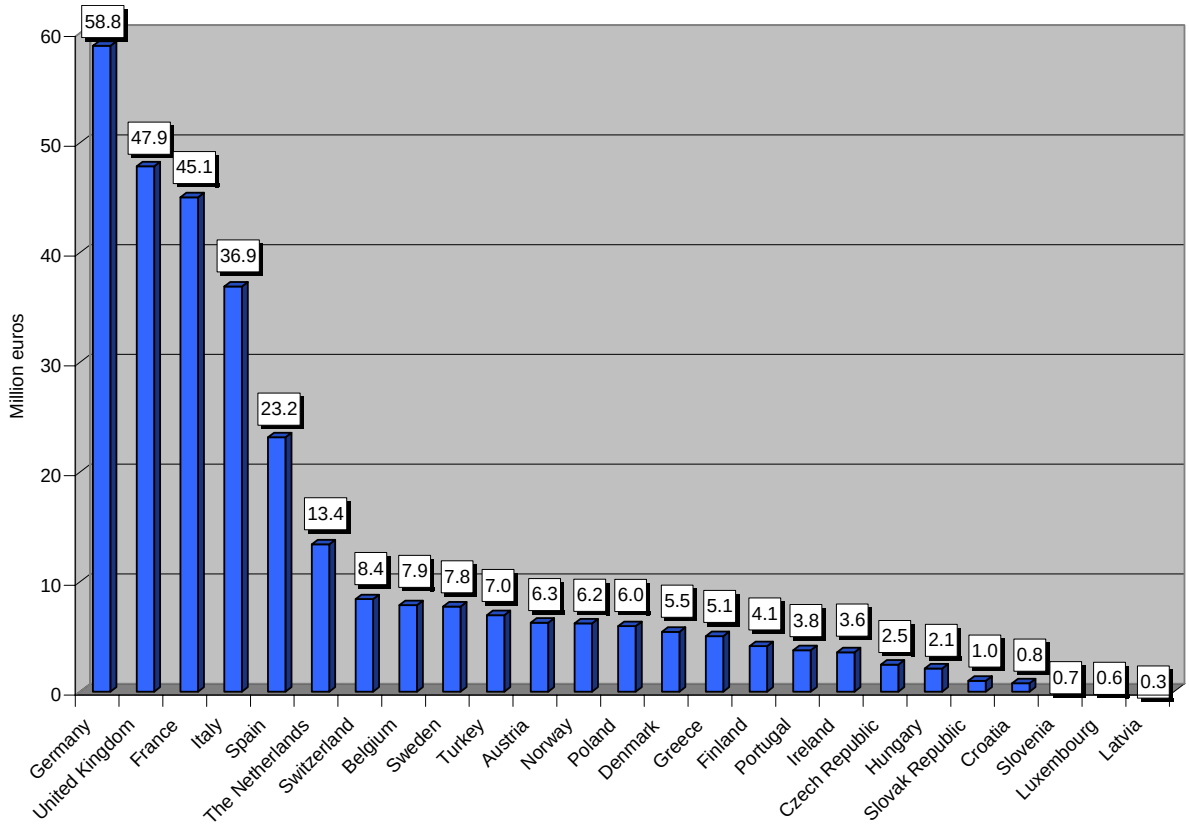

Figure 4.6: Member states' contributions to EUMETSAT in 2011 (Source: EUMETSAT)

[151] Svitak, Amy. "Astrium Gambles On Potential Satellite Data Relay Market." Aviation Week & Space Technology 17 Oct. 2011: 49.
[152] Taverna, Michael A. "German OK Paves Way For Weather Sat Program Launch." Aviation Week & Space Technology 28 June 2010: 32.

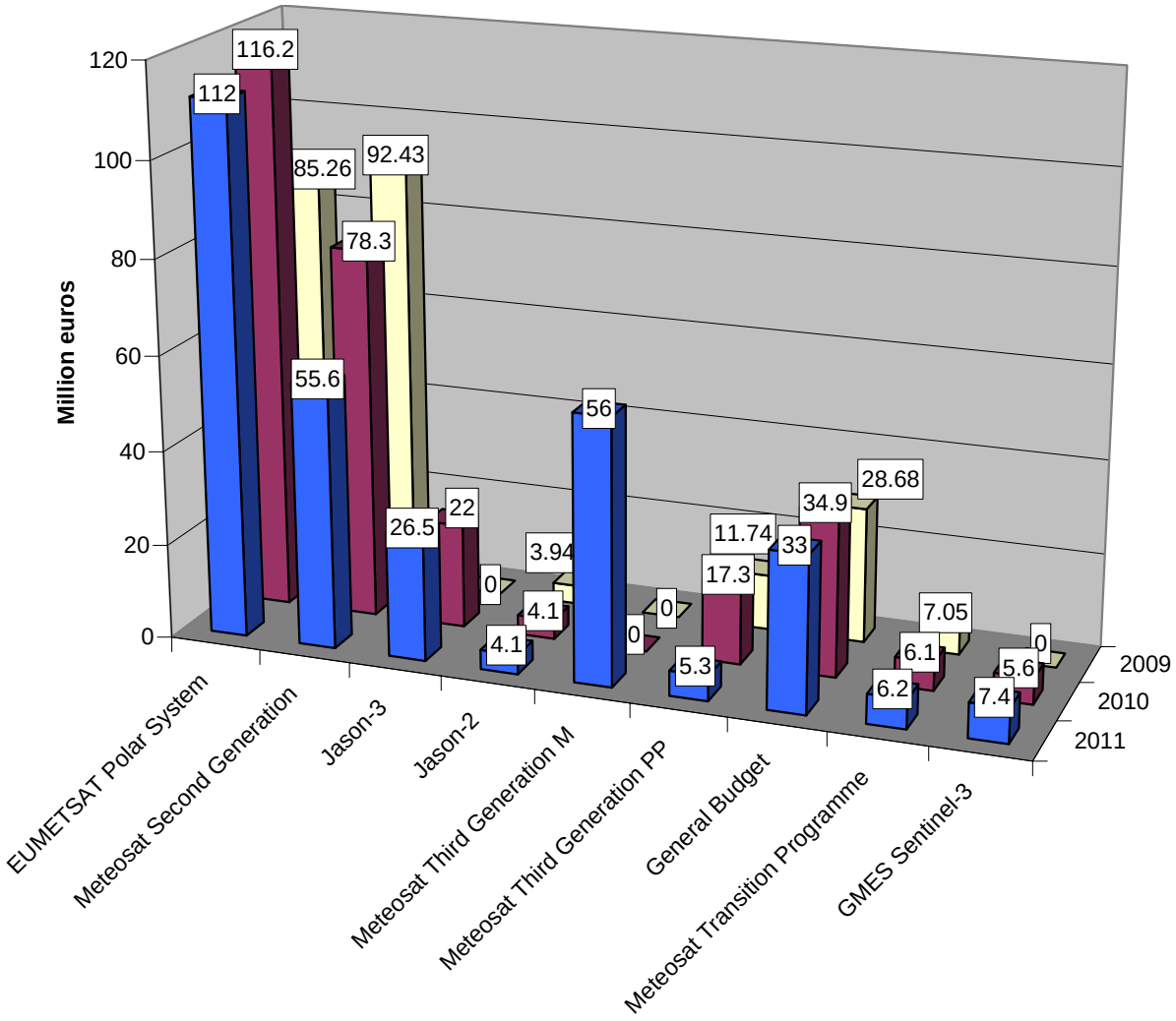

Figure 4.7: Major Programmatic Allocations of EUMETSAT 2009-2011

The vast majority of EUMETSAT's budget comes from contributions from member states and cooperating states. Member contributions are calculated on the basis of their Gross National Income (GNI), rather than GDP. The percentage distribution of contributions in 2011 remained roughly similar to that of 2010. Germany maintained its position as the largest contributor with a slightly diminished share contribution of 19.20% from the previous 19.47%; likewise, the UK followed with 15.62%, France with 14.70%, and Italy with 12.04%. Spain and the Netherlands continued their noteworthy participation at 7.54% and 4.34 %, respectively. These six states account for 73.44% of the total 2011 allocation (Figure 4.6). The contributions from the remaining member states consist of percentage shares that range from 2.75% to as low as 0.10%, with little variation from the amounts invested in 2010.

The 2011 general budget of EUMETSAT has increased to €306.1 million to allow a substantial increase of participation in the programme Jason-3 and the start of the METEOSAT Third Generation Programme. Whereas contributions to Jason-2 have remained unchanged, Jason-3 has received a boost in funding to €26.5 million. As expected, funding for the METEOSAT Third Generation Preparatory Programme has been diminished to 1/3 of its previous funding, at €5.3 million, while €56 million was put toward the METEOSAT Third Generation programme proper. The year's budget allocated more funds to GMES Sentinel 3, evincing also its greater importance in EUMETSAT's budget during the coming years. Despite a budget increase of €30.9 million in 2010, the EUMETSAT Polar System was allocated less funding in 2011, with a cyclical decrease of €4.2 million; yet, the system still received a considerable amount of €110 million for 2011. Allocations for METEOSAT Second Generation have decreased more significantly than the previous reduction of €14.1 million; this year, the program decreased by another €22.7 million, operating at €55.6 million. These consistent sizable drops in funding demonstrate purely that METEOSAT Second Generation is getting close to the end of infrastructure investment, and that in future operational costs will dominate in the pro-

gramme. In the geostationary field the investment focus will thus shift to METEOSAT Third Generation, where Preparatory Programme funding will increasingly be replaced by very significant investment in the main programme. It is likely that 2012 will continue the levels of investment in MTG and GMES Sentinel 3, while the other programmes are going to stay stable (e.g. the Polar system) or decrease (e.g. METEOSAT Second Generation). The question on the horizon is the funding for the METOP Second Generation Programme; considering that the second satellite in the current series of three is to be launched in the second half of July 2012.[153] Fundamental decisions on Metop Second Generation will have to be made at the ESA Ministerial Meeting at the end of 2012 and by the Eumetsat Council in 2013.

4.5 National Agencies

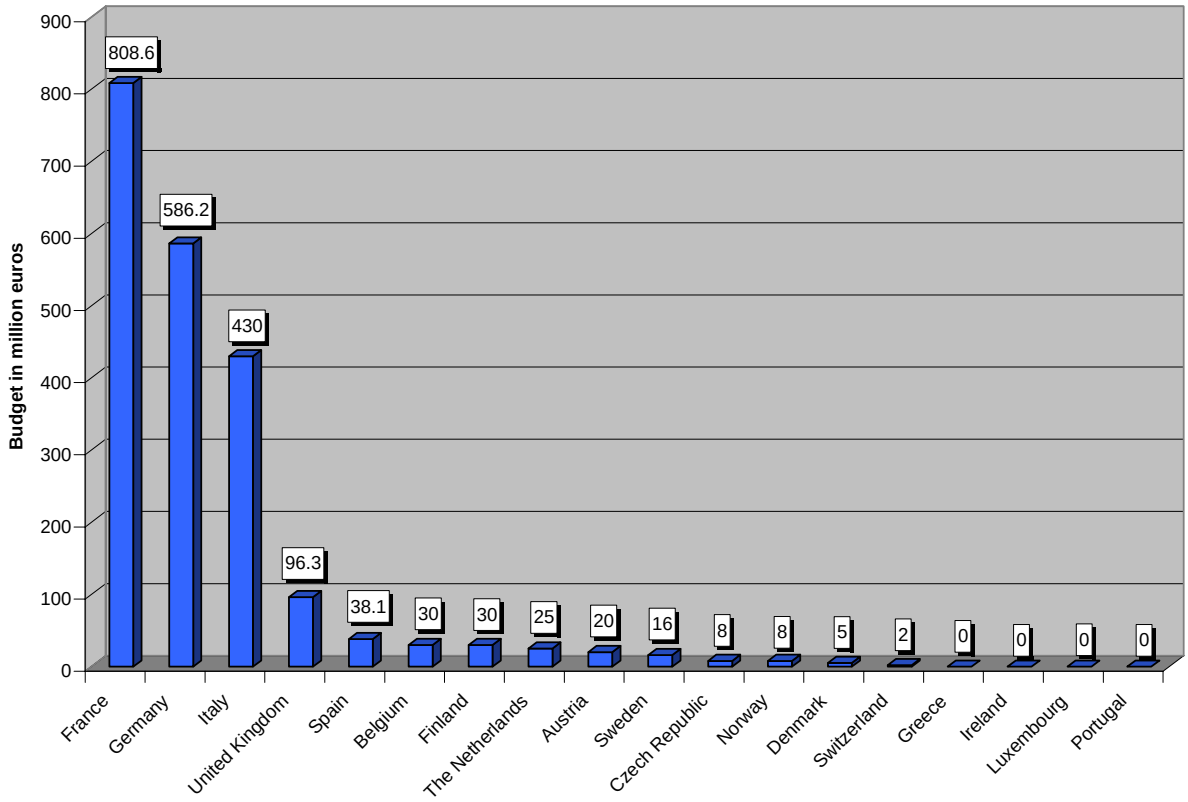

Figure 4.8: National civilian programmes 2011 in million euros

4.5.1 France

France's space budget might not be diminished by Europe's sovereign-debt crisis; while political pressure on public spending has motivated the government to look for budget cuts, it considers investment in the future of the space sector to be a necessity. With a new President coming in, and parliamentary elections in June, it is difficult to know whether the very steady course in space steered until now will continue. With a space budget that has increased by 16% over the past five years, the French Space Agency (CNES) will get €500 million as a public bond issue for upcoming projects in 2012. This funding will be allocated with €250 million in funding for the Ariane 5's successor - €83 million has already been released. An additional €170 million will go toward the Franco-American Surface Water Ocean Topography mission, and €40 million toward Merlin, the Franco-German Earth observation satellite that will measure methane emissions. Another satellite project is being developed for consumer satellite broadband in areas not now covered by terrestrial links, with some spending requiring PPP investment from the French industry.

Following the release of its space strategy report in March 2012, French space priorities are in need of an update if France is to remain Europe's biggest space power. While France was the largest

[153] "MetOp-B launch postponed." 27 Apr. 2012. ESA News 25 May 2012 <http://www.esa.int/esaCP/SEMVIUNW91H_index_0.html>.

contributor to ESA in 2011, it is at risk of being eclipsed by Germany in the coming years. France has contributed €751.4 million, a 25.3% share of the total budget, whereas Germany contributed €713.8 million, 1.3 percentage points below France; the other ESA Member States all contributed less than 13% shares of the rest of the budget. France's space report reiterates France's position on investing in space capacity. However, the strategy document remains unclear on whether to enhance the current Ariane 5 launcher or to develop a successor to the Ariane 5 launch vehicle. Whatever the decision, the report argues for an overhaul of the Ariane 5 launcher.[154]

French space industry revenue for 2011 barely increased from the previous year, earning a total of around €4 billion, with the commercial sector accounting for about 60% of that total; whilst its entire aerospace sector posted a 3.3% increase in revenue, amounting to €38.5 billion. The French space sector represents more than 50% of the European space industry, and hence its 2011 exports dipped along with the global satellite telecommunications satellite market. The revenue from commercial sales was equally split between orders from domestic and foreign customers. GIFAS reports around 13,000 people to be employed within the French space sector.[155]

4.5.2 Germany

Germany would rather commit funding toward upgrading Europe's Ariane 5 rocket, than develop a next-generation launcher. According to the German view, key decisions must first be made on Galileo and GMES prior to addressing launcher development, as Galileo lacks over €1 billion necessary to develop and launch the 30-satellite constellation, and financing for GMES was completely removed from the European Commission's seven-year budget proposal. Meanwhile, Germany and France have tentatively agreed to update the Ariane 5 with a re-startable upper stage that uses the Vinci engine, now in development. With a total upgrade cost of €1.5 billion, this launcher would be capable of launching 10,500 kg into geostationary transfer orbit, an increase of 1000 to 1200 kg from the present Ariane 5 model. The launcher's development will be decided in 2012, with the choice between an Ariane 5 Mid-life Evolution (ME) and an Ariane 6 depending on the demands of government and commercial customers.[156] A high priority for Germany remains exploration and human spaceflight, and hence in 2012 a solution must also be found for the funding of Ariane 5's successor in order to have an overall solution at the ESA Ministerial Council.

Meanwhile, the German Aerospace Center (DLR) has tasked OHB AG to conduct the definition phase of its Heinrich Hertz telecommunications technology-demonstration satellite – to be launched in 2016. Wrought with delays, the €11 million project has moved up the list of German government space priorities as part of a 15-month contract with OHB. While coordinated by the DLR, the responsibility for payload selection will be shared with the German Defence Ministry, and German defence forces will be able to access part of the satellite's payload. Heinrich Hertz will use the Small-Geo platform being developed by OHB, a platform similar to the telecommunications satellite OHB is building for Spanish satellite fleet operator Hispasat.[157]

Germany has also contracted with Darmstadt-based Vega Space GmbH to provide equipment and training for the new German Space Situational Awareness Centre. The contract obliges Vega Space to install the necessary hardware and software by July 2012. The facility will develop space object tracking capabilities by 2019, and it will be operated by the German Armed Forces. Vega will also provide a space objects data catalogue that collates information from sources like ESA's Database and Information System Characterizing Objects in Space (DISCOS). Germany's current method for tracking space objects is through the use of ground radars that work together to give a basic assessment of what satellites are passing over European territory. The questions remaining relate to the financial details of the contract, and whether the system will be controlled by civil or military authorities.[158]

[154] De Selding, Peter B. "French Strategy Paper Says ESA Should Fall Under EU Authority." Space News 2 Apr. 2012: 4.
[155] Press Release. "French Aerospace, Defence and Security Electronics Industry 2011 Results." 4 Apr. 2012. GIFAS 8 May 2012 <https://www.gifas.asso.fr/reaxia/files/ppfwu/2012avril4_GIFAS_Communique_de_Presse_en.pdf>.
[156] De Selding, Peter B. "Germany Reaffirms Commitment to $2B Ariane 5 Upgrade." 28 Oct. 2011 Space News 8 May 2012 <http://www.spacenews.com/civil/111028-germany-reaffirms-commitment-ariane.html>.
[157] De Selding, Peter B. "Germany Moves Ahead with Heinrich Hertz Demo Satellite." 10 May 2012. Space News 12 May 2012 <http://www.spacenews.com/contracts/120510-germany-heinrich-hertz.html>.
[158] De Selding, Peter B. "Germany Awards Contract for Space-tracking Work."30 Mar. 2012. Space News 7 May 2012 <http://www.spacenews.com/military/120330-vega-support-german-center.html>.

