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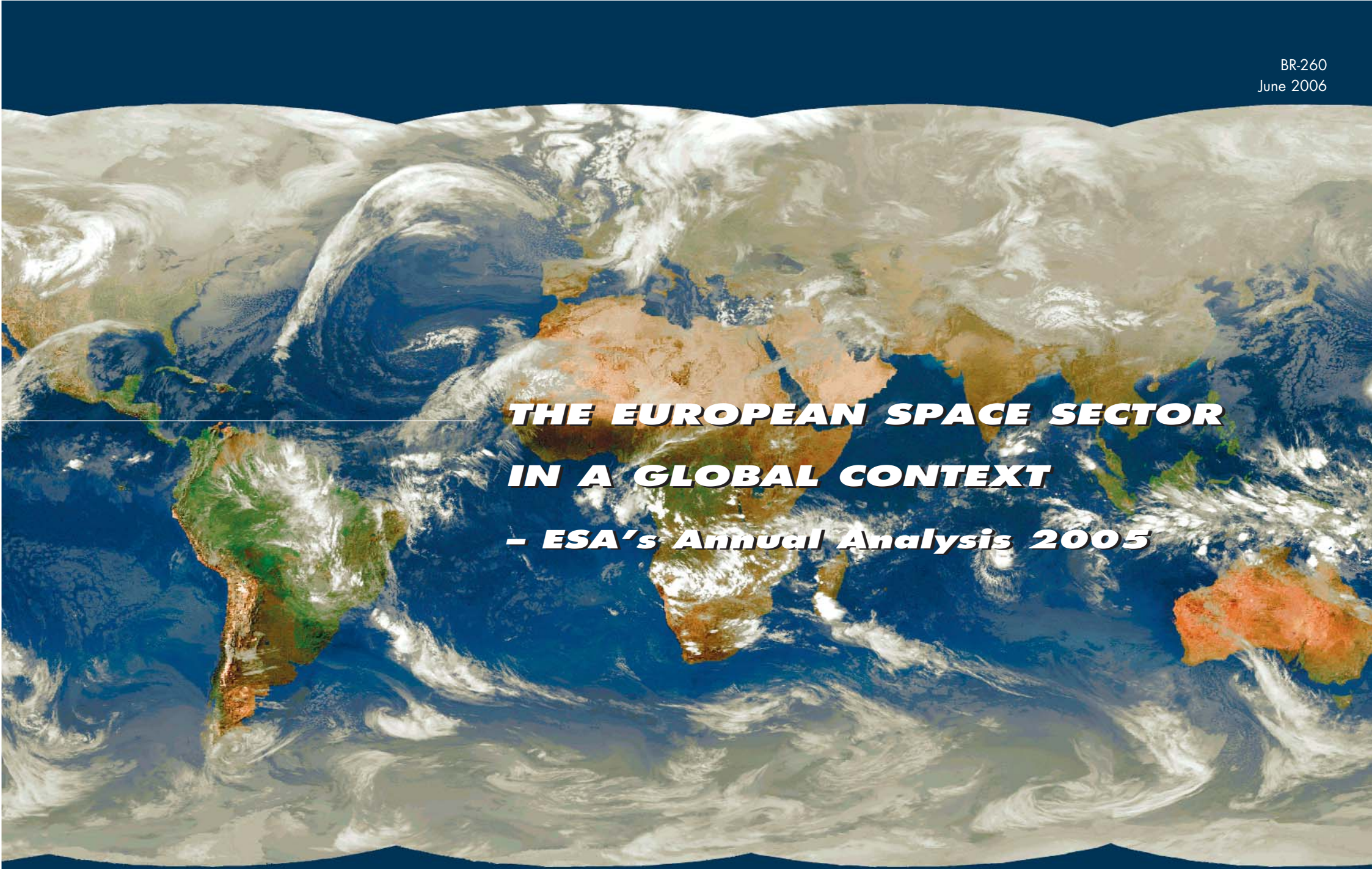

THE EUROPEAN SPACE SECTOR IN A GLOBAL CONTEXT

– ESA's Annual Analysis 2005

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This report provides an overview of the European space sector in a global context. It takes into account the geopolitical and economic changes that occurred in the World during 2005 and are of importance to current and future development of the European space sector. It therefore provides facts and figures with regard to the latest state of European space policies and industry, while putting recent developments into perspective with the situation of other space powers.