4.5.3 Italy

The European Space Agency has contracted with Thales Alenia Space to study satellite communications technologies for unmanned aerial vehicles. While ESA is a civilian agency, it is still able to be involved in security related activities.

With the ExoMars programme in limbo during most of this reporting period, Italy had the most to lose if the first stage of the programme was scrapped. Italy is Europe's biggest ExoMars Programme supporter in terms of financial backing, contributing 33% of the €850 million raised by ESA toward the project. However, those funds still fell €150 million short of the amount ESA budgeted to launch both parts of the ExoMars mission. Italy and France are developing the entry and descent demonstration module for the project, which is part of the 2016 mission which was at risk of being cancelled to sufficiently fund the 2018 launch. Aside from Italy's 33% share in the programme, the three other top contributors are Britain at 20%, France at 15%, and Germany at 10%.[159] Following the United States' complete withdrawal from the ExoMars mission, ESA agreed to continue funding the 2016 telecommunications orbiter and atmospheric gas analyzer mission (along with an entry, descent and landing module) through the use of a Russian Proton Rocket which would be provided by the Russian Space Agency. Thereafter, the 2018 mission will launch the ESA-built Mars rover, and a second entry, descent and landing module (built 80% by Russia and 20% by ESA).[160]

4.6 European Union (EU)

Following its decision to remove the Global Monitoring for Environment and Security (GMES) system from its next 7-year Multiannual Financial Framework (MFF), the European Commission is facing considerable opposition from ESA and other GMES backers. ESA has indicated that it will not launch the first group of GMES satellites unless the programme and its operational expenses are securely funded. While the removal from the budget was considered by some to be a manoeuvre to elicit the support of European nations to increase the capped MFF, reversing the proposal of the Commission will be a difficult task that may result in the programme's failure. ESA has invested about €1.7 billion in the GMES programme over the past 13 years, developing a series of satellites, called Sentinels, with the first 3 satellites ready to be launched. The Commission has also invested €1.4 billion to help develop the system and prepare for its debut in 2014. An additional €5.8 billion is needed for GMES between 2014 and 2020.[161]

Funding for the EU's other flagship programme – Galileo – was factored into the multi-year budget; where the Commission allocated €7 billion to it, despite a high likelihood of costs overruns occurring beyond the allocated amount.[162] The Galileo constellation is already several years behind schedule, and will likely cost 40% more than its €3.4 billion budget.[163] The GMES system and the Galileo navigation constellation were adopted as Europe's two flagship endeavours; still, only the Galileo system is covered under the 7-year budget. The Commission has legal ownership of Galileo, and that may partly explain the difference in approach. Forty-four members of the European Parliament signed a petition directed to the European Commission to reinstate Europe's flagship GMES project into the EC's proposed multi-year funding plan, or risk its collapse. The cost of GMES (including overall network operation) is estimated at €834 million per year.

Europe was successful in conducting the first launch of its Galileo satellites on the newly acquired Soyuz 2 ST launch vehicle in Kourou, French Guiana. The first Soyuz 2 launch from the European launch complex carried two Galileo satellites into medium Earth orbit on 21 Oct. 2011.[164] Two more Galileo satellites will launch from Kourou onboard another Soyuz launcher in 2012, and the Commission plans to order more launches with the remaining funds in Galileo's currently approved budget of €3.4 billion; the number of launches dependent on the remaining funds in the budget, expected to be about €250 million. In terms of cost-effectiveness, Soyuz is a less expensive way to

[159] De Selding, Peter B. "Italy OK with Canceling ExoMars Demonstration Lander." Space News 11 July 2011: 7.
[160] De Selding, Peter B. "ESA Ruling Council OKs Funding for Mars Mission with Russia." 15 Mar. 2012. Space News 12 May 2012 <http://spacenews.com/civil/120315-esa-council-oks-exomars.html>.
[161] De Selding, Peter B. "European GMES Program at Risk as Battle Over Funding Escalates." 10 Nov. 2011 Space News 7 May 2012 <http://www.spacenews.com/civil/111110-budget-battle-threatens-gmes.html>.
[162] De Selding, Peter B. "European Commission Broaches New Funding Scheme for GMES – Individual Nations Would Be Asked To Contribute Voluntarily." Space News 25 July 2011: 6.
[163] De Selding, Peter B. "European Commission Broaches New Funding Scheme for GMES – ESA Protests Earth Observation Program's Removal from Multiyear Budget Proposal." Space News 25 July 2011: 6.
[164] Federal Aviation Administration. Commercial Space transportation: 2011 Year in Review. Washington DC: FAA, Jan. 2012: 25.

launch civil and military science and Earth observation satellites than Ariane 5. However, this approach has already sparked opposition from Ariane 5 contractors, who dislike the competition created by Soyuz, as well as some opponents in Russia who consider the Soyuz arrangement to be below-value priced.[165]

Europe's Seventh Framework Programme (FP7) for Research and Technological Development passed its fifth year, covering the period from 2007 to 2013. The programme, with a total budget of €50.5 billion to be distributed over the 7-year period, allocates €32.265 billion to a series of Cooperation Programmes; within the Cooperation Programme, space activity gets 4.4% of its 7-year budget.[166] Throughout the duration of the FP7, 85% of the €1.43 billion allocated to space is intended to go toward GMES.[167] The fifth open call for proposals (FP7-SPACE-2012-1) for the budget of 2012 was published on 20 July 2011, with a funding request amounting to €84 million,[168] a 15% decrease from the previous year, and a 70.8% decrease as compared to 2010; this reduction seems to indicate that many projects have moved into the next stage beyond initial development. With a submission deadline on 23 November 2011, evaluations were conducted on a total of 189 proposals (minus 2 ineligible proposals).[169] With an available budget of €84 million, the total requested EU contribution from the above-threshold proposals amounted to €259.81 million; the number of proposals that will finally be funded depends on the available budget, the outcome of negotiations, and the completion of the formal procedure – where successful applicants will begin receiving grants by November 2012.[170]

4.7 Emerging Commercial Activity

Space Tourism in Europe is getting closer to becoming a reality, with spaceport facilities tentatively planned should the market for commercial space tourism develop. Spaceport Sweden, located in Kiruna, might facilitate launches by Virgin Galactic and other sub-orbital spaceflight providers, offering space travel to private citizens at roughly $200,000 per seat. Rocketplane Global Inc. is considering developing a second spaceport in Lleida, Spain, offering its own space flights aboard its Rocketplane XP as early as 2015. And Lelystad Airport in the Netherlands is another candidate that might be appropriate as an international space hub, with its vast airspace over the North Sea, and close proximity to Amsterdam, Brussels, and other top tourist destinations.[171]

[165] De Selding, Peter B. "Soyuz Lofts Two Galileo Satellites In Debut from European Spaceport." Space News 24 Oct. 2011: 1+.
[166] "FP7 – Tommorrow's answers start today." European Commission 12 May 2012 <http://ec.europa.eu/research/fp7/pdf/fp7-factsheets_en.pdf>.
[167] European Space Technology Master Plan 2010: 60.
[168] "Space Call 5." European Commission – Research & Innovation Participant Portal 12 May 2012 <http://ec.europa.eu/research/participants/portal/page/cooperation?callIdentifier=FP7-SPACE-2012-1>.
[169] "Flash Information - Results evaluation Space Call 2012." European Commission – Research Executiye Agency 12 May 2012 <http://ec.europa.eu/research/participants/portal/page/cooperation?callIdentifier=FP7-SPACE-2012-1>.
[170] Id.
[171] Svitak, Amy. "Space Tourism Activity Sprouts In Europe." Aviation Week & Space Technology 3 Oct. 2011: 62.

5. The Defence Perspective

This chapter considers key developments related to the field of military space activities. These developments include 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. Given the confidential nature of military space spending, calculating the exact volume and nature these activities is difficult as the analysis is based only on open sources. Consequently, the facts and figures presented must be considered as incomplete in assessing the full range of military space programmes and should be treated accordingly. For these reasons, the following figures are conservative estimates and it is very likely that actual military space budgets far exceed the amounts that are reported. This is particularly the case with Russian and Chinese programmes that are often classified. With these factors in mind, readers can take from this chapter a relative assessment of global military space activities as per key space faring states, along with an overall estimate of the general trends in this field.

5.1 Trends in Military Expenditure

Space-related military spending has remained relatively flat since 2010, with total military spending amounting to $27.85 billion in 2011.[172] Alternatively, the Euroconsult reported a similar outcome, estimating world government expenditures for defence space programs to total $30.04 billion in 2011, from $32.54 billion in 2010. Whereas last year's Space Policies, Issues and Trends Report estimates total U.S. military expenditures to amount to $46 billion, there is a risk that such a figure is inflated based on military activity that was already included in larger budgets, resulting in the risk of double-counting. Moreover, while missions, often listed as civil programmes, may also serve dual-purpose military objectives, their expenditure is not included in this section. The Space Report 2012 lists United States military spending as being $26.46 billion, staying level with the 2010 budget, basing its assessment on the fact that the U.S. government failed to pass a new defence budget.[173] Interestingly, the figure only takes into account the space portion of the U.S. Department of Defense budget. Alternatively, the Euroconsult report noted a significant expenditure decrease on defence space programmes, spending $22.41 billion in 2011 from $26.13 billion in 2010.[174] While there is a significant discrepancy between the two authorities, it is likely due to the availability of information at their times of publication in addition to the programmes considered. It should be noted that these are conservative estimates that do not factor in U.S. government programmes of a dual use nature, including military use of the National Oceanic and Atmospheric Administration (NOAA) weather satellite data. It should also be noted that Chapter 2 relies on solely on the Space Report 2011 values for the U.S., Russia, Japan, China, and France, while Chapter 5 will include Euroconsult 2012 defence assessments for the countries which are addressed.

The Space Report 2012 estimates the U.S. to represent about 95% of global military space spending, whereas the remaining $1.39 billion spent in 2011 is the estimated combined military spending of the rest of the world (excluding dual-use systems).[175] However, the Euroconsult report is more conservative in this area, estimating U.S. defence expenditure to be $22.41 billion in 2011, or 75.2% of the world total.[176] Once again, Russia and China followed the U.S. in military space spending, with 2011 defence spending estimates of $3.28 billion and $2.69 billion.[177] However, due to fluctuating exchange rates, variations in purchasing power, and differing employment costs, a direct comparison of the budgets of these countries in fixed dollar values would not present a clear picture of their relative space defence efforts.

[172] The Space Report 2012. Colorado Springs: The Space Foundation, 2012: 58.
[173] Id.
[174] Euroconsult Report 2012. Overview - Global Dynamics in Government Space Programs: 12.
[175] The Space Report 2012…: 58.
[176] Euroconsult Report 2012…: 12.
[177] Id.

Europe's combined 2011 expenditure on military space activity is estimated to be $1.16 billion, staying level with Euroconsult's defence expenditure estimate in 2010 amounting to $1.15 billion.[178] However, an apparent conflict exists between the Space Report 2012 and the Euroconsult report 2012, where the former indicates that 5% of the $27.41 billion in global military space spending ($1.39 billion) is non-U.S. spending; whereas, the latter indicates that 24.8% of the $30.04 billion in global military space spending or ($7.63 billion) is non-U.S. spending. This considerable variation is likely due to the inclusion of dual-use systems within the census, while also remaining conservative in other areas. The best approach would be to view these two assessments as indicative of a trend relative to the sectors they assess. Moreover, as Europe's expenditure in the Euroconsult Report 2012 would represent the majority of the Space Report 2012's total $1.39 billion spent on military space activity by the rest of the space-faring world, the amount Europe expends in space defence must be considered to be a conservative estimate. The development of the GMES Earth observation constellation is expected to increase the role that dual use systems play in the European security space architecture, consequently increasing the military spending of Europe's member states. Moreover, the majority of new Earth observation revenue, having already experienced an increase of 6% to $2.24 billion in 2011 from $2.11 billion in 2010, is expected to be funded by government and military organizations.[179]

Despite a significant decrease of 32.2%, Japan once again maintained its position as the country with the fifth largest military space budget; its 2011 Ministry of Defence space budget amounted to ¥41.300 billion ($512.4 million) in 2011, from ¥60.933 billion ($668.41 million) in the previous year. The reduction in military spending was the main factor that caused the 8.7% reduction in Japan's total 2011 space budget, amounting to ¥309.4 billion ($3.836 billion) in 2011 from ¥338.965 billion ($3.830 billion) in 2010.[180] Its budget signalled a shift in Japan's space priorities in view of the adverse geopolitical environment in the region. The Euroconsult was more liberal in its estimation, noting a 52.2% increase in Japanese space defence spending, from $717 million in 2010, to $1.09 billion in 2011 (including dual-use systems).[181]

5.2 Europe

EU Member States continue to dictate the level of spending that is put toward military space programmes. They are carried out by all major European space faring nations, with an even larger number of European countries participating on the basis of bilateral or multilateral agreements and arrangements. European budgets in terms of military spending tended to stay level for 2011; France was the only state to decrease its military spending by a significant margin, $519 million in 2011, from $587 in 2010.[182] Italy experienced a sharp increase, from $100 million in 2010, to $148 million in 2011; while the rest of the military space budgets in Europe remained flat compared to the 2010 military space budgets.[183] This indicates that states may be increasing their cooperation to reduce redundant expenditure on military security. Outsourcing services and reducing public budget costs through public-private partnerships is being established as an efficient alternative to individual government spending on Earth observation and dedicated military satcom services. Through cooperation and innovative funding schemes, European governments will be able to maintain current levels of security at less expense to tax payers.

In an effort to reduce expenditure, the United Kingdom, France, Italy, Poland and Romania will back the European Defence Agency (EDA) by pooling resources to purchase commercial satellite bandwidth on the spot market for military use. No more than €2 million ($2.6 million) would be placed in an EDA account to be used by Astrium Services to purchase C-band and Ku-band satellite capacity for the five participating nations. A number of similar start-up efforts are being conducted to test the method of pooling and sharing military resources and budgets to reduce the overall cost to taxpayers. Governments, while open to the prospect, seem somewhat reluctant to put this method into effect, as in the present case where two years passed after the agreement was made before the first pilot was put into effect. When purchasing commercial satellite bandwidth individually, governments may pay up to a €50 million ($64.7 million) premium. Pooling resources would result in cost savings as governments could aggregate their demands and share data. Britain, France, Italy, Spain and Germany have developed five individual military satellite communications

[178] Id.
[179] The Space Report 2012…: 38.
[180] Id. at 55. Cf. The Space Report 2011. Colorado Springs: The Space Foundation, 2011: 52.
[181] Cf. Euroconsult Report 2012…: 12.
[182] Id.
[183] Id.

networks, at a cost between €6 and €8 billion ($7.77 and $10.36 billion) each, although these governments could significantly benefit from the shared use of a single next-generation military satellite communication system, enabling a cost savings of more than €1 billion ($1.3 billion) each while still retaining much of their autonomy.[184]

Some European governments have taken a limited approach to pooling resources, such as where Norway which has teamed up with Spain to build the HisNorSat military communications satellite; they are currently seeking a developer. The satellite will have both Norwegian and Spanish payloads. Norway will invest around $600 million in its development over a 5-year period; where $200 million will go toward building Norway's share of the satellite. Norway will procure 300 satellite communications terminals. Spain's key contribution will be an orbital slot at 29 degrees east. The capital expenditure in building the large X- and Ka-band telecommunications satellite and operating it over a 15-year period will actually be far less expensive than continued leasing of commercial satellite capacity on the spot market. The satellite will carry almost all of Norway's military satellite communications traffic, excluding Arctic operations that exceed the range of the geostationary satellite. However, Norway will continue to get its UHF capacity from the 28-nation NATO alliance, which leases bandwidth from French, British and Italian military satellite telecommunications systems.[185]

On 17 December 2011, France launched its Electronic Intelligence Satellite (ELISA) demonstration project, consisting of four micro satellites positioned in low Earth orbit, spaced several kilometres apart. The system, lofted on the second Soyuz 2 ST to launch from Kourou, will pave the way for its larger scale successor programme ROEM (Elint), which will map the positions of radar and other transmitters throughout the world, while also providing their technical characteristics. The ELISA programme aims to achieve the following two objectives: it will update databases used for electronic warfare, and it will detect and monitor activities during operations. The ELISA satellites record all signals they intercept; thereafter, upon combining the measurements stored by each micro-satellite, it will be possible to locate and characterise the source of each signal.[186] Incidentally, onboard that same Soyuz launcher, France launched its Pleiades 1 satellite, as part of a future series. These optical satellites are designed to provide imagery covering small areas but with a resolution of 0.70 m. Pleiades 1 complements the SPOT optical satellites, providing imagery that has dual-use purposes.[187] While CNES is funding 90% of the project,[188] other participants in the Pleiades system include Austrian, Belgian, Spanish and Swedish space agencies, as well as French, Spanish and Italian Defence ministries.

5.3 The United States

While exceeding the combined the military space budgets of the world by a vast margin, the U.S. Department of Defense's space budget has remained relatively flat since the previous year. The U.S. spent an estimated $26.46 billion in 2011, whereas it spent an estimated $26.66 billion in the previous year.[189] Compared to the $1.39 billion by the rest of the world in 2011, the U.S. makes up 95% of global military space spending.[190] The Euroconsult report is more conservative in this area, estimating U.S. defence expenditure to be $22.41 billion in 2011, or 75.2% of the world total.[191] However, this assessment does not factor in additional civilian dual-use programmes where operators provide service to military authorities and civil authorities based on need. Hence, this subsection will focus on U.S. Department of Defense (DoD) programmes as listed by the Space Report 2012, allowing readers to clearly distinguish purely DoD expenditures from that of other space faring nations.

The U.S. military space budget decreased by about $200 million between 2010 and 2011. This would be a significant change for any other space faring country, yet relative to the entire U.S. military space budget, it is a mere 0.7% reduction. That trend may continue into 2013 as the Defense Weather Satellite System (DWSS) will likely be cancelled, along with plans for the procure-

[184] De Selding, Peter B. "Five European Nations Agree to Pool Resources for Satellite Bandwidth Buys." Space News 5 Dec. 2011: 5.
[185] De Selding, Peter B. "Norway, Spain Expected to Order Milcom Satellite Before New Year." Space News 5 Dec. 2011: 6.
[186] "Elisa – Mapping radar stations from Space." CNES 12 May 2012 <http://www.cnes.fr/web/CNES-en/5940-elisa.php>.
[187] "Pleiades – Imagery to Meet European Civil and Military Challenges." CNES 12 May 2012 <http://www.cnes.fr/web/CNES-en/3236-pleiades.php>.
[188] "First Pléiades Satellite to Launch 16 December." 9 Dec. 2011. CNES 12 May 2012 <http://www.cnes.fr/web/CNES-en/9844-gp-first-pleiades-satellite-to-launch-16-december.php>.
[189] Cf. The Space Report 2012…:44 & The Space Report 2011…: 43.
[190] The Space Report 2012…: 58.
[191] Euroconsult Report 2012…: 12.

ment of a second Space-Based Space Surveillance satellite, designed to detect debris, spacecraft or distant space objects without interference related to weather, atmosphere or the time of day.[192] Additional cost savings may come from the U.S. Air Force conducting a block buy strategy that would involve the procurement of 6 to 10 rockets annually from the United Launch Alliance over a three to five year period. Moreover, the space program office at Kirtland Air Force Base in California, may be shut down, with its rapid-response and emergency deployment capabilities transferred to the Space and Missile Systems Center in Los Angeles.[193] The budget for the U.S. Missile Defense Agency (MDA) will likely decrease by 8% between 2012 and 2013, from $8.42 billion to $7.75 billion. However, MDA's 2013 budget request would boost funding for certain programmes such as its proposed Precision Tracking Space System (PTSS), a satellite constellation capable of tracking ballistic missiles during the midcourse portion of flight; and its Standard Missile (SM)-3 Block 2B interceptor, a next-generation version of the Aegis Ballistic Missile Defense System.[194]

Back in 2009, the Obama Administration cancelled plans to deploy a missile defence system in Europe in favour of a Phased Adaptive Approach built around the Aegis Ballistic Missile Defense system. This system would be developed in stages, with the first phase involving the deployment of Naval Aegis ships, carrying SM-3 Block 2A interceptors, in European waters within 2012. The second phase would place a land-based variant of the Aegis system and SM-3 Block 2A interceptors in Romania by 2015. By 2020, the third stage would replace the current interceptor with the next-generation Aegis SM-3 Block 2B interceptor, capable of targeting larger intercontinental ballistic threats.[195]

The U.S. Air Force relied on Europe's Ariane 5 to launch an American broadcasting SES-2 commercial satellite carrying the Air Force's Commercially Hosted Infrared Payload (CHIRP); a staring, wide-field-of-view telescope designed to test infrared sensor technologies.[196] Operating for a period of 9.5 months, its controllers will select targets to validate CHIRP's ability to detect missile launches, while also assessing whether the U.S. military's use of commercial satellites and its requirements would conflict with that of the owners of the commercial host satellites. In 2011, the DoD had 9 launches, 4 carried classified National Reconnaissance Office payloads and the other 5 carried DoD or DoD-sponsored payloads.[197]

Although this report focuses on space project developments, the actual use of space assets also merits occasional mention. The year 2011 marked the end of a decade-long man-hunt for Osama Bin Laden. Surveillance satellites were a catalyst in finding Bin Laden, assisting the U.S. Central Intelligence Agency and U.S. military by creating a detailed map from above. The U.S. National Geospatial-Intelligence Agency likely participated in the pursuit, along with a number of other military and commercial satellites that may have provided relevant mapping data. Images taken over the 10 year period showed the development of a fortified compound from an empty lot in 2001. The map produced was so detailed that it enabled operation planners to build a mock-up of the compound to be used for rehearsal sieges. It is also likely that secure satellite communications were used in directing the final operation.[198]

5.4 Russia

Russia has a long tradition of military space activity; however, when assessing its current activity it must be put in current day context. Maintaining a reputation in the military space field might be in Russia's interest in a geopolitical sense, yet it should be remembered that Russia's reported military space budget makes up only a portion of the total $1.39 billion spent in 2011 by all countries in the world (not including the U.S.), while the U.S. spent $26.46 billion. The Euroconsult Report 2012 is unclear as to the total amount Russia puts toward its military program, but reports that it should be at least $3.28 billion (including dual-use programmes).[199] In 2011, Russia launched one

[192] Ledbetter III, Titus. "U.S. Military Space Spending To Decline 22 Percent in 2013." 13 Feb. 2012. Space News 12 May 2012 <http://www.spacenews.com/military/120213-mil-space-spending-decline.html>.
[193] Id.
[194] Ledbetter III, Titus. "Missile Defense Agency Seeks Big Increase in Space Spending." 14 Feb. 2012. Space News 12 May 2012 <http://www.spacenews.com/military/120214-mda-seeks-increase-spending.html>.
[195] Turner, Brinton. "MDA Budget Would Ramp Up Spending on European Missile Shield." 28 Feb. 2011. Space News 12 May 2012 <http://www.spacenews.com/military/110228-mda-budget-spending-european-missile-shield.html>.
[196] De Selding, Peter B. "Ariane 5 Lofts Hosted Payload for U.S. Air Force." 22 Sept. 2011 Space News 12 May 2012 <http://www.spacenews.com/launch/ariane-lofts-hosted-payload-for-air-force.html>.
[197] Commercial Space Transportation: 2011 Year in Review…: 9.
[198] Boyle, Alan. "How satellites helped get Osama." 2 May 2011. Cosmic Log – MSNBC 12 May 2012 <http://cosmiclog.msnbc.msn.com/_news/2011/05/02/6571688-how-satellites-helped-get-osama?lite>.
[199] Cf. Euroconsult Report 2012…: 12.

classified payload, the Cosmos 2472; whereas the U.S. DoD launched 9, China and Japan each had 2 classified launches, and France launched its military ELISA constellation.[200] However, in that same year, of the 92 commercial and non-commercial payloads launched, 11 were Russian military payloads (2 failed to reach orbit), while the U.S. had 9, China had 6, and Europe had 5.[201] It should be noted that Russia also conducted the highest number of launches, both commercial and non-commercial, and nearly doubled all other states in the number of payloads it launched into space, i.e. whereas Russia launched 53 payloads, the U.S. launched the second highest number of payloads at 28, followed by China with 21.[202]

On 30 March 2012, Russia launched its last Oko-series missile early warning satellite, labelled Cosmos 2479.[203] The satellite is designed to detect missile launches using an infrared telescope that senses infra-red radiation emitted by the exhaust of the rocket engines; it is part of an 8-satellite constellation – the first of the series was launched in 1991.[204] Russia reportedly operates between 60 to 70 military satellites, and it plans to launch at least 100 additional satellites in the next decade.[205] These satellites are meant to boost the country's reconnaissance and ballistic missile detection capabilities; the influx also benefitting the military's navigation and imaging capability.

Russia's dual-use GLONASS GNSS constellation increased by another 5 satellites in 2011.[206] By 2010, Russia had invested $925 million in its navigation system overtaking U.S. investments in navigation systems for that year.[207] The system is getting updated with next-generation GLONASS-K satellites, the successor to the previous GLONASS-M, with 23 operational satellites as of November 2011, and additional spacecraft in production.[208] The system requires 24 operational satellites to provide complete global navigation coverage, with 3 sets of 8 satellites operating on three orbital planes.[209]

Another Russian military communications satellite crashed into the Pacific Ocean in April 2012, highlighting Russia's increasing need to replace its aging military communication satellites. The Molniya-1-89, launched in 1996, was part of a fleet of Molniya-1T military communications satellites that was discontinued in 2006; it was subsequently replaced by the Meridian satellite series.[210]

5.5 Japan

The Euroconsult Report lists Japan's space defence budget at $1.09 billion in 2011 (including dual-use systems), with 23% of that budget directed toward satcom, and the other 77% toward Earth observation.[211] As a leading space faring country with broadly developed space capabilities, Japan is channelling its efforts from its traditional multilateral "peaceful-use-only" position in space activity to the space security and defence areas. In the wake of several significant regional and international security events in recent years, Japan's space priorities have adapted to a more active role in the field of national security through the use of space technologies. A leader in multilateral diplomacy, it has increased even more its cooperation with multilateral organizations, as well as with its allies in building common space capabilities. In 2010 to 2011, Japan became acutely aware of the challenges stemming from its region both in geopolitical terms and in terms of natural disasters. Hence, Japan increased its focus on security; the results of which are new agreements, budget reshufflings and accelerated project completion times.

In 2008, Japan changed its basic law to allow active involvement in military space, whilst still respecting that this must be for peaceful purposes. Japan's 2009 5-year Basic Space Plan should also

[200] Commercial Space Transportation: 2011 Year in Review…: 22.
[201] Id. at 2, 7.
[202] Id. at 2-5.
[203] Clark, Stephan. "Russian early warning satellite orbited by Proton." 30 Mar. 2012. Spaceflight Now 12 May 2012 <http://www.spaceflightnow.com/news/n1203/30proton/>.
[204] Graham, William. "Russian Proton-K completes 45 years of service with US-KMO satellite launch." 29 Mar. 2012. NASA Spaceflight.com 12 May 2012 <http://www.nasaspaceflight.com/2012/03/russian-proton-k-rocket-launch-us-kmo/>.
[205] "Russian Military Orders Missile Early Warning Satellites." 25 Apr. 2012. Defence Talk 12 May 2012 <http://www.defencetalk.com/russian-military-orders-missile-early-warning-satellites-41939/>.
[206] Commercial Space Transportation: 2011 Year in Review…: 22.
[207] According to Euroconsult 2010 data.
[208] Clark, Stephan. "Proton rocket replenishes Russian navigation system." 4 Nov. 2011. Spaceflight Now 12 May 2012 <http://www.spaceflightnow.com/news/n1111/03proton/>.
[209] "Glonass System." Glonass.it 12 May 2012 <http://www.glonass.it/eng/glonass-story.aspx>.
[210] Brown, Mark. "Dead Russian military satellite drops into the Pacific ocean." 10 Apr. 2012. WIRED.CO.UK 12 May 2012 <http://www.wired.co.uk/news/archive/2012-04/10/molniya-satellite>.
[211] Cf. Euroconsult Report 2012…: 459.

be mentioned in this context, as it calls for strengthening security through the utilisation of space. The plan recommended ¥2.5 trillion ($26 billion) in financing for civil and military space development activities between 2010 and 2014. In October 2011, Japan's Ministry of Defence requested an additional ¥260 billion in funding for military-purpose space programs in 2012. The 2011, the budget of the Ministry of Defence was reduced by 32.2% amounting to ¥41.3 billion, from ¥60.933 billion in 2010.[212] If the October request is accepted, the Ministry of Defence's budget would be increased by 53%. If approved, these funds would be used toward the purchase of satellite imagery systems and development of space-based infrared missile warning sensors. And a significant part of the budget would go toward developing a regional satellite communication network. [213]

In December 2010, Japan released a 10-year strategy document called the National Defense Program Guideline.[214] It calls for the strengthening of development efforts and the use of outer space in the field of information gathering, communications, disaster management and arms proliferation control. One of the main reasons why Japan decided to strengthen its position in space defence and security is constant security uncertainties from the Korean peninsula and East Asia military and space ambitions. On 12 December 2011, it successfully launched its next instalment of the much delayed Information Gathering Satellite (IGS) system, consisting of two satellites with optical sensors and radar monitoring.[215] But this reconnaissance satellite constellation is still far from delivering its intended operational capability. A second radar satellite is planned to be launched in early 2013 and the third-generation optical satellite constellation is in the works for late 2013 or early 2014.[216]

In January 2012, a governmental panel on Japan's space program strategy planned to revise Japan's space law to allow the Japan Aerospace Exploration Agency (JAXA) to become involved in the use of space for national security. If implemented JAXA would be allowed to cooperate in developing spy and early warning satellite systems.[217] Furthermore, on 30 April 2011, Japan and the U.S. announced plans to jointly develop a framework for sharing surveillance data as part of their expanded space related activities. Both also agreed to pursue an international code of conduct on outer space activities, but not in the form it was originally proposed by the EU.[218] Both partners agreed to assure interoperability between Japan's Quasi-Zenith Satellite System and GPS, in addition to expanded cooperation in the use of space-based systems for environmental monitoring.[219] And Japan, as one of the five partners of the ISS, agreed to continue operations beyond 2015.

5.6 China

China's space defence budget is estimated to have increased by 19.4% from $1.11 billion in 2010 to $1.32 billion in 2012.[220] Throughout 2011 and 2012, China has been actively and aggressively strengthening its position as one of the leading space faring nations. This was significant not only in the means of technological and space capacity development, but also in the general increase in launch activities. At the end of 2011, China broke its own record in the number of space launches conducted in one year; also beating the United States in the number of launches for 2011. China performed 19 launches during 2011, with the United States following close behind with 18 launches.

The manner in which China develops its technical capabilities and the depth of its military interest in the space program merits analysis. It seem to be clear that Chinese space efforts are intimately connected to the Chinese army, principally because many space activities are under the direct control of the People's Liberation Army (PLA); moreover, all Chinese space operation facilities are all manned and operated by the PLA. In the case of manned space activities, all development and plans are directly under the control of the Chinese military and political bureau.

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[212] Cf. The Space Report 2012 …: 55 & The Space Report 2011 …:52.
[213] "Japan to Boost Military Space Spending in 2012." Space News, 10 Oct. 2011: 8.
[214] "National Defense Program Guidelines for FY 2011 and Beyond." Japan Ministry of Defense 11 May 2012 <http://www.mod.go.jp/e/d_act/d_policy/pdf/guidelinesFY2011.pdf>.
[215] Kallender-Umezu, Paul. "Japan Launches IGS Radar Reconnaissance Satellite". 13 Dec. 2011. Space News 8 May 2012 <http://www.spacenews.com/launch/121311-japanlaunches-latest-radar-reconnaissance-satellite.html>.
[216] "H-2A Launch Helps Rebuild Japan's IGS Constellation." Space News 3 Oct. 2011: 3.
[217] "JAXA to get National Security Role; NASA Password Leaked." 14 Jan. 2012. The Japan Times 9 May 2012. <http://www.japantimes.co.jp/rss/nn20120114x2.html?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+japantimes_news+%28The+Japan+Times+Headline+News+-+News+%26+Business%29>.
[218] Weisgerber, Marcus. "U.S. Wants Changes to EU Space Code of Conduct." Space News 16 Jan. 2012: 3.
[219] Ledbetter III, Titus. "U.S., Japan To Explore Space Surveillance Data Sharing." 1 May 2012. Space News 9 May 2012 < http://www.spacenews.com/military/120501-us-japan-space-data-sharing.html>.
[220] Euroconsult Report 2012…: 17.