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ESA Council Meeting at Ministerial Level in Berlin in December 2005

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Introduction

The year 2005 was particularly dynamic for the European space sector, the major events being ESA's Council at Ministerial Level in Berlin in December, and two Space Councils, convened to debate European Space Policy, in June and November. The decisions taken and orientations adopted at these meetings are designed to maintain and increase the future competitiveness of the European space sector, while also opening the way for new discoveries. By approving the continuation of ongoing programmes and the start of new activities with a particular focus on technology development and demonstration, Ministers set the agenda for the coming years. Putting Europe's space effort into a long-term perspective, they responded positively to the proposal by ESA's Director General to uphold a commitment to a strong Science Programme, emphasise the intensification of innovative technology development, start a new exploration programme, and support a GMES space component programme in support of European Union and global policy needs.

The Council at Ministerial Level was able to build on the pertinent decisions taken in previous years, with major science missions and application programmes coming to fruition in 2005. With the supply of stunning scientific data from missions such as Huygens and Mars Express, and the launch of various missions such as Venus Express, the second-generation Meteosat and the first Galileo satellite GIOVE-A, 2005 gave a sense of the qualitative and quantitative substance of ESA's programmes. This success was further underlined by the two Ariane-5 qualification flights, one of which put the heaviest ever commercial satellite into orbit.

However, it should be borne in mind that the European space sector, and its industry in particular, is a fragile instrument, subject to growing challenges as international competition increases. The global space sector has become more diverse than ever. China and India are now established space powers, while Russia continues to launch more spacecraft than any other country and is upgrading its overall space effort. In this context, China's second manned space flight in 2005 symbolises its political ambition and ability to achieve rapid progress in a full range of space activities. Science, exploration, technology and applications offer greater potential for international cooperation, which goes hand in hand with stiff competition. With greater cooperation on launchers with Russia and the signature of a Framework Agreement between ESA and the Chinese National Space Administration, Europe has demonstrated its willingness to adapt rapidly to changing circumstances. It is determined to strike a balance between mutually beneficial cooperation, and continuing competitiveness combined with strategic non-dependence with respect to other World players.

Europe's competitiveness will depend not only on the intensification of R&D efforts, but also on a stronger institutional market to counterbalance temporary commercial downturns. Security technology and applications – ranging from environmental issues to space-debris surveillance and some European Security and Defence Policy (ESDP) applications – will consequently play an important role. Acknowledging this field's inherent potential and responding to EU policy papers highlighting required space capabilities, ESA decided to start a new technology programme taking into account dual-use technologies. The Agency has also continued extending the scope of its dialogue with national and international security stakeholders.

Putting the decisions taken in 2005 in a global context helps in understanding the extent to which they represent intermediate steps towards securing Europe's lasting industrial competitiveness, and its ability to embark on international cooperation from a strong position while putting its know-how and political will at the service of global development and the environment.

Image of Europe under snow, taken in March 2005 by ESA's Envisat spacecraft

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Global Political and Economic Trends

2.1 Europe

GENERAL DEVELOPMENTS

2005 proved a critical year for European institutions and their decision-making processes, with two national referendums rejecting the Treaty establishing a Constitution for Europe, a stalemate in negotiations on the European Union budget up to the very end of the year, and problems in implementing the Lisbon Strategy.

Following the signature in Rome by all EU Member States of the Treaty establishing a Constitution for Europe in October 2004, ratification was to be achieved EU-wide by either parliamentary votes or referenda, depending on national traditions. Despite a favourable referendum in Spain and Luxembourg and ratification of the Treaty by a total of fourteen countries, Heads of State and Government suspended the ratification process after negative votes in France and the Netherlands. The votes prompted strong public debate on the Treaty and policy issues, which many voters saw as being linked, in particular to future EU enlargement and economic policies. Although no formal agreement about how to proceed has been reached, European Governments underlined the need to engage in a far-reaching debate with EU citizens on future developments.