Analysis of China's space defence prospective is very difficult due to a dearth of unclassified sources. What is apparent is that nearly all Chinese reports about its human spaceflight program and lunar exploration mission involve the PLA. International cooperation in space activities with China will hence mostly involve cooperation with its military.[221] However, this does not necessarily impede China's aim for international cooperation; on 31 October 2011, the Shenzhou-8 capsule carried 17 biological and medical experiments developed by German and Chinese researchers.[222]

According to the Chinese government's 11th Five Year Plan, space activities are considered as one of China's major military advances. It suggests that development of certain technological areas, including space related capabilities, will play an important role in the army's modernisation efforts.[223]

At the end of 2011, China issued a statement on its five-year space program, which includes several fields that relate to security: the development of three new launch vehicles with one launcher serving as a rapid-response launch system; its contribution to space debris mitigation (usually connected to its ASAT test in 2007); and development of its fourth space launch facility, located in the southern part of the country, intended mainly for manned spaceflights.[224]

The possible dual-uses of satellites and any related space activities give China a strong opportunity to develop its civilian and military space capabilities. This is in reference to China's array of intelligence satellites for space reconnaissance and surveillance, as well as technologies used for Earth observation. An example of Chinese development of its remote sensing capabilities was the launch on 8 November 2011 of the Yaogan 12 remote sensing satellite, which will provide information and scientific experiments for better land use.[225] China is also known to have the ability to jam satellite communications and GPS receivers, and is developing directed energy anti-satellite capabilities.[226]

5.7 India

India has only recently begun to develop its own space military programme; whereas the majority of the activities of the Indian Space Research Organization (ISRO) still focus on civil applications. This tranquillity might continue to change in upcoming years with the ebb and flow of the geostrategic positions in this region. Pakistan and China still provoke increasing concern to India for geopolitical reasons related to their proximity, in addition to China's anti-satellite (ASAT) test in 2007. Following China's ASAT test, defence scientists in India began focusing on "space security" to protect India's $12 billion (Rs 60,000 crore) space infrastructure from electronic or physical destruction.

On 19 April 2012, India launched a 5,000 km range Agni-5 missile, which reached an apex altitude of 600km in space while following its parabolic trajectory. This is India's first Inter-Continental Ballistic Missile (ICBM). Indian Scientists claim that Agni-5 can travel beyond the entire region of China, Eastern Europe, North Eastern and Eastern Africa, and even Australia if fired from the Nicobar Islands. India plans to introduce the missile into India's strategic forces arsenal by 2014-2015, to function more in a deterrent capacity against China. Until recently, only the permanent members of the UN Security Council - China, Russia, France, the United States, and the United Kingdom had access to such long-range ballistic missiles.[227]

Dr. VK Saraswat, chief of the Defence Research and Development Organisation (DRDO) and scientific adviser to the Defence Minister said that India is proud to be part of the elite group of nations as a missile power. The aim of India is to build the 21st century missile. He also highlighted India's role as a peaceful country, against militarisation of space, and not in the missile race. But, added that the launch of Agni-5 is a "game-changer" because it created a new dimension to India's stra-

[221] Cheng, Dean. "Five Myths about China's Space Program." 29 Sept. 2011. The Heritage Foundation 10 May 2012 < http://www.heritage.org/research/reports/2011/09/five-myths-about-chinas-space-program>.
[222] De Selding, Peter B. "German Experiments Onboard Chinese Shenzhou-8 Capsule." Space News 7 Nov. 2011: 12.
[223] Cheng, Dean. "China's Space Program in the National Security Context." 18 Jan. 2012. The Heritage foundation 10 May 2012 <http://www.heritage.org/research/reports/2012/01/us-needs-to-meet-chinas-space-challenge-of-the-next-5-years>.
[224] De Selding, Peter B. "China Outlines Space Priorities: Debris Mitigation, New Rocket." Space News 9 Jan. 2012: 14.
[225] "China Launches Imaging Satellite." Space News 14 Nov. 2011: 3.
[226] Houpt, Danny. "A New Policy Typology to Better Understand the Goals of China's Space Program." 31 Oct. 2011. The Space Review 10 May 2012 < http://thespacereview.com/article/1958/1>.
[227] "Agni-V Test-Fired Successfully, Expands India's Missile Reach from China to Eastern Europe." 19 Apr. 2012. IBN Live 11 May 2012 <http://ibnlive.in.com/news/china-to-europe-agniv-expands-indias-reach/249977-3.html>.

tegic warfare capacity.[228] Following its successful Agni-5 ICBM test, India intends to develop its own anti-satellite weapons.[229]

Currently, India is working on mini-satellites for battlefield use to protect India's main satellites. Dr. Saraswat emphasized the mini-satellites will provide communication and navigation to armed forces for a limited time.[230] Furthermore, the first test of a PDV interceptor will be in late 2012. This slender two-stage missile can destroy incoming ballistic missiles at an altitude of 150 km. The Ballistic Missile Defence (BMD) project that aims to protect the country from hostile ballistic missiles has developed a long-range radar system which is able to detect these missiles and launch its own counter-projectile. All these elements have been developed under the BMD programme.[231] According to some sources, India's military equipment and systems will be valued at over $100 billion by 2015.[232]

Finally, following the Mumbai terror attacks and the successful use of Israel's spy satellites, India has becoming increasingly interested in additional cooperation with Israel Aerospace Industries (IAI) in the space field.[233] India has 10 satellites including ISRO's new Radar Imaging Satellite (RISAT).[234]

5.8 Iran

In 2009, Iran became the 11th country with space launch capabilities. Its inaugural launch put the Omid satellite (meaning "Hope") into orbit using the Iranian-developed launch vehicle, Safir-2.[235] Since that launch, the state has steadily invested an estimated $100 million per year in its civil space budget; increasing that amount to $120 million in 2011.[236] Iran has begun acting on its desires to be a Middle-East space power by 2020.[237] By February 2012, Iran had launched a small Earth-observing satellite into orbit, its third successful launch out of four attempts. This new Iranian satellite has a mass of 50 kg and was built by students at the Sharif University of Technology. Its applications can be used for meteorology, management of natural disasters and measuring the temperature and humidity of air.[238] Contrary to international suspicions, the Islamic Republic of Iran maintains that it has no military ambitions for its space program.[239]

However, many Western countries, especially the United States and Israel remain concerned that Iran may be gaining more military power.[240] Some experts expect Iran to use dual-use technology for military build-up purposes, while remaining under the guise of non-military purposes.[241] Iran states it wants to put its own satellites into orbit for civil protection purposes, monitoring natural disasters in the earthquake-prone nation, in addition to improving its telecommunication infrastructure. Iranian officials were quick to point out the United States use of satellites to monitor Afghani-

[228] Bhatt, Sheela. "Agni-5 Has Put India in the Elite Club." 20 Apr. 2012. Rediff News 10 May 2012 http://www.rediff.com/news/report/agni-5-has-put-india-in-the-elite-club/20120420.htm>.
[229] "India Developing Anti-Satellite Weapons." 21 Apr. 2012. United Press International 10 May 2012 <http://www.upi.com/Top_News/Special/2012/04/23/India-developing-anti-satellite-weapons/UPI-87941335189998/#ixzz1uO2euIGT>.
[230] "After Agni-V Launch, DRDO's New Target is Anti-Satellite Weapons." 21 Apr. 2012. The Economic Times 10 May 2012 <http://economictimes.indiatimes.com/news/politics/nation/after-agni-v-launch-drdos-new-target-is-anti-satellite-weapons/articleshow/12772355.cms>.
[231] "India Takes on China." 01 May 2012. Military & Aerospace Electronics 09 May 2012 <http://www.militaryaerospace.com/news/2012/05/01/india-takes-on-china.html>.
[232] Egozi, Arie. "India Successfully Launches New Long-Range Ballistic Missile." 19 Apr. 2012. Israel Defense 10 May 2012 <http://www.israeldefense.com/?CategoryID=472&ArticleID=1186>.
[233] Egozi, Arie. "India Expansion of Israeli Support to India in the Space Field Is on the Agenda." 14 Feb. 2012. Israel Defense 09 May 2012 <http://www.israeldefense.com/?CategoryID=472&ArticleID=927> .
[234] India Takes on China…
[235] "Iran sends first home-built satellite into orbit." 03 Feb. 2009. AFP 10 May 2012 <http://www.google.com/hostednews/afp/article/ALeqM5h6jwhaLtMvmnBIjBipoPXdLDlgpw>.
[236] Cf. Euroconsult Report 2012…: 8.
[237] Derakhshi, Reza. "Iran unveils missiles and satellites as warning to foes" 07 Feb. 2011. Reuters 10 May 2012 <http://www.reuters.com/article/2011/02/07/us-iran-military-missiles-idUSTRE7162F520110207>.
[238] "Satellite 'Promise of Science, Industry' put on orbit successfully: Defense Min." 03 Feb. 2012. IRNA10 May 2012 <http://irna.ir/News/Politic/Satellite-%E2%80%98Promise-of-Science,-Industry%E2%80%99-put-on-orbit-successfully,-Defense-Min/30795827>.
[239] Malik, Tariq. "Iran Launches Small Earth-Watching Satellite Into Orbit: Report." 03 Feb. 2012. SPACE.com 10 May 2012 <http://www.space.com/14464-iran-launches-small-satellite-orbit.html>.
[240] Brinton, Turner. "Iran's Satellite Launch a Signal of Missile Progress, Analysts Say." 12 Feb. 2012. SPACE.com 10 May 2012 <http://www.space.com/5624-iran-satellite-launch-signal-missile-progress-analysts.html>.
[241] Hsu, Jeremy. "Iran's Space Program: Lots of Talk, but a Chance to Shine." 09 Nov. 2011. SPACE.com 10 May 2012 <http://www.space.com/9499-iran-space-program-lots-talk-chance-shine.html>.

stan and Iraq, and say they need similar abilities for Iran's security.[242] Another development affecting Iran's regional security is its potential cooperation with China in space activity. Ahmad Motamedi, Iran's Minister of Communications and Information Technology, referred to China as an attractive partner partly because of its track record of successfully launching 40 launch vehicles since 1996.[243]

Unlike other Islamic countries that operate civilian-purpose satellites, the Iranian defence ministry plays a key role with potential contributions from the Islamic Revolution Guards Corps (IRGC). This military element also manages the Shahab ballistic missile program, which is capable of being modified into a space launch vehicle. The enhancement of the Shahab, with satellite-guided navigation, is a big concern for the U.S. and Israel, because this would allow Iran to strike objects with increased precision.[244] Western countries are concerned that long-range ballistic technology used to propel Iranian satellites into orbit might one day be used to launch atomic warheads. On the one hand, Iran asserts its nuclear work is purely for peaceful purposes, adding that it hopes to launch a human into space by 2020 and land an astronaut on the moon by 2025.[245] Yet, Iran also seeks to challenge Israel's regional monopoly in outer space. Israel is the only regional actor in the Middle East that can launch satellites onboard Israel's own Shavit launch vehicle.[246]

Analysts claim Iran's space goals are probably both scientific and militaristic in purpose, with the increase of national pride - important to legitimize the current regime's policies and actions.[247] Iran plans to launch its first remote-sensing satellites, Tolu (Sunrise) and Fajr (Dawn), in 2012.[248]

5.9 North Korea

Whereas in 2011, North Korea did not conduct any launches into space, the country returned to the space scene once again in April 2012, test launching a long-range ballistic rocket. However, the launch was unsuccessful, with the missile disintegrating prior to escaping Earth's atmosphere; U.S. and Japanese sources report that the spacecraft fell into the sea. Prior to the launch, North Korea's Foreign Ministry ignored the UN Security Council's condemnation of the launch of a long-range rocket and reasserted the nation's right to develop its own autonomous civilian space program. Paek Chang Ho, chief of the North Korean command centre, said the launch was for peaceful purposes.[249] He said the Kwangmyongsong-3 satellite, onboard the failed launcher, was designed to send back images and data that will be used for meteorological and Earth observation purposes.[250]

The failed Pyongyang rocket had the size and thrust profile to loft a payload into space. Its 32 meter, three-stage Unha-3 booster, was powered by liquid-fuelled engines - North Korea's preferred motor for manned launches and major satellites. Most U.S. long-range missiles use solid-fuel propellant.

Western experts reflect that the launch's apparent failure "shows the weakness of the North Korea missile program" and suggest that the threat from North Korea has been "exaggerated." The United Nations and diplomats had warned that Pyongyang would face further isolation if it went ahead. For example, the White House press secretary described the failed launch as a threat to regional security, a violation of international law and a breach of its own recent commitments.[251] Shortly after the launch, South Korea convened an emergency security meeting and said that Seoul

[242] "Iran Launches Rocket Capable of Carrying Satellite." 17 Aug. 2008. The Telegraph 10 May 2012 <http://www.telegraph.co.uk/news/worldnews/middleeast/iran/2575063/Iran-launches-rocket-capable-of-carrying-satellite.html>.
[243] Kass, Lee. "Iran's Space Program: The Next Genie in a Bottle?" Sept. 2006. The Middle East Review of International Affairs 10 May 2012 <http://meria.idc.ac.il/journal/2006/issue3/jv10no3a2.html>.
[244] Kahn, Gabe. "The Iranian Space Monkey Cometh." 17 June 2011. Israel National News 10 May 2012 <http://www.israelnationalnews.com/News/News.aspx/144990#.T6o56egx_zA>.
[245] Iran's Space Program: The Next Genie in a Bottle?...; "Iran Plans to Send Monkey Into Space." 28 June 2011. Al Jazeera 10 May 2012 <http://www.aljazeera.com/news/middleeast/2011/06/201162812040876380.html>; "Iran Space Monkey Launch Failed." 13 Oct. 2011. National Turk 10 May 2012 <http://www.nationalturk.com/en/iran-space-monkey-launch-failed-14383>.
[246] Iran's Space Program: The Next Genie in a Bottle? ...
[247] Moskowitz, Clara. "Iran Says It Launched New Rocket and Capsule Into Orbit." 17 Mar. 2011. SPACE.com 10 May 2012 <http://www.space.com/11153-iran-launches-rocket-space-capsule.html>.
[248] "Iran Satellites to be Placed in Orbit Next Year." 20 Feb. 2012. Jamejam Online10 May 2012 <http://jamejamonline.ir/en/newstext.aspx?newsnum=100804691135>.
[249] "North Korea Threatens Retaliation for U.S. Aid Clawback." 17 Apr. 2012. CBCNEWS 10 May 2012 <http://www.cbc.ca/news/world/story/2012/04/17/north-korea-rocket-reaction.html>.
[250] "Japan on Full Alert Ahead of North Korean Launch." 12 Apr. 2012. AdelaideNow 10 May 2012 <http://www.adelaidenow.com.au/news/world/japan-on-full-alert-ahead-of-north-korean-launch/story-e6frea8l-1226324759731>.
[251] Schwarz, Tim. "North Korea Rocket Breaks Up in Flight." 17 Apr. 2012. CNN 10 May 2012 <http://edition.cnn.com/2012/04/12/world/asia/north-korea-launch/index.html>.

would continue to closely monitor its neighbour's actions.[252] For now, the international community may have to accept that North Korea will soon have the technical capability to reach orbit and must consider the consequences of such a development.

[252] McCurry, Justin. "North Korea's Failed Rocket Launch Triggers Indifference in Seoul" 13 Apr. 2012. The Guardian 10 May 2012 <http://www.guardian.co.uk/world/2012/apr/13/north-korea-failed-rocket-launch-reaction>; Young-jin, Kim. "DUP Head Urges NK Against Nuke Test." 05 July 2012. The Korea Times 10 May 2012 <http://www.koreatimes.co.kr/www/news/nation/2012/05/116_110488.html>.

6. Space Policies and Strategies around the World

The following chapter presents 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 rationales. Military space and defence related policies were considered in more detail in chapter five.

6.1 European Union

In 2011 and 2012, the European Union continued its efforts to position itself as a leading global actor in space activities. Despite the unquestionable stimulus that the Lisbon Treaty ratification contributed to this effort, significant challenges remained regarding the future of the European space policy and programmes heralded in the treaty, especially from a budgetary point of view. The effects of the continued economic crisis discussed above might have played a significant part in this state of affairs. In general, developments during the reporting period present a mixed picture and included considerable breakthroughs, but also set-backs.

An example of the latter was illustrated by developments regarding the GMES programme, and especially the efforts undertaken to resolve outstanding budgetary and governance issues among the European Commission, the European Space Agency (ESA) and Member States. This important complication for the programme's future appeared in July 2011, when the European Commission announced that it did not intend to finance GMES through its next seven year framework programme (known as FP8). This appeared to be an effort on the side of the EC to tighten its research and development budget in view of the ongoing economic crisis. The proposal of the Commission was to create a funding mechanism outside the Multiannual Financial Framework (MFF), based on voluntary subscription based on GNI contributions from all Member States. This proposition might prove challenging, considering the fact that the project's annual costs were projected to reach €834 million[253] and the general reluctance of the EU stakeholders to create funding mechanisms outside the MFF.