Agreement on the Union's financial perspectives for the period 2007-2013 was only reached in December 2005. Discussions in the EU Council revealed stark national differences regarding allocation priorities for future funding. While some countries defended the need for more research and innovation-driven spending, mainly at the expense of the Common Agricultural Policy (CAP), others voiced the need to maintain financial support for European agriculture at the levels decided in 2003. The delay in agreeing on the level and structure of the future budget left various policy matters on standby, rendering long-term planning of future R&D priorities particularly delicate. Agreement was finally reached on a total budget of €862.4bn for the 2007-2013 period, which amounts to 1.045% of the gross national income in the EU.

A major factor in recent events is the desire by many EU Member States to limit their own contribution to the EU budget, at a time when national budgets are running at a deficit, a point illustrated by the European Commission's warnings to several Member States – Germany, France, Italy, Greece, Portugal and the United Kingdom – in breach of the Stability and Growth Pact. Similarly, countries committed to joining the Euro Zone by 2010, such as Hungary, have received warnings from the Commission about their excessive deficits

The difficult budgetary situation in Member States and late agreement on the future EU budget have further increased uncertainty regarding implementation of the Lisbon Agenda, designed to make Europe the most advanced knowledge society in the World. A high-level group's report in 2004 painted a disappointing picture of the EU's overall competitiveness and achievement of the targets it had set itself. However, the newly elected Barroso Commission has underlined its ambition to make European competitiveness a top priority. Yet, despite having outlined intermediate milestones and the need for Member States to boost national R&D policies, progress has been slow. While most Member States have complied by preparing national action plans in 2005, it is now up to the Commission to review them, measure progress and take supportive measures at a European level.

Another issue widely debated in 2005 was EU enlargement, notably the opening of accession talks with Turkey. It was only after major negotiations that the EU agreed to open talks with Turkey and Croatia. The Commission has started a preliminary screening process for these countries, singling out science, research, education and culture as the first areas for review. While accession talks may last 10 to 15 years, tentative dates indicate that Croatia may join in 2009 and Turkey around 2015.

Ongoing accession talks with Bulgaria and Romania have meanwhile progressed and the Commission's 2005 progress report underlines the significant advances achieved. But although both countries seem on track, accession is still conditional on substantial progress, mainly in reforming public administration and the justice system, fighting widespread corruption and organised crime, and improving environmental standards. A final decision on accession in 2007 is expected to be made in the course of 2006.

Given the difficulties encountered in 2005 regarding ratification of the EU treaty, future-enlargement scenarios and the enduring economic difficulties, Europe's decision-makers have acknowledged the need to engage in a wider dialogue with European citizens. Taking into account people's major concerns, several high-level meetings under the UK Presidency focussed on the sustainability of the European social model and the challenges of globalisation. In this context Ministers considered the possibility of a globalisation fund to help absorb economic hardship. At the same time the Commission has tried to involve European citizens by presenting a plan for 'Democracy, Dialogue and Debate'. Its main idea is to support Member States in organising a dialogue involving national parliaments, civil society and the media, the aim being to create a 'European public sphere'. An initial appraisal of the national debates was held in April 2006, with a summary report being issued at the end of the Austrian Presidency in June 2006.

Notwithstanding the results of this process and despite the difficult context in 2005, the European Union made progress in four major policy fields: research and innovation, industry, environment and sustainable development, and security and defence.

RESEARCH AND INNOVATION – A NEW EU ACTION PLAN AND FP7

To boost R&D and innovation, the Commission presented an integrated research and innovation action plan, designed to improve conditions for private-sector investment, pulling together 19 existing initiatives. The plan sets the following priorities:

- providing for R&D tax incentives
- improving research collaboration and knowledge transfer between public research and industry
- defining and implementing innovative services, in addition to establishing a European industrial research and innovation monitoring system.

The proposed measures in support of the Lisbon Partnership for Growth and Jobs are cross-sectoral, and the plan offers an integrated approach to research and innovation with European guidelines and communications to be drafted in 2006. The EU thereby intends to strengthen Europe's position compared to other global competitors by attracting new investments in research and innovation. It is up to the Member States to implement the actions and adapt national policies and funding to the defined targets.

This effort will rely on the Competitiveness and Innovation Framework Programme (CIP) and on the Seventh Framework Programme for research and development (FP7). In general terms, the EU Council asked for higher priority to be given to

enhancing the EU's research effort, with an increase in funding in real terms by around 75% between 2006 and 2013.