Immediately after this announcement, the European Commission's decision came under scrutiny on multiple fronts. For example, concerns were raised by industry officials and associations, such as the European Association of Remote Sensing Companies (EARSC). They claimed that the EC's decision would create uncertainty regarding its funding, consequently deterring the private sector's further engagement in it and jeopardising its future. Other concerns were voiced by Member State officials, who considered this an effort on behalf of the EC to actually raise the programme's long-term budget.[254]

The greatest concern about this decision, however, seems to have been expressed by ESA, the European Commission's partner in GMES technology development and programme management. ESA officials were reported to have addressed this concern to ESA Member States. They stated that by excluding GMES from FP8, the European Commission increased uncertainty over the programme's funding beyond 2013. The programme was expected to enter its operational deployment phase at that time, with the EC assuming the bulk of its funding after ESA has completed the development. Finally, the fact that the EC took this decision unilaterally, at a moment when the programme's ownership had not yet been decided, was a further source of concern.[255]

The decision to remove GMES funding from the European Commission's medium-term research and development budget came as a surprise, as the EC had allocated €104 million to the programme only a month prior to this decision. This payment had allowed ESA to book launching slots for the GMES satellites starting from 2015, according to the original timetable. With the funding of the

[253] De Selding, Peter B. "European Commission Broaches New Funding Scheme for GMES." Space News 25 July 2011: 6.
[254] Id.
[255] Id.

operational phase still pending, the decision to finance its launch now seems premature.[256] Finally, the programme's funding mechanism revision came at a time when its development was on track and no significant delays or budget overruns were anticipated, raising questions as to whether the decision was based on broader policy and budgetary considerations, rather than on the project's own merit.[257]

Criticism of the European Commission's decision was voiced in the European Parliament as well, with 44 of its members calling for its withdrawal. In their petition, the MEPs cautioned against the risk of the programme's collapse as a result of budgetary uncertainty. Furthermore, they pointed out that in a time of economic crisis, the chances of EU Member States bearing the programme's entire operating costs were slim. On the contrary, failure to finance GMES operations would nullify the nearly €1.6 billion investment already made in spacecraft development by ESA.[258]

In stark contrast to developments regarding GMES, the second half of 2011 saw the achievement of a milestone first launch for the Galileo GNSS. On 21 October 2011, two Galileo satellites were placed to orbit on the inaugural flight of the European version of the Soyuz rocket, launched from the European spaceport in French Guiana. The successful launch signified the opening of the system's operational deployment phase, with the scheduled launch of fourteen satellites out of a total of thirty required to achieve full operational capability. A further 6 to 8 spacecraft were expected to be ordered in early 2012, depending on the level of the remaining funds from the programme's original €3.4 billion budget. Further steps would include the development of a customised fairing stage for the Ariane 5 launcher, capable of carrying four Galileo satellites to orbit. This would enable the use of both types of rockets and consequently speed up the satellite's launch sequence.[259]

On the other hand, having met with a 40% budget overrun, the Galileo project will require significant further funding to become fully operational. As a matter of fact, the effort of reducing the programme's budget overrun and securing its future funding also made progress in 2011 and 2012. In June 2011 it was projected that the project's original €3.4 billion budget would only cover the deployment of roughly twenty spacecraft. In order to complete the thirty-satellite constellation, an additional sum of up to €1.9 billion would be required. In the course of July 2011, European Commission officials pledged to curtail this figure by at least €500 million, at the request of European Member States. At the same time, they announced the EC's decision to include funding for this additional sum in the EU's eighth framework funding programme (FP8) for research, thus drawing a distinction with the GMES funding. Finally, the programme's development goals were concluded with the finalisation of the system's ground segment procurement contracts.[260]

A further sign of the European Commission's renewed interest and status as a global stakeholder in GNSS development and operations was revealed when EC officials protested to their U.S. counterparts against the development of LightSquared (see above). In their communications, European authorities expressed their concern about possible interference with Galileo signals over the United States, especially for safety critical operations.[261]

6.2 European Space Agency

The second half of 2011 and the first half of 2012 constitute a degree of transition for the European Space Agency. On the one hand, with the Agency's budgetary cycle nearing its end, and a Ministerial Council coming up, the focus had been on accelerating and completing the implementation of the strategic directions decided in 2008, such as developing space applications missions, increasing cooperation with the European Union, and utilising the European contribution to the ISS to its full potential. On the other hand, with preparations for the next budgetary cycle well underway, developments in ESA programmes also offered a glimpse of the mission areas that will come into focus shortly, such as the future of the ISS and Ariane 5. In the same context, the period in review also witnessed the emergence of trends in ESA policies as a response to the rapidly changing geopolitical and economic conditions of our time. These include an acute emphasis on international cooperation, as well as on the use of more flexible and purpose-specific funding mechanisms, capable of maximising investment returns, both on operational and industrial levels.

[256] De Selding, Peter B. "European Commission Doles out Down Payment for Initial GMES Launches." Space News, 13 June 2011: 10.
[257] De Selding, Peter B. "European Commission Broaches New Funding Scheme for GMES." Space News 25 July 2011: 6.
[258] "European Commission Urged To Put GMES Back in Budget." Space News 12 Sept. 2011: 3.
[259] De Selding, Peter B. "Soyuz Lofts Two Galileo Satellites In Debut from European Spaceport." Space News 24 Oct. 2011: 1.
[260] De Selding, Peter B. "European Governments Trim Galileo System Cost Overruns." Space News 27 June 2011: 5.
[261] De Selding, Peter B. "European Commission Adds Voice to LightSquared Opposition." Space News 25 July 2011: 21.

An example of this trend has been ESA's contribution to the development of private-public partnerships (PPPs) in European space programmes. In 2011 and 2012 this mutually beneficial interaction between the public and private sectors slowly expanded on a European, as well as national level. In fact, on a national level, all major space faring countries are continuing to explore this sort of advantage, with the United Kingdom, Germany and France taking the lead. Especially in the United Kingdom, almost two thirds of all European PPPs are anchored. On a regional level, and despite the European Commission's reservations (mostly due to the negative prior experience on Galileo), the European Investment Bank has provided no less than €225 million in PPPs funding. It was ESA, however, that initiated the most important such partnerships on an institutional level, especially through its participation in satellite communications projects. In this context, ESA has implemented a PPP-type financial arrangement for a data-relay satellite system over Europe (EDRS) that would have commercial, civil-government and military uses.[262]

Beyond GMES, economic and fiscal instability in Europe has also clearly impacted on the development of other important future ESA projects, such as the development of an Ariane 5 upgrade. Funding required to complete the development of a new upper stage for the rocket was expected to rise to approximately €1 billion. However, budgetary constraints have prompted ESA Member States to scrutinise the programme's funding and request that it would be at least partially compensated by a reduction of the launcher's operational costs, which are also partially borne by ESA. In this context, significant efforts were undertaken to broaden the programme's supplier base as much as possible, within the limits of the Agency's fair geographic return principle. As in the case of PPPs, emphasis was placed on improving the cost to benefit ratio of the investment, mainly through increasing the programme's development flexibility and adjustability to changing conditions.[263]

Contrary to the uncertainty regarding the future of Ariane 5, 2011 and 2012 witnessed the successful development conclusion and inaugural launch of the European Soyuz and Vega rockets. The former is the European version of the Russian launcher, modified for operations from equatorial French Guiana. Further improvements included new safety, telemetry and tracking systems that would qualify the rocket for launch from the European spaceport. Thanks to the latter's geographical position, the European Soyuz has an increased lift capacity of over three tones, making it suitable for placing light communications satellites to orbit. On the other hand, the rocket's development met with a three year delay and a 36% budget increase, mainly related to the completion of ground launch infrastructure. Yet, the launcher carried the first two Galileo satellites to orbit with its inaugural flight in October 2011.[264]

A third recurring trend in ESA policies in 2011 and 2012 was, as mentioned, increased emphasis on future international cooperation, especially in the fields of space transportation and exploration. The retirement of the space shuttle during this period has increased the potential for cooperation between Europe and the United States in terms of access to space vehicles. At the same time, it indirectly increased the value and relevance of ESA's Automated Transfer Vehicle (ATV). The combined use of the ATV and other similar spacecraft from the U.S., Japan and Russia to serve ISS supply needs could create opportunities in the long term for the creation of common transportation policies among all participating space actors. Due to their technological proximity and operationally complementary nature, these spacecraft could also pave the way for future cooperation on a technology development level.[265]

Another example of the European Space Agency's efforts to position itself at the centre of international cooperation manifested itself in October 2011, when the agency formally invited Russia to join the U.S.-European ExoMars space exploration mission. The Russian space agency Roscosmos was invited to participate as a full partner in the endeavour, and to contribute a third of its budget. Its potential contribution to the mission could include the provision of the launcher and of the orbiter's entry, descent and landing system. ESA's decision was partially dictated by a previous NASA budgetary tightening that prohibited it from committing to the originally set 2016 launch timeframe. At that time, ESA was also only able to secure €850 million out of its €1 billion originally planned funding commitment. In this situation, the agency would either have to curtail the mission, or seek a third partner.[266] The latest development in the ExoMars programme was that NASA an-

[262] De Selding, Peter B. "Europe Knocked for Balking at Public-Private Satellite Venture." Space News, 20 June 2011: 7.
[263] De Selding, Peter B. "ESA Industrial Policy Limits Ariane 5 Cost-saving Potential." Space News 27 June 2011: 6.
[264] De Selding, Peter B. "European Soyuz Must Pass Final Exam Before October Debut." Space News 4 July 2011: 5.
De Selding, Peter B. "Insiders Hard-pressed to Say Why European Soyuz Was Delayed." Space News 4 July 2011: 5.
[265] Svitak, Amy. "U.S. And Europe Explore Common Space Transportation Needs." Aviation Week & Space Technology 27 June 2011: 41.
[266] De Selding, Peter B. "ESA Formally Invites Roscosmos To Join ExoMars Mission as Full-fledged Partner." Space News 17 Oct. 2011: 1.

nounced on 13 February 2012 that it would have to withdraw entirely for budgetary reasons, which has thrown the planning into disarray and made the need for cooperation with Russia even more crucial.

Budgetary tightening in the U.S. might also take its toll on other cooperation already initiated between ESA and NASA on space science and exploration missions. Important joint projects, such as Laplace and LISA missions could be jeopardised by short term cuts in NASA's budget. Thus NASA might not be able to meet its obligations as a true partner in some of these missions. On the upside, however, budgetary constraints across the Atlantic could further increase the incentive for ESA to engage in international cooperation with various partners in this mission area. Increased cooperation in this case would aim at harmonising operational, technological and scientific space science and exploration mission objectives. The greater the degree of that cooperation, the more ESA could hedge against future budgetary threats to these missions. In reality, cooperation would not only need to be broadened, but also deepened in order to meet this objective.[267]

Finally, apart from cooperating on an international level, in 2011 and 2012 ESA continued its efforts to strengthen its relations with other European institutional space stakeholders. An apparent manifestation of this tendency was an agreement reached with the European Defence Agency (EDA) to cooperate on the development of dual use satellite applications. Although this agreement did not go as far as jointly financing such programmes, it did, however, create the vehicle to share competencies in the interest of developing European dual use technologies and operational concepts. The first such project would be a demonstration mission for the control of Unmanned Aerial Systems (UAS) through satellite.[268]

6.3 EUMETSAT

In 2011 and 2012, EUMETSAT pursued its plans to develop a polar-orbiting constellation to succeed the current METOP meteorological satellites in use. Despite reluctance from some of its members on budgetary grounds, the agency aspired to begin early design and conceptual work on the spacecraft. The current METOP program consists of three identical satellites launched at six-year intervals between 2006 and 2018, with operations running until 2023. ESA invested about €1.5 billion in METOP, while EUMETSAT's share was €2.4 billion.[269] The timely launch of preparatory work on the second generation programme is crucial in order to achieve continuity of service.[270]

On 24 February 2012, ESA entered into a $1.8 billion deal with Thales Alenia Space to build 6 satellites for its METEOSAT Third Generation system, aiming to provide meteorological services for 20 years starting in 2018. Whereas ESA is covering 62% of the cost of the 6 satellites, EUMETSAT will cover the other 38% of the contract and is also funding more than two-thirds of the entire MTG program (budgeted at about €2.4 billion).[271]

Data from China's polar-orbiting FY-3B meteorological satellite has been distributed by EUMETSAT since 24 January 2012 as part of the EumetCast broadcast network. EUMETSAT has been distributing microwave humidity and temperature data from the FY-3A spacecraft since late 2010. Users in the Asia-Pacific region will also be receiving the Chinese satellite data from the China Meteorological Administration's (CMA) own dissemination network, which resembles EUMETSAT's EumetCast and will be operational later in 2012.[272]

[267] Svitak, Amy. "NASA's Money Woes Thwart Joint Science Missions with ESA." Aviation Week & Space Technology 8 Aug. 2011: 24.
[268] "ESA, European Defense Agency Strengthen Ties." Space News 27 June 2011: 5.
[269] De Selding, Peter B. "Figures Demonstrate Value of Polar-Orbiting Weather Satellites." Space News 21 Nov. 2011: 6.
[270] De Selding, Peter B. "Four Eumetsat Members Block Approval of Polar-orbiting Satellite Constellation." Space News 4 July 2011: 1 and 14.
[271] De Selding, Peter B. "ESA Signs $1.8B Deal with Thales Alenia for Six Weather Sats." 24 Feb. 2012. Space News 15 May 2012 <http://www.spacenews.com/earth_observation/120224-esa-deal-thales-weather-sats.html>.
[272] "Eumetsat to Distribute Chinese Weather Sat Data." Space News 23 Jan. 2012: 3.

6.4 National Governments

6.4.1 France

In this reporting period several different issues emerged regarding France and its space activities. As a leading country in European space cooperation activities and one of the two biggest donators to the ESA budget, the main discussion related mostly to launch issues. Of significance was its debate over the successor of the Ariane 5 launcher, the development of France and Germany's relations between ESA and the EU, and finally French support in the field of international cooperation to build the space capacity of other actors.

France has already invested €250 million in a public bond to finance early development work on the Ariane 5 Midlife Evolution (Ariane 5 ME), one of the proposed future successors to ESA's heavy lift Ariane 5 launcher. This vehicle would be modular design, capable of launching 10,500 kilograms into geo-stationary orbit, and is planned to debut in 2018. France and Germany had agreed that a new re-startable upper stage of the current Ariane 5 rocket would be a top priority for the ESA's next multiyear budget and spending priorities, on which negotiations have to be concluded at the November ESA Ministerial Council meeting. Completing this stage will likely cost €1.5 billion - a considerable impact on France's national space policy related to keeping launch abilities in a sustainable frame. At the end of 2011, France was undecided about whether ESA governments should invest the required €1 billion in an upgrade from the ESA's next budget. ESA governments pay around €120 million per year to Arianespace to offset fixed costs. Within this future project evaluation period, France will need to take a position on the already initiated Ariane 5 ME development or the development of the next generation Ariane rocket. While the German government has continued to stress its support for the Ariane 5 ME upgrade, French officials are uncertain that, in a time of enormous pressure on its public budget, the upgrade of the current launcher is the way to go. As the then French President said in November 2011, he would maintain France's space budget despite the pressure on the public budget, when the investment into the space activities amounted approximately to €530 million from public bonds. In early 2012, France and Germany agreed to move the discussion over the Ariane 5 successor and decided to establish a working group to resolve differences over the project's future. The working group expects to come to a conclusion on the Ariane 5 by late June 2012.

On 22 March 2012, France released a space strategy report advocating the absorption of ESA by the European Union. The report also stressed the need for EU help in financing Europe's Guiana Space Centre spaceport in Kourou. Europe's Ariane 5 launcher was designed to thrive in global market conditions that did not factor in competition from China, India and the commercial launch providers in the United States. Now, European nations are urged to confront the fact that this model has become obsolete, manifesting the need for a broad update of priorities. The report calls on ESA to soften its geographic return rules along with urging the European Commission to apply a different standard to its competition requirement in areas like space, as there is only one viable European launch provider. And it further went on to express France's position on Galileo, emphasizing the need for the complement of 30 satellites plus spares.[273]

On 7 June 2011, France concluded a cooperation agreement with Azerbaijan for the promotion of satellite communication services. The agreement followed Azerbaijan's procurement of its first national communications satellite. Its launch is scheduled for the end of 2012, onboard an Ariane 5 rocket, for which Azerbaijan planned to secure a loan from the French export credit agency Coface.[274]

6.4.2 Germany

In 2011 and 2012 Germany continued its effort to position itself as the European space technology leader by taking the lead in key European space technology development projects, both in the framework of the EU and ESA. At the same time, it increased the visibility and public impact of its technological capabilities, both through its participation in the International Space Station (ISS) and in initiating its own national programmes. The German space programme focuses on the following priorities: the completion of the Galileo and GMES constellations; the full exploitation of ISS

[273] De Selding, Peter B. "French Strategy Paper Says ESA Should Fall Under EU Authority." Space News 2 Apr. 2012: 4.
[274] De Selding, Peter B. "France-Azerbaijan Accord Emphasizes Space Cooperation." 8 June 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/policy/110608-france-azerbaijan-space-cooperation.html>.

for as long as possible; the development of new or improved launch vehicles; and the realization of space exploration missions.[275]

After Galileo and GMES, reaching an understanding with its European partners on the development of future access to space systems was a key issue for Germany during the review period. Negotiations were undertaken with France to agree on this issue prior to the ESA Ministerial Council of late 2012 that would decide on the matter. From the outset, the German position favoured developing an upgrade for Ariane 5 ME, instead of building an entirely new rocket. Equipped with a new upper stage, Ariane 5 ME would be able to lift nearly 10.5 tons to GEO (one ton more that the current version) and could make its debut flight in 2018, for a cost of up to €1.5 billion.

The still unresolved challenges in the development of German national space programmes through public-private partnerships were evident in projects such as the country's use and further development of Radar Earth observation spacecraft. Although German Radar EO satellites (TerraSAR-X and TanDEM-X) were developed on public funding, their products were partially commercialised on a private sector basis. Despite the fact that their commercial operators were originally planned to take over the development of the next generation of such satellites, their weak commercial revenue quickly suggested that this would not be possible. This example demonstrated once more the difficulty of funding, developing and operating Earth observation services on a purely commercial basis in the absence of a minimum guaranteed commercial income provided by long-term government product purchases, as in the case of the United States. On the other hand, it has become clear that in the absence of an anchor tenancy of the satellites' operational use, the German space agency would have no choice but to subsidize the development of their successors, in the interest of maintaining service continuity.[276]

6.4.3 Italy

Cooperative public-private partnerships in developing space capabilities were also highly relevant for Italy in 2011 and 2012, particularly in the field of satellite communications. In this context, the Italian space agency (ASI) resorted to cooperation with the private sector, both in procuring satellite services and promoting the commercialization of its own satcom spacecraft. These seemingly opposite approaches had in fact a common denominator: scaling down operating costs for satellite application missions, either by outsourcing services or commercializing already acquired assets. An example of the former was ASI's €50 million deal with Eutelsat to purchase the exclusive use of ten Ku-band transporters onboard one of its future satellites. An example of the latter was the agency's decision on 15 July 2011 to create the commercial company Asitel, in order to promote services based on the Athena-Fidus Ka-band satellite, scheduled for launch by 2014. The set up of Asitel and the advanced commercialization of Athena-Fidus services even prior to its launch have the potential to transform the satellite's operational use to a PPP scheme, if commercial clients are willing to purchase not only services, but indeed exclusive transponders for use onboard the spacecraft.[277]

6.4.4 United Kingdom

In 2011 and early 2012, the United Kingdom (UK) successfully continued to develop its space activities and cooperation with other partners, related in part to its recently established UK Space Agency. Within the reporting period, the UK signed several cooperation agreements. On 14 July 2011, officials from the Russian space agency and UK space agency signed an agreement that outlines cooperation in several areas of space activity. They will establish a working group consisting of experts from both sides, to review application issues to the GLONASS system, in addition to potential microgravity experiments on the ISS.[278] Thereafter, on 18 April 2012, British and Japanese officials signed an agreement on space research and other potential commercial opportunities. One of the key domains is cooperation on Earth observation technologies, including the NovaSAR programme (i.e. the Disaster Monitoring Constellation) run by the British firm Surrey Satellite Technology Limited (SSTL).[279] Prior to this agreement, on 29 November 2011 the British government announced that it would finance about half of the costs of this project. The investment,

[275] De Selding, Peter B. "Germany Reaffirms Commitment to $2B Ariane 5 Upgrade." Space News 31 Oct. 2011: 6.
[276] "Public Funding on the Table for Germany's Next Radar Satellite." Space News 11 July 2011: 12.
[277] De Selding, Peter B. "Italian Space Agency Signs Bandwidth Deals with Eutelsat." Space News 11 July 2011: 6.
[278] "UK Space Agency and Roscosmos Signed Agreement." 14 July 2011. UK Space Agency 6 May 2012 <http://www.bis.gov.uk/ukspaceagency/news-and-events/2011/Jul/uk-space-agency-and-roscomos-sign-agreement>.
[279] "UK and Japan Commit to Greater Collaboration on Space." 18 Apr. 2012. Department for Business Innovation & skills, UK Space Agency 6 May 2012 <http://www.bis.gov.uk/ukspaceagency/news-and-events/2012/Apr/uk-and-japan-commit-to-greater-collaboration-on-space>.

amounting to £21 million, is meant for launching the first SSTL built NovaSAR satellite (the total cost amounts to £45 million).[280]

In October 2011, the UK Space Agency launched a call for proposals to support space science research related to Mars exploration. The call, amounting to a total of £1.6 million, would be distributed in the form of research grants to promote planetary science research in the UK, with a particular focus on exploiting data from NASA's Mars Science Laboratory and (at that time) the Russian Phobos-Grunt mission.[281]

6.5 United States of America

From a policy perspective, the second half of 2011 and the first half of 2012 was a transition period for United States' space activities. This period witnessed the implementation and further elaboration of the Obama Administration's prior ground breaking decisions to adopt a new strategic orientation for NASA and to implement a new National Space Policy. During this time, concrete actions were undertaken to realise the new strategic orientations, amid political controversy on their declared objectives and how best to accomplish them.

A focal point related to this process has been the development of new access to space technologies. In an important speech on 6 July 2011, President Obama laid down the strategic rational behind his policy. He defended his decision to invest in the development of new relevant technologies, instead of diverting resources to the exploitation of existing ones that date back to the Apollo era. He maintained that rather than keeping on doing the same thing, it would be better to invest in the search for breakthrough technologies that would revolutionise spaceflight. Furthermore, he confirmed that LEO human spaceflight missions would be completely outsourced to the private sector, while the NASA Human Spaceflight programme would be reoriented for a mission to an asteroid, rather than Mars, which would become an ultimate goal.[282]

Another issue area that preoccupied the Obama Administration was its plan to reform the export licensing procedures regarding space technology components. After nearly two years of consultations, government officials announced in July 2011 their proposal for a comprehensive new regulation on the subject. In a nutshell, the proposed reform would remove a great number of space related items from the Department of State's U.S. Munitions List (USML) and return it to the Commerce Department's Commerce Control List (CCL). The immediate result of this reform would be to significantly simplify and speed up export procedures, thus restoring U.S. commercial space companies' competitive situation in the international space market. At the same time, U.S. officials offered reassurances that the reform would protect the country's national security interests by only affecting non-military parts and components. Furthermore, Administration officials qualified the new export rule as a "common sense" approach. They maintained that the new rule would contain a more precise description of the USML items, which would then be reviewed on a case by case basis based on their actual nature and not on the broad generic definitions used thus far. According to the Administration, the implementation of the new paradigm would result in the migration of as much as 90% of the items to the CCL list, 50% of which were expected to be relieved of any export licensing obligation whatsoever.[283] Despite the Obama Administration's zest in promoting the reform, its implementation was hampered by political controversy and administrative delays. On the one hand, the USML review that was a prerequisite for the reform's presentation to legislative authorities was reported to be eighteen months overdue. On the other hand, the Administration's plans to couple the export licensing progress overhaul with the creation of a single government authority to supervise it ran into bureaucratic and political turmoil.[284]

6.5.1 National Aeronautics and Space Administration (NASA)

The implementation of the NASA new direction continued to preoccupy the Agency in 2011 and 2012. One of the most controversial aspects of its progress, however, was the Agency's efforts to manage the further development of the cancelled Constellation programme's technological spin offs, the centrepiece of which was the implementation of its 2010 Authorisation Act that mandated the development of a new spacecraft and heavy-lift vehicle. The new Multi-Purpose Crew Vehicle

[280] De Selding, Peter B. "British Government Backs SSTL's Low-Cost Radar Satellite Project." Space News 5 Dec. 2011: 4.
[281] "UK Space Agency Solicits Mars Research Grant Bids." Space News 24 Oct. 2011: 8.
[282] "Obama: Spaceflight Need a Technological Breakthrough." Space News 11 July 2011: 8.
[283] Brannen, Kate. "Obama's Export Licensing Regulation Reform Takes Step Forward." Space News 1 Aug. 2011: 13.
[284] Leone, Dan. "White House Report on Export Reform Still Expected This Fall." 17 Oct. 2011. Space News 6 Feb. 2012 <http://www.spacenews.com/policy/111017-report-export-reform-fall.html>.

(MPCV) would be based on the groundwork conducted on the Orion capsule, while the launcher would draw upon components designed for the Ares rocket. Throughout the reporting period, NASA's decisions regarding the implementation of this project came under intense legislative scrutiny. For example, Congress members from states where the Constellation was to be manufactured pressed NASA to make use of the programme's existing sub-contractors to develop the new spacecraft and launcher. NASA officials, on the other hand, demonstrated a clear preference to re-open the competition in an effort to cut down development costs for the Constellation spin offs, and avoid an indirect "resurrection" of the cancelled programme. Nevertheless, the cost cutting potential of using already developed components for the new spacecraft and launcher remained an important factor.[285]

In the course of the year, the large divergence of views regarding the future of the U.S. access to space programme between the executive and legislative branches of government became apparent, adversely affecting NASA appropriations. Indeed, in its 2012 NASA spending bill, Congress effectively proposed the nullification of the new NASA direction by multiplying funding for the development of the Constellation spin offs to the point of resurrecting it. For example, it recommended a ten-fold increase (to $1.95 billion) to the budget for the development of the Space Launch System (SLS), NASA's future launcher mandated by its 2010 Authorisation Act. These funds were to be used for related research and development alone, meaning that total spending on the project out of NASA's budget would be even higher. At the same time, it slashed appropriations to develop innovative access to space technologies and fund private spaceflight companies by two thirds, limiting them to $375 million.[286] According to NASA sources, if the spending bill were to be fully implemented, the development of the MPCV and SLS tandem would cost between $41.6 and $63 billion through 2025, depending on the programme's progress and the evolution of NASA's budget. In addition to this, it was foreseen that SLS would not fly before 2018, which would be too late to meaningfully support ISS operations that were scheduled to be terminated in 2020. At the same time, development of the even heavier SLS variant foreseen in the bill would not be completed before 2030. However, several Congress members doubted the accuracy of these estimates, qualified as an attempt to "sabotage" SLS.[287]

In an indirect reply to these accusations, NASA announced on 15 September 2011 its SLS development plans. The new rocket would have two stages, the first one making extensive use of Space Shuttle components (including its external fuel tank and spacecraft engines), and the second one based on the prototype J-2X engine developed for Ares. According to NASA, the entire development project for SLS, MPCV and their required ground infrastructure was not expected to cost more than $18 billion through 2018. Based on tested and reliable technologies, the development process was not expected to create delays or budget overruns, except in the case of the SLS first stage that would be based on an entirely new concept.[288] Congress's encouragement to rely as much as possible on existing Shuttle and Ares components and their subcontractors in order to minimise technological and budgetary risks was fully reflected in the NASA SLS procurement plan. Nevertheless, other members of Congress and experts questioned whether the adopted approach would in fact be less expensive than opening the contract to competition. In addition to this, this approach could be found in violation of U.S. federal procurement laws that laid down open market procurement rules for all public purchases.[289]

While NASA was struggling to meet Congressional demands on the exploitation of existing Space Shuttle and Constellation components for its future space transportation programme, it also moved toward exploring new propulsion technologies, as required by its new direction. Nuclear propulsion technology was one of the options under study, with an initial budget of $7.5 million allocated to it. Such technologies would prove especially useful to planetary science and exploration missions. For the realisation of further conceptual and development work in this field, NASA asked that pluto-

[285] Leone, Dan. "Senators Call for Competitive Heavy-Lift Propulsion Procurement." 2 June 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/civil/110602-senators-competitive-heavy-lift-procurement.html>.
[286] Leone, Dan. "Committee Cuts NASA Budget, Adds Cash for SLS, Crew Capsule." 11 July 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/policy/110711-committee-cuts-nasa-budget.html>; Leone, Dan. "Support for Commercial Crew Transports Also Singled Out for Less Funding in 2012." 18 July 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/policy/110718-commercial-crew-transports-less-funding.html>.
[287] Leone, Dan. "Obama Administration Accused of Sabotaging Space Launch System." 9 Sept. 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/policy/110909-obama-admin-accused-sabotaging-sls.html>.
[288] Leone, Dan. "NASA Commits To Building Mandated Heavy-lift Rocket." 19 Sept. 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/civil/110919-nasa-commits-heavy-lift.html>.
[289] Leone, Dan. "NASA's SLS Procurement Plans Prompt Call for GAO Investigation." 3 Oct. 2011. Space News 6 Feb. 2012 < http://www.spacenews.com/civil/111003-sls-procurement-gao-investigation.html>.

nium-238 production be restarted by the Department of Energy. However, the programme faced difficulties in receiving Congressional approval.[290]

NASA efforts to maximise the gains from technology spin offs during 2011 and 2012 were not limited to the field of space transportation, but also included the exploitation of the ISS. In the interest of maximising the use of in-orbit experiments onboard the ISS, NASA increased its outreach activities to the scientific community at large, multiplying opportunities for researchers. In order to do so, it set up a non-governmental organisation to run the ISS National Lab established since 2005. Space related research areas included the creation of an analogue spacecraft for deep-space missions, as well as an engineering lab to test new materials. Other potential research objectives included work on robotic tools and systems, as well as on advanced propulsion, habitation and radiation protection technologies. In addition to this, particular emphasis was placed on broader technological spinoffs that would be able to produce benefits for society at large. Such experiments included the development of satellite application technologies through the onboard testing of cubesats, as well as pharmaceutical research.[291]

6.5.2 National Oceanic and Atmospheric Administration (NOAA)

In 2011 and early 2012, two main issues developed related to the U.S. National Oceanic and Atmospheric Administration (NOAA). The first concerned its total budget, while also connected to its financial ability to invest in the space projects and international cooperation relating to them. The second issue initiated by the Obama Administration, was a new proposal for its organizational plan and its affiliated institutional competencies.

Debates over ever-decreasing funding for the U.S. Administration departments also affected the final negotiations for NOAA funding in 2011. On 14 June 2011, NOAA's officials asked Congress to approve a revised 2011 spending plan to operate and develop its space technology activities and shift $90 million to a new polar-orbiting weather satellite system. During the second half of 2011, NOAA proposed boosting spending on the already delayed Joint Polar Satellite System (JPSS) project, proposing to increase funding by more than $470 million. The proposal also tried to facilitate the increase by cutting spending on several other satellite programs. NOAA had been left with a $678 million shortfall that had already delayed the launch of the first JPSS spacecraft by at least a year. Within the 2011 budget proposal, there was a $17 million reduction in the agency's $58 million budget for operating its fleet of geostationary weather satellites, and a $5 million reduction for the Geostationary Operating Environmental Satellite R-Series program. Moreover, there was a $13 million cut to the Comprehensive Large Array Data Stewardship System, leaving the programme with only $5.4 million; funds were not allocated to the COSMIC-2 mission being developed with Taiwan; and funds were also not allocated to the Deep Space Climate Observatory (DSCOVR) project.[292]

Thus, on 13 July 2011, the U.S. House of Representatives Committee on Appropriation approved a 2012 spending bill that rejected development of the pair of satellites that would give advance warning of solar storms and of a collaborative project with Thailand. NOAA repeatedly asked for $47.3 million in funding for the DSCOVR project, and more than $11 million for the Constellation Observing System for Meteorology Ionosphere and Climate-2 (COSMIC-2) projects – these requests were rejected.

NOAA's 2012 funding bill would provide $567.4 million for its Geostationary Operational Environmental Satellite R-Series and it would also provide $20 million for the Jason-3 ocean altimetry satellite that is being co-developed with EUMETSAT. However, by December 2011, the U.S. government informed NOAA that it would be unable to furnish three observing instruments it had planned to provide for Europe's next-generation polar-orbiting weather satellite system.[293] At that time, NOAA had not yet been able to secure financing for its part of the Jason-3 satellite. NOAA's difficulty in financing a Jason-3 launcher has already forced a nearly one-year delay in the satellite's launch, with a new expected date of mid 2014. Its predecessor, the Jason-2 satellite, is nearing the end of its planned operational life. Finally, the U.S. House of Representatives trimmed $50 million from NOAA's $617.4 million request to develop a new generation of geostationary orbiting weather satellites. The savings are meant to help the JPSS program, which has been already delayed by the

[290] Werner, Debra. "NASA Presses on with Pu-238 Restart Despite Congressional Resistance." 26 Sept. 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/civil/110926-nasa-presses-pu238-restart.html>.
[291] Morring, Jr., Frank. "Exploration, Earth Spinoffs Planned For NASA At ISS." Aviation Week & Space Technology 20 June 2011: 130.
[292] "NOAA Ask to Move $90M Into Cash-Strapped JPSS." Space News 27 June 2011: 3.
[293] De Selding, Peter B. "NOAA Cancels Sensor Contribution to European Weather Satellite Program." Space News 12 Dec. 2011: 1.

protracted budget process in 2011.[294] The final proposal of NOAA's 2012 budget was appropriated by the U.S. Congress to the amount of $4.9 billion.[295] The last development was reported on 13 February 2012, when the Obama Administration proposed the budget request for the 2013 budget period.