Based on an open consultation process with public and private stakeholders on research topics (EU science and technology foresight), FP7 is designed to give the Lisbon Strategy new impetus towards creating a European Research Area (ERA). In the wake of the EU's financial perspective for 2007-2013, about €45bn is likely to be allocated to FP7. The Framework Programme will be divided into four specific programmes corresponding to major European research objectives:

(a) Cooperation: improving trans-national cooperation on R&D, with Space and Security a new priority compared with FP6.

(b) Ideas: establishing a European Research Council (ERC) to stimulate innovation by funding ground-breaking research projects.

(c) People: Marie Curie actions to strengthen the training, careers and mobility of European researchers, in particular between universities and industry.

(d) Capacities: developing and fully exploiting EU research capacities through support for large-scale infrastructures, regional cooperation and innovative SMEs.

Furthermore, a specific programme has been set up for the Commission's Joint Research Centre (JRC). Following the Commission's decision to rethink the role of life sciences and biotechnology in the Lisbon Agenda, the JRC launched a study of the social, economic and environmental consequences and challenges involved in modern biotechnology in October 2005. The Council and all stakeholders have been invited to participate in this reflection process, which is due to be completed by 2007.

Some specific research areas within the FP7 Cooperation Programme (out of a total of approx. €29bn)	
Space	€1.4bn
Security	€1.4bn
Transport (including aeronautics)	€3.9bn
ICT	€8.3bn
Environment	€1.7bn

While the detailed allocation of funds with regard to the sub-headings within FP7 has not yet been decided, estimates as of March 2006 for the thematic priority Space, as part of the FP7 Cooperation Programme, are about €1.4bn for the 2007-2013 period. Some 85% of this amount is currently earmarked for GMES (Global Monitoring for Environment and Security).

The Commission has announced the publication of a modified proposal on the FP7 on 28 June 2006, based on the budget agreement and amendments made by the Council, as well as the amendments proposed by the European Parlaiment. Modified proposals on the specific programmes will follow, most likely in September 2006.

INDUSTRIAL POLICY

Over and above efforts to boost research and innovation, the Commission issued a Communication in October 2005 on its new industrial policy in support of employment and the Lisbon Strategy. Following previous Communications on industrial policy in 2002 and 2004, the 2005 document favours a cross-sector approach, while introducing some tailor-made measures for individual sectors. They will complement work at national level to address the key challenges facing various sectors of the manufacturing industry. The Communication details several key policy initiatives:

- An Intellectual Property Rights (IPR) and counterfeiting initiative (2006).
- A high-level group on competitiveness, energy, and the environment (end 2005).
- External aspects of competitiveness and market access (spring 2006).
- A new programme to simplify legislation (October 2005).
- A programme to improve sectoral skills (2006).
- An integrated European approach to industrial research and innovation (2005).

Several new sector-specific initiatives were also decided, in particular the start of a new pharmaceutical forum in which Government Ministers, senior representatives of industry and other stakeholders will concentrate on R&D, national regulations and the development of a single market. There are plans too for a mid-term review of life science and biotechnology strategy (2006-2007), reinforcing cooperation with industry and establishing a regular annual tripartite dialogue with industry and Member States through a Biotechnology Advisory Group. Of particular relevance for the aerospace sector are measures on R&D and innovation policies:

- **European Space Programme:** common, inclusive and flexible programmatic basis for the activities of ESA, the EU and their respective Member States.

- Task force on **information and communications technology** (ICT) **competitiveness** (2005/2006): a task force with stakeholder representatives will be set up to identify and remove obstacles to effective ICT take-up and the competitiveness of ICT manufacturing in Europe.

- **Mechanical-engineering policy dialogue** (2005/2006): separate forums will examine the sector's strengths and weaknesses, and propose initiatives.

- A series of **competitiveness studies by sector**, including ICT, analysing the trends affecting the competitiveness of industrial sectors, with scope for adapting policies where necessary.

- New high-level groups on the **chemical** and the **defence** industry (2007): new high-level groups will be established to focus on the REACH Directive's impact on competitiveness in the chemical sector and consider procurement and standardisation in the defence area.