Among the above-mentioned developments relating to NOAA's overall budget and particular program costs, a new proposal was made by the Administration to move NOAA out of the U.S. Commerce Department and into the U.S. Interior Department. This raised several concerns as to whether the proposal was the right direction for NOAA and its nature, or whether it would better fit with an "interior" purpose, creating a more flexible administration as a result.[296]

6.6 Canada

Despite the fact that Canada increased its budget for the period 2011-2012 to a record high of $424.6 million, and that the Canadian government has identified space as a key national strategic capability, its overall budgetary situation must be considered as one of the main reasons why it might be intended to keep expenditure on space activities rather low in the long-term. On the one hand, Canada is an important partner to the ISS program through its Mobile Servicing System and through its cooperation on the NASA's James Webb Space Telescope, in addition to having a status similar to that of an associate member with ESA. On the other hand, the country still lacks a comprehensive, broadly endorsed political approach toward space activity. In the review period, Canada released its new Report on Plans and Priorities in reference to its space activity. Despite this fact, Canada may still be waiting for clarification as to where its space agency's (CSA) sustainable and strategic plan is headed. For now, a wait-and-see approach has been noticeable, and has already brought some criticism.[297] Space industry representatives and politicians have expressed concern that CSA is still without guidance from the government in handling anticipated problems, resulting in a haphazard approach to budgeting. The lack of information and direction from the Canadian government on its commitment to a long-term space plan also makes it difficult for other countries to be involved in Canada's space activities.[298]

In March 2011, the Canadian government decided to commit to the ISS from 2015 to 2020. This decision also means that in addition to technical cooperation on this international project (e.g. the Special Purpose Dexterous Manipulator), Canadian astronauts will return to space.[299]

According to Canada's Report on Plans and Priorities, the budget increase in 2011 and 2012 was mainly for finalizing the Radar Constellation Mission (RCM) and the Polar Communication and Weather mission. However, budget cuts for the next period make the future of the RCM uncertain. This project is part of a constellation of radar-imaging satellites conducting maritime and Arctic surveillance. The satellite's developer, McDonald Dettwiler, has raised doubts whether the project will proceed, as the government's budget does not include the funds required to continue to the next project's phase. This phase involves the production of the first satellite for the constellation. Given the uncertainty of the project funding, McDonald Dettwiler will probably restructure its work force, likely resulting in employment layoffs.[300]

6.7 Russia

In 2011 and 2012 Russia has continued the modernisation of its space infrastructure according to the 10 year Federal Space Programme announced in 2005. The document, which provides main strategic orientations and guidelines for the Russian space programme for the 2015 horizon, is still relevant for the interpretation of the country's current ambitions in space.[301] One more space pol-

[294] Brinton, Turner. "House Panel Denies Funding for Pair of NOAA Satellite Projects." Space News 18 July 2011: 4.
[295] Werner, Debra. "NOAA Budget Proposal Includes Boost for Satellite Programs." Space News 20 February 2012: 8.
[296] Eilperin, Juliet. "NOAA's Proposed Move Raises Questions about its Role." 23 Jan. 2012. The Washington Post 8 May 2012 <http://www.washingtonpost.com/national/health-science/noaas-proposed-move-raises-questions-about-its-role/2012/01/20/gIQANNPYJQ_story.html>.
[297] "Canada's Space Planning Should Emphasize Flexibility." Space News 27 June 2011: 18.
[298] Pugliese, David. "Canadian Space Spending to Recede Following this Year's Spike." Space News, 20 June 2011: 7.
[299] Rakobowchuk, Peter. "Canada to Support Space Station till 2020." 1 Mar. 2012. Herald News 8 May 2012 <http://thechronicleherald.ca/canada/68715-canada-support-space-station-till-2020>.
[300] Pugliese, Dave. "CSA Budget Cuts Put Radarsat Constellation Mission in Limbo." Space News 9 Apr. 2012: 5.
[301] "Major Provisions of the Federal Space Programme of the Russian Federation for 2006-2015." 22 Oct. 2005. Russian Federal Space Agency (Roscosmos) 30 Apr. 2010 < http://www.federalspace.ru/main.php?id=85>.

icy related paper was produced in 2008 by Russia's Security Council, updating the security related project priorities.[302] The implementation of this programme so far has demonstrated considerable resilience and political commitment, despite the recent years' economic downturn on a global scale. In fact, a declared objective of Russian space activities is precisely to revitalise its economy and consolidate its space industrial basis. In addition to this, it seeks to generate technological and economic spinoffs from space science research and development, for the benefit of the entire society. Finally, it seeks to improve its defensive power.

Looking back, space technologies were first to contribute to the country's economic recovery after the "lost decade" of the 1990's, increase the external trade volume, and exploit Russian industry's competitive advantage in space. At the current time, further research and development areas include expanding space application utilisation, as well as implementing modern programme management and funding tools (such as public-private joint ventures) in order to conduct scientific research and diffuse its results to society at large.

The issue of improving Russian space industry's competitiveness on a global scale was a key plank of the country's space policies in 2011 and 2012. According to Russian space agency data, the country's space industry has only managed to capture 3% of international space business, despite the fact that it conducts 40% of worldwide launches and manufactures 20% of all spacecraft produced. This evidence suggests that Russia's space market penetration is very narrow, especially compared to the size and expertise of its industrial base. In order to remedy this problem, during the reporting period the Russian government continued efforts to restructure the country's space industry.[303]

One of the key aspects of this effort would be to improve the industry's workforce skills, especially on a managerial level, through the adoption of common best practices and a unified management culture. Another key plank of the restructuring efforts would be to break up contractual work among several holding companies, effectively replacing the existing public quasi-monopoly with an open market competition environment. This step would also gradually introduce more private funds into the space sector. Bringing private funds into Roscosmos programmes was in fact identified as a significant objective of the restructuring in itself. It is believed that creating a competitive environment would benefit the quality and innovative nature of Russia's space products and services. However, with the government being by far the greatest employer and client of the space industry, real privatisation efforts might prove elusive, especially if the state were to maintain its role as the single most important funding source for space technologies.[304]

Another key plank of Russian space policies during 2011 and 2012 has been to improve the country's self-sufficiency across the board, on technological and operational levels. This is particularly true regarding the development of access to space systems, where Russian authorities expressed their desire to maintain their country's forefront position by developing an entirely new space transportation system that would include a new crew/cargo transport vehicle and a medium-class launcher to be used at the new spaceport under construction in the Russian Far East. Although the launcher was expected to be a variation of the Zenith or Angara rockets, the spacecraft would be an entirely new design, in the area of twelve to fourteen tons in weight. For the latter, a very tight development schedule was foreseen, with the first automated flight taking place in 2015 and the first manned flight in 2018, possibly with a crew of six.[305]

Finally, a third main characteristic of Russian space policies during the review period has been its increased involvement in international cooperation, especially regarding the present and future of ISS operations. Indeed, in June 2011 the Russian space agency announced its plans to improve ISS exploitation and multiply the scientific experiments conducted onboard. In order to do so, it engaged in improving the scientific facilities of the Russian ISS module, notably with the addition of two new science power platforms and an improved docking module. This modernisation would also end the Russian segment's reliance on the U.S. segment for supplying the power required to conduct experiments on the ISS.[306]

At the same time, Roscosmos initiated planning for the period beyond 2020, when the ISS programme is scheduled to be terminated according to its current budgetary provisions. On this issue as well, Russian authorities seemed to carefully balance between adopting a cooperative approach

[302] "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>.
[303] Zaborskiy, Victor. "Revamping Russia's Space Industry: For Better or Worse?" Space News 1 Aug. 2011: 19.
[304] Id.
[305] Wall, Robert. "Russian Industry Eyes New Space Concepts."Aviation Week & Space Technology 22 Aug. 2011: 31.
[306] Pyadushkin, Maxim. "Russia To Increase Research On ISS."Aviation Week & Space Technology 20 June 2011: 135.

and maintaining their independent space capabilities. Regarding the former, in October 2011 the Russian space agency agreed with NASA to set up an expert-level group to investigate the possible options for ISS use after 2020. Similar contacts had been initiated with the other participating space agencies as well. One of the possible scenarios under discussion envisaged the exploitation of ISS components for the benefit of future space exploration missions.[307] In addition to this, however, Roscosmos also initiated studies on what it would take to operate the ISS alone beyond 2020. With the future of ISS still undecided, this should be considered as a purely theoretical problem. Nevertheless, it does illustrate Russia's rising sense of self confidence in the field of space technology and operations.[308]

6.8 Japan

Japan's space activities in the second half of 2011 and the first half of 2012 followed the broad strategic orientations of the country's basic plan for space (BSP). The BSP had previously established a five year roadmap for 2009-2013, along six basic pillars: the realisation of a "secure, pleasant and affluent society" utilising space; the enhancement of Japan's national security; the promotion of "space diplomacy"; the creation of a "vigorous future" by promoting space related research and development; the fostering of strategic space industries for the 21st century; and the consideration of the environment.

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 noticed 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 (including independent manned flights) also receives special attention in the document.

From a programmatic point of view, one of the key developments in Japanese space policy during the review period has been the decision to proceed with the development of the Quasi-Zenith Satellite System (QZSS), the country's future regional satellite navigation constellation. The Japanese Cabinet requested an initial ¥4.1 billion ($53.4 million) to begin manufacturing the first satellite. QZSS is scheduled to be fully operational by 2020, and it is designed to augment the regional accuracy of the GPS signal. The system promises to provide Japanese authorities with a more accurate, secure and independent service. The future deployment of four spacecraft will allow for twenty-four hour regional coverage, for an estimated cost of ¥170 billion ($220 million). The deployment of the full seven satellite constellation will dramatically decrease its dependence on GPS for regional coverage, but for an additional cost of ¥90 billion ($116 million). The decision to bring the system to its full potential might have been influenced by the swift deployment of China's own Beidou GNSS, which was expected to be finished by 2018. From a strategic point of view, increased competition between China and the United States in the region might pose a long-term threat to GPS signal availability and reliability. If such an eventuality were to occur, the timely development of the full QZSS constellation would help to mitigate its effects on Japanese citizens.[309]

From a space governance perspective, the second half of 2011 also introduced possible plans to break-up the Japan Aerospace Exploration Agency (JAXA) and concentrate all space activities under a smaller dedicated space agency directly under the Prime Minister's authority. Japan's newly appointed Prime Minister Yoshihiko Noda was considered in favour of this already existing proposal, which would effectively remove control of the Japanese space program from competing ministries and place it under centralised Cabinet-level management. Officials from JAXA's parent Ministry of Education, Culture, Sports, Science and Technology (MEXT) were reported to be against it, this opposition was founded on budgetary grounds, as the plan would move a third of the Ministry's budget to the Cabinet. However, by shifting the balance of power within the Cabinet, the appoint-

[307] Morring, Jr., Frank. "Spacefaring Nations Regroup For Push beyond LEO." Aviation Week & Space Technology 10 Oct. 2011: 46.
[308] Morring, Jr., Frank. "Keep On Trucking." Aviation Week & Space Technology 10 Oct. 2011: 26.
[309] Kallender-Umezu, Paul. "Japan Commits To Deploying Satellite Navigation System by 2020." Space News 17 Oct. 2011: 14.

ment of the new Prime Minister had the potential to provide a forward push for the reorganisation plan.[310]

Finally, during the reporting period JAXA unveiled its long-term human space exploration strategy. Its objective is to develop a vehicle capable of human spaceflight based on the HTV cargo spacecraft created to support ISS operations. However, no budget has yet been allocated to the programme, nor has it received a green light from Japan's Space Activities Committee. Since the original HTV spacecraft was operationally conceived as a part of the ISS programme, development of its human spaceflight capable variant would face a tight programmatic timeline, in view of the possible retirement of the ISS in 2020.[311]

6.9 China

Chinese space policy evolves around the country's five years' economic development plans. The country's space programme is therefore meant to support its overall development objectives, while maintaining a comprehensive set of objectives for space activities. The main challenge for the Chinese programme is to achieve the right mix of national space capabilities and participation in international space cooperation. In December 2011, the Chinese government announced its latest five year plan for 2011-2016, in the form of a government White Paper entitled "China's Space Activities in 2011."[312] This document updates and extends the country's strategic and operational objectives in space, depicting the progress made since 2006 and laying down its short term plans, divided into four main activity areas: space transportation, satellite development, space applications and space science. In addition to this, it presents China's ambitions to play a pivotal role on the international scene and underpins the contribution of space activities to achieving this purpose.

China's principle policy objectives in space are all related to promoting the country's scientific, economic and social development, securing its national security and independence (in its broader sense) and improving its international influence by engaging in space cooperation. More specifically, it relates space activities to achieving the objectives of its scientific and technological innovation policies. At the same time, it stresses the importance of maintaining independent space capabilities, while carefully trying to balance this with an open approach to international cooperation and insistence on the peaceful exploitation of space. In a nutshell, the new Chinese space policy's principal axes are:

- Enhance space science and technology capabilities through innovation.
- Maintain technological and operational self-reliance across the board.
- Adopt an open and constructive attitude to international cooperation on the basis of mutual benefit.
- Oppose space weaponisation and protect the space environment.

All of the aforementioned policies converge to achieve the general national objectives of economic development, social progress and comprehensive national strength.

Apart from these general principles, China's new space policy recites in detail the country's achievements in space over the past five years and declares its programmatic intentions for the future. The level of operational and technological details provided is unprecedented for a Chinese document of this kind; combined with the clear description of future programmes, it implies a higher level of confidence and pride in the country's space capabilities than before. The Chinese five year space programme focuses on four mission areas: transportation, satellites, spaceflight and applications.

In the field of space transportation, it focuses on the development of three new launcher configurations by 2016, using more efficient engines and an entirely new upper stage. They include Long March 5 (with a 14 tons to GEO lift capacity), Long March 6 (1 ton to LEO), and Long March 7 (5.5 tons to LEO). The realisation of this programme will provide China with comprehensive and flexible access to space capability, in line with the current and prospective space rocket development plans of all other major space faring nations. This fact underpins China's willingness to improve its space capabilities on a peer-to-peer basis. Of particular interest is Long March 6, which is described as a "high-speed response launch vehicle". This light weight launcher will provide China with an opera-

[310] Jayaraman, K.S. "Japan's Latest Political Shake-up Stirs Hope for Space Agency Overhaul."12 Sept. 2011. Space News 25 Jan. 2012 <http://www.spacenews.com/policy/110912-japan-space-agency-overhaul.html>.
[311] Perrett, Bradley. "Japan Charts Path for Manned Space Missions." Aviation Week & Space Technology 8 Aug 2011: 48.
[312] White Papers of the Government of China. "China's Space Activities in 2011." Beijing 29 Dec. 2011. 6 Mar. 2012 <http://www.china.org.cn/government/whitepaper/node_7145648.htm>.

tionally responsive launch capability for the first time, with obvious national security and commercial applications.

In the field of satellite development, the new Chinese space policy describes a comprehensive programme embracing all fields of satellite and spacecraft use. It calls for the development of improved weather and communications satellites, as well as of an entirely new Earth observation and electromagnetic monitoring satellite series. The key plank of this programme would be the development of a satellite fleet capable of all-weather 24-hour operations worldwide, which would imply making significant advancements in space borne SAR and high resolution optical instrument technologies. Finally, the new policy reiterates China's goal of fielding a regional satellite navigation capability by the end of 2012 and to complete the deployment of its entire thirty-five satellite Beidou GNSS constellation by 2020.

In the area of orbital spacecraft development and human spaceflight, the new Chinese space policy is much more reserved in providing details, conscious perhaps of the higher technical challenges involved in these endeavours. It nevertheless draws an accurate picture of its short term steps, principally related to the full exploitation of the Tiangong-1 vehicle for operational testing and technological R&D purposes. To this end, it announced the launch of two more spaceflight missions, Shenzhou-9 and Shenzhou-10. In the long run, the new policy reiterates China's ambitions to independently develop all technologies necessary for human space flight and for maintaining a permanent human presence in orbit. Finally, the new policy announces the beginning of concept studies for a future Chinese human lunar landing programme.

Regarding space applications, the new Chinese space policy represents a significant push towards the full exploitation and commercialisation of the country's emerging satellite capabilities. Particular attention is attributed to the utilisation of the Beidou GNSS and the new Earth observation and communications satellite fleet mentioned above. A broad market-oriented distribution of such services is described in the document, indicating China's ambition to establish itself in the global commercial satellite services market in the same fashion that it has in the commercial space launch market. The approach adopted to meet this objective seems to be equally motivated by the need to expand the industrial and commercial scope of the Chinese space industry, as well as by the willingness to improve the down-streaming of satellite services and consequently increase societal benefits from them.

The implementation of the aforementioned programmes is envisaged to be assisted by a set of appropriate policy measures. They include plans for a broad restructuring of the space related industrial and R&D base, including the encouragement of sustainable scientific innovation, the creation of new research facilities, and the renewal of the country's skilled human capital relevant to space activities. The new industrial capabilities are expected to be coupled with a suitable funding and legal framework that will include the adoption of a national space law. It is foreseen that this new framework will also encourage the development of space entrepreneurship and market-oriented satellite utilisation schemes. It should be noted that all these policies are explicitly reserved for the field of satellite application, which seems to be the focal point of the new space policy's practical implementation, and the activity area expected to be most influenced by it.

Finally, the new Chinese space policy pays significant attention to the role of international space cooperation, both as a means to fulfil the country's national objectives in space and as a tangible recognition of its rising space status. The policy document proceeds to give a very detailed account of China's principal bilateral and multilateral cooperation agreements on space activities. It attributes particular emphasis on bilateral cooperation with Russia, Europe (ESA, EUMETSAT and individual Member States), Brazil, Ukraine and an array of smaller emerging countries. Furthermore, it underpins China's increasing engagement in multilateral cooperation, especially in the context of the UN and the Asia-Pacific Space Cooperation Organization (APSCO). The principal guidelines of China's international engagement in space activities remain unchanged, advocating the promotion of "…inclusive space development on the basis of equality and mutual benefit, peaceful utilization and common development."[313] However, increased emphasis is given to regional cooperation, and the further development of APSCO.

It is noteworthy that China explicitly positions itself between developed and developing countries. This approach implies a two-fold strategy seeking to exploit the country's comparative technological advantages vis-à-vis the latter and remedying its weaknesses compared to the former. It therefore implies that the Chinese officials are keenly aware of their country's unique position on the global space activities' scene, and they are hopeful to fully exploit it. Presumably, this would involve providing affordable space applications to their developing country partners, and engaging in

[313] Id.

high profile missions with more established space faring nations. In this context, the areas of scientific research, satellite applications, human spaceflight, technological cooperation and satellite services' commercialisation are identified as principal future cooperation areas. When considering this list, it is indeed probable that Chinese officials aspire to establish their country as a satellite applications' provider to emerging economies, and a peer partner to developed space powers for innovative space science, technology and spaceflight missions.

On 11 July 2011 China successfully launched its second data relay satellite Tianlian 1-02. The spacecraft joined the Tianlian 1-01 data-relay satellite, launched in 2008, that supports China's manned flights, while its launch was also considered related to the deployment of its first space station. Thus, China became only the third nation after the United States and Russia to build an operational data-relay service.[314]

In 2011 and 2012 China continued its intensive launching campaign. On 27-29 July 2011 for example, it orbited two satellites in two consecutive days, with the orbiting of a Beidou/Compass navigation satellite, and the experimental Shijian SJ-11-02 spacecraft, both built by China Space Co. Ltd.[315] This frantic pace continued throughout the reporting period, undeterred by temporary setbacks, such as the failure of the SJ-11-04 experimental satellite, due to a malfunction of the Long March 2C rocket that carried it.[316]

6.10 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.