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Following its commitments at the Conference of Parties to the UN Framework Convention on Climate Change (COP-10), the EU started outlining its post-2012 policy on climate change. The new Commission's strategy is entitled 'Winning the Battle against Climate Change'. It continues to see Europe spearheading global efforts to:

- Persuade all major World emitters to commit themselves to a binding scheme, including the United States and rapidly emerging economies such as China and India.
- Include more sectors in emissions reductions, including transport (sea and air), as well as tackling deforestation.
- Promote climate-friendly technologies.
- Introduce market-based instruments such as the EU Emissions Trading Scheme.
- Adapt policies in Europe and globally to deal with the impacts of climate change.

In support of these objectives, the Commission launched the second European Climate Change Programme (ECCP II). Yet, contrary to what was intended earlier, no greenhouse-gas reduction targets have been set for 2020. While the EU Emissions Trading Scheme (ETS), in place since 2005, will continue to be a major instrument to reduce global warming, the new programme is stepping up innovation and investment in clean technologies, with a view to including all emitting sectors, such as aviation, shipping and road transport, in mitigation efforts. In line with these efforts, the UK in its capacity as G8 President organised a major international conference focusing on low-carbon technologies as a major path to a global consensus on tackling climate change after 2012, including appropriate time scales on which technologies need to be developed and deployed. This also includes new approaches to funding technology acquisition and transfer by developing

economies, the overall challenge being to create incentives for private-sector investment.

At the COP-11 Conference in Montreal in December, European efforts to bring more countries into global talks to take action on global warming concentrated on the promotion of the Europe-wide CO_2 Emissions Trading Scheme and progress towards a global carbon market and Clean Development Mechanism. The Conference, in which ESA presented delegates with the results and future potential of environmental monitoring projects using satellites, attracted unprecedented business interest. Most importantly, European efforts paid off, with the decision to start negotiations in May 2006 to extend the Kyoto Protocol beyond 2012, even if the US and Australian delegations continue to refuse any binding commitment within this framework.

Overall efforts in the field of climate change and the environment will be further integrated into a wider EU strategy for sustainable development, first adopted by the European Council in Gothenburg in June 2001. It focuses on four key priorities: limiting climate change and increasing the use of clean energy; addressing threats to public health; managing natural resources more responsibly; improving the transport system and land use. After a critical assessment of the progress achieved by the Commission in February 2005, the sustainable-development strategy is currently being reviewed and brought into line with a declaration on guiding principles for sustainable development by Heads of State and Government, agreed in June 2005. Various aspects must be distinguished as the EU sustainable-development strategy includes the following elements: first, how to integrate environmental issues into other EU policy areas (the Cardiff Process); secondly, how to make EU policy more sustainable (Gothenburg Declaration); and thirdly, how to deal with the EU's role in the global agenda, in particular implementation and further evolution of existing targets decided at the Johannesburg World Summit on Sustainable Development.

After a major stakeholder conference bringing together EU institutions, NGOs and business, the Commission announced plans for a more ambitious sustainable-development strategy, the major outcome being the mutual reinforcement of the Lisbon Agenda and the Sustainable-Development Strategy. Main proposals include:

- Integrated Impact Assessments (IAs), to be used as a tool for sustainable development. These assessments should measure the economic, social and environmental impact of EU proposals at the earliest stage of policy preparation.
- A more ambitious long-term strategy for sustainable energy and the sustainable use of natural resources.
- Increased support at a local and regional level from the EU's Sustainable-Development Strategy, with sustainability requirements being taken into account as part of Structural Fund programmes.
- An EU white paper on a new European social and cultural model.
- An action programme for the communication and education of sustainable development, with a budget of between €20 and €30 million.

SECURITY AND DEFENCE

Progress with European Security and Defence Policy (ESDP) has been marked by increased capability-building, both civilian and military, the newly created European Defence Agency's first year as an operational entity, and further intensification of ESDP operations.

ESDP has a strong civilian component concerning conflict prevention that goes beyond defence aspects. Progress has been made with the definition of the Civilian Headline Goal 2008, decided in December 2004 to complement the military-oriented Headline Goal 2010. The policy was drawn up under

the auspices