A key plank of India's space policy in 2011 and 2012 has been the emphasis on international cooperation. Encouraged by the development of its space programme, India's space agency adopted a more extrovert approach to relationships with established space faring powers, such as the U.S., but also Europe, albeit on a bilateral basis with European Member States, rather that on an institutional level. The rapid development of the country's space capabilities has boosted its self confidence to engage in joint projects with such partners, based primarily on the low cost of its technologies, but also on their increasing reliability. In this case as well, priority was given to space application missions. An example of this trend can be seen in the successful launch of a joint Earth observation mission with the French space agency CNES. On 12 October 2011, the Megha-Tropiques satellite was successfully placed in LEO on board a PSLV launcher. The spacecraft was designed to operate for three to five years, for the purpose of studying tropical monsoons with the use of a microwave instrument. The Indian contribution to the mission was significant, including the provision of the launcher, spacecraft development and 60% of the approximately $152 million budget. Despite the project's successful development, no follow-up mission has been yet foreseen. In addition to its main payload, the PSLV rocket also carried three Indian microsatellites to orbit, including a demonstrator commercial ship-monitoring spacecraft.[317]

Another key plank of Indian space policy during the reporting period, and a sign of the country's increased self-confidence and open approach to international space activities, were the steps taken to boost commercial space activity, especially in the Earth observation product market. This was exemplified by the Indian authorities' decision in July 2011 to lift existing restrictions on the sale of high resolution satellite imagery of the Indian subcontinent. Until then, ISRO policy distinguished between government and commercial clients of Earth observation products from its satellites. Consequently, ISRO announced that all imagery of up to one metre spatial resolution would be available on a non-discriminatory basis for distribution. Data of better than one metre resolution destined to non-governmental users would be screened prior to distribution, to protect national security interests. Private entities requesting such products would still need the endorsement of a government agency. More importantly, ISRO approved the open sale of such products to foreign

[314] "2nd Chinese Data-Relay Satellite Reaches Orbit." Space News 18 July 2011: 9.
[315] "China Launches Two Satellites in Two Days." Space News 1 Aug. 2011: 8.
[316] "Long March Failure Mars China's Launch Tempo." Space News 22 Aug. 2011: 8.
[317] De Selding, Peter B. "ISRO Launches Joint French-Indian Satellite To Study Tropical Monsoons." Space News 17 Oct. 2011: 5.

entities as well, consequently opening up relevant Indian data to the international market. In relation to this, a High Resolution Image Clearance Committee was set up to approve foreign sales of Earth observation images, conditional on the signing of nondisclosure agreements with ISRO's Remote Sensing Centre.[318]

6.11 Brazil

Despite long-term obstacles in Brazil's space and R&D development, and the lack of expertise in its workforce Brazil is fast becoming an important space player in the future due to its geographic position close to the equator, and its rapidly growing economy,. On March 2011, Brazilian officials made an announcement on the ambitious plan to triple the space agency's budget from 300 to 900 million Brazilian reals (from $185 million to $555 million); it will also streamline its management, boost private sector involvement, and educate and train more aerospace workers.[319] In recent years, Brazil has reached a point of recognition as a global economic leading country. By 2011, Brazil was the sixth largest country by nominal GDP, and it is expected advance to the fifth position by the end of 2012. Moreover, Brazil is a member of the BRIC, consisting of Brazil Russia, China, and India. At the last BRIC conference, several partners stated that their economic cooperation should also include cooperation between their space sectors.[320] While all BRIC members are space faring nations, and cooperation already exists between Brazil and Russia (and Ukraine) in the development of launch capabilities, in the wake of delays and funding uncertainties, strengthening cooperation between Russia and China would also help Brazil in developing its own space programme and industry.

Brazil is already undertaking cooperative programs with Ukraine and Russia to build six Cyklon-4 rockets that could launch small satellites into low Earth orbit (LEO) and heavy geosynchronous communications satellites. The head of the Ukrainian Space Agency expressed concern that the project is underfunded, however, as $280 million has been spent and around $260 million is still required; Brazil has invested $50 million more than Ukraine in that project.[321]

The United States is still an important partner for Brazilian space activity. In October 2011, NASA and the Brazilian Space Agency (AEB) signed an agreement for a scientific and engineering feasibility study for potential cooperation in the Global Precipitation Measurement (GPM) mission project (this project is already established between NASA and JAXA). The two agencies also signed a cooperation agreement on an ozone study. Moreover, Brazil will play an important role in the dissemination of NOAA data for the South America region. Brazil's National Institute for Space research (INPE) is already cooperating and trying to expand the GeoNetCast program. These activities foster collaboration among scientific organisations on an international scale by improving the availability of scientific data for *inter alia*, global climate protection and environmental monitoring. Brazil has also expressed strong interest in cooperating on international projects for crisis management dealing with major natural or technological disasters. On 5 April 2012, Brazil and USA held the first space related security dialogue, affirming both nations' commitment to collaboration in working towards a sustainable, safe and secure space environment.[322]

6.12 Emerging Space Actors

In 2011 and 2012, South Korea was one of the most active emerging space actors, especially in the field of space applications. In October 2011, the Korean Aerospace Research Agency announced its plans to launch two additional Earth observation spacecraft of the Kompsat satellite series by mid-2012. The first would be equipped with a Synthetic Aperture Radar instrument, and the second with an improved optical one. Both spacecraft would be locally designed and built by the Korean space agency and the country's aerospace industry (KAI). This campaign would bring the number of Korean-built satellites in orbit to a total of five, significantly improving both ground resolution and operational flexibility. Although the satellites were poised to provide imagery for

[318] "India Eases Restriction on Satellite Imagery Sales." Space News 11 July 2011: 8.
[319] Messier, Douglas. "Will a New Space Power Rise along the Atlantic?" 15 Aug. 2011. The Space Review 8 May 2012 <http://www.thespacereview.com/article/1904/1>.
[320] "Dmitry Medvedev: BRIC Cooperation has Great Potential." 13 Apr. 2012. The Voice of Russia 8 May 2012 <http://english.ruvr.ru/2010/04/13/6382853.html>.
[321] Will a New Space Power Rise along the Atlantic…
[322] "State Dept. Fact Sheet: U.S.-Brazil Space Cooperation." 9 Apr. 2012. U.S. Department of State, Office of the Spokesman 8 May 2012 <http://iipdigital.usembassy.gov/st/english/texttrans/2012/04/201204063457.html#ixzz1uHwajBn0>.

civilian and scientific purposes, their improved operational characteristics would enable their military use as well. It is noteworthy that Korean authorities opted for open commercial market procedures in awarding the programme's contract, because the same commercially-oriented approach is expected to prevail in the distribution of the satellites' products.[323] In addition to this, Korea's increased Earth observation capabilities have fuelled the country's stronger participation in international cooperation schemes in this field. For example, in July 2011 the Korea Aerospace Research Agency became the newest member of the International Charter on Space and Major Disaster. The country pledged to provide data from the Komp-2 spacecraft in support of the Charter's emergency relief support operations.[324]

During the reporting period, Singapore emerged as another South-East Asian country with significant space aspirations. Most international commercial space companies maintain offices in the country, encouraged by favourable tax laws. In October 2011 Singapore's government unveiled its plans to transform this international space-related presence to a more comprehensive space industry and business hub for the entire South-East Asia region. In recent years, Singapore has developed a full-fledged space research industrial and administrative infrastructure to support its space activities. Furthermore, the country's space programme was created on a fully outsourced PPP basis from the outset. The foundations of this approach were laid down in 2006, with the creation of the Singapore Space & Technology Association (SSTA), a private entity. SSTA's board includes senior representatives from the Singapore Economic Development Board, the Defence Sciences Organization, the Civil Aviation Authority of Singapore, the National University of Singapore and Singapore Technologies (ST) Electronics. The latter is a joint venture company created on a PPP basis for the purpose of commercialising locally developed EO technologies and services, including data from the country's first Earth-observation satellite X-SAT, built by the Nanyang Technological University (NTU). SSTA is the centre of space-related activities in Singapore. It organises an annual Global Space & Technology Convention, animates the Asia-Pacific Regional Space Agency Forum in cooperation with JAXA, and runs the Singapore Space Academy.[325]

In the Middle East region, Iran continued to establish itself as a strong regional space actor, through the implementation of a comprehensive space programme. The focus of Iran's space activities in 2011 and 2012 was on the space application's mission area. The country's relevant programme culminated on 15 June 2011 with the launch of the Rasat-1 Earth observation satellite, onboard a Safir rocket. Rasat-1 was Iran's second locally designed and built satellite, after the launch of the spacecraft Omid in March 2011. Although Rasat-1 is considered to be a technology validation mission, the spacecraft's EO capabilities might be suitable for operational use. According to Iranian officials, the mission's objectives were to establish contact with Earth stations, obtain orders from those stations, take Earth images and transmit them along with telemetry information back to its ground station.[326]

On 12 March 2012, the official representatives of the two biggest satellite fleet operators based in the Middle East, Nilesat and Arabsat, said in separate statements that intentional jamming of their signals has resulted in substantial business and revenue-losses during the Arab spring. Nilesat representatives said the jamming started with Libya and then moved to Bahrain, Iraq, Syria, Iran and other places. Nilesat's five satellite transponders carrying more than 60 television channels have been interrupted for varying lengths of time. The international regulatory radiofrequency body (ITU) was asked for an official reaction, thus calling on operators to react to current jamming issues, and prevent problems from occurring in the future.[327] On 7 December 2011, five international television and radio broadcasters (incl. the BBC, Voice of America, Deutche Welle, Audiovisuel Exterieur de la France and Radio Netherlands Worldwide) called on international regulators to address the issue of international satellite signal interference as an agenda item at its 2012 ITU conference. These operators all indicated that Iran was trying to jam their satellite signals.

The ITU's World Radiocommunication Conference (WRC-12) was held in Geneva early in 2012. Despite the increased number of issues since the last conference, some issues were given higher priority for future consideration by international regulatory officials. In the short-term, there will be increased demand for access to satellite orbital slots, mainly by developing and emerging nations. The inevitable result of current trends in demand for orbital slots has intensified competition between developing and emerging economies, mainly in Africa, Asia and the Latin America region.

[323] Perrett, Bradley. "Seoul Pushes Ahead With Spacecraft Program." Aviation Week & Space Technology 24/31 Oct. 2011: 44.
[324] "South Korean Space Agency Joins Disaster Relief Pact." Space News 25 July 2011: 8.
[325] Francis, Leithen. "Singapore Aims To Become Space Industry Powerhouse." Aviation Week & Space Technology 17 Oct. 2011: 50.
[326] "Iran Lofts Imaging Satellite In Orbit atop Safir Rocket." Space News, June 20 2011: 8.
[327] De Selding, Peter B. "Jamming No Mere Nuisance for Middle East Satellite Operators." Space News 26 Mar. 2012: 6.

The WRC delegates agreed to extend the amount of time a satellite operator has to replace a failed satellite, i.e. from two years to three years; it also formally set the agenda for strengthening the rules related to registering satellite systems.[328] Finally, the long dispute over Iran's Zohreh-1 satellite has moved to the next stage after the 153 delegates decided to reinstate Iran's right to the previously licensed slot position.[329]

[328] De Selding, Peter B. "Iran Decision, British About-Face among Surprises at Radio Frequency Conclave." Space News 27 Feb. 2012: 1 and 4.
[329] "Looking Beyond WRC-12." Space News 12 Mar. 2012: 26.

List of Acronyms

Acronym	Explanation
A	
AEB	Agência Espacial Brasileira (Brazillian Space Agency)
AG	Aktiengesellschaft
AIA	Aerospace Industry Association
APSCO	Asian-Pacific Space Cooperation Organization
ASAT	Anti-Satellite
ASD	Aeronautics, Space & Defence industries association
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
ATV	Automated Transfer Vehicle
B	
BMD	Ballistic Missile Defence
BRIC	Brazil, Russia, India, China
BSP	Basic Space Plan
C	
CAGR	Compound Annual Growth Rate
CASBAA	Cable and Satellite Broadcasting Association of Asia
CAST	China Aerospace Science and Technology corporation
CCL	Commerce Control List
CEO	Chief Executive Officer
CHF	Swiss franc
CHIRP	Commercially Hosted Infrared Payload
CMA	China Meteorological Administration
CNES	Centre National d'Études Spatiales (French Space Agency)
COP	Conference of the Parties
CSA	Canadian Space Agency
D	
DARS	Digital Audio Radio Service
DBS	Direct Broadcast Services
DISCOS	Database and Information System Characterizing Objects in Space
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center)
DoD	Department of Defence
DRDO	Defence Research and Development Organisation
DSCOVR	Deep Space Climate Observatory
DTH	Direct To Home
DWSS	Defense Weather Satellite System

Acronym	Explanation
E	
EADS	European Aeronautic Defence and Space company
EAP	Environmental Action Programme
EARSC	European Association of Remote Sensing Companies
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EC	European Commission
EDA	European Defence Agency
EDRS	European Data Relay Satellite System
ELISA	Electronic Intelligence Satellite
EO	Earth Observation
ESA	European Space Agency
EU	European Union
EUMETSAT	The European Organisation for the Exploitation of Meteorological Satellites
EUTELSAT	European Telecommunications Satellite Organisation
F	
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FP7	Seventh Framework Programme
FP8	Eighth Framework Programme
FSS	Fixed Satellite Services
G	
GDP	Gross Domestic Product
GEO	Geostationary Earth Orbit
GIFAS	Groupement des Industries Françaises Aéronautiques et Spatiales
GLONASS	Globalnaya Navigatsionnaya Sputnikovaya Sistemya (Russian GNSS Constellation)
GmbH	Gesellschaft mit beschränkter Haftung
GMES	Global Monitoring for Environment and Security
GNI	Gross National Income
GNSS	Global Navigation Satellite System
GPM	Global Precipitation Measurement
GPS	Global Positioning System
H	
HDTV	High-Definition Television
HTV	H2A Transfer Vehicle
I	
IAI	Israel Aerospace Industries
ICBM	Inter-Continental Ballistic Missile
IGS	Information Gathering Satellite
IMF	International Monetary Fund
IMO	International Maritime Organisation

Acronym	Explanation
IMPEL	Implementation and Enforcement of Environmental Law
INPE	Instituto Nacional de Pesquisas Espaciais (Brazil's National Institute for Space Research)
IOV	In-Orbit Validation
IRGC	Islamic Revolution Guards Corps
ISRO	Indian Space Research Organisation
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
ITU	International Telecommunication Union
J	
JAXA	Japan Aerospace Exploration Agency
JPSS	Joint Polar Satellite System
K	
KAI	Korean Aerospace Industries
KSC	Kennedy Space Center
L	
LEO	Low Earth Orbit
LTRO	Long-Term Refinancing Operation
M	
MDA	Missile Defense Agency
MDA Corp.	MacDonald, Dettwiler and Associates Ltd.
ME	Mid-life Evolution
MEO	Medium Earth Orbit
MEP	Member of the European Parliament
METOP	Meteorological Operational satellite
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MFF	Multiannual Financial Framework
MPCV	Multi-Purpose Crew Vehicle
MTG	METEOSAT Third Generation
N	
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
NEC	Nippon Electric Company
NGA	National Geospatial-Intelligence Agency
NOAA	National Oceanic and Atmospheric Administration
NRO	National Reconnaissance Office
NTIA	National Telecommunications and Information Administration
NTU	Nanyang Technological University
O	
OECD	Organisation for Economic Co-operation and Development
OHB	Orbitale Hochtechnologie Bremen

Acronym	Explanation
P	
PLA	People's Liberation Army
PND	Portable Navigation Devices
PPP	Public-Private Partnership
PSLV	Polar Satellite Launch Vehicle
PTSS	Precision Tracking Space System
Q	
QZSS	Quasi-Zenith Satellite System
R	
R&D	Research and Development
RCM	Radar Constellation Mission
RISAT	Radar Imaging Satellite
ROEM	Renseignement d'Origine Électromagnétique
S	
SAR	Synthetic Aperture Radar
SAS	Société par Actions Simplifiée
SES	Société Européenne des Satellites
SIA	Satellite Industry Association
SIS	Space Infrastructure Service
SLS	Space Launch System
SM	Standard Missile
SpA	Società per Azioni
SpaceX	Space Exploration Technologies
SPOT	Satellite Pour l'Observation de la Terre
SS/L	Space Systems/Loral
SSC	Swedish Space Corporation
SST	SpaceShip Two
SSTA	Singapore Space & Technology Association
SSTL	Surrey Satellite Technology Limited
STE	Singapore Technologies Electronics
T	
TAI	Turkish Aerospace Industries
U	
UK	United Kingdom
U.S.	United States
UAS	Unmanned Aerial Systems
UHF	Ultra High Frequency
ULA	United Launch Alliance
UN	United Nations
UN CTAD	United Nations Conference on Trade and Development
UN FCCC	United Nations Framework Convention on Climate Change

Acronym	Explanation
UN REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
USAT	Ultra Small Aperture Terminals
USML	United States Munitions List
V	
VSAT	Very Small Aperture Terminals
W	
WRC	World Radiocommunication Conference

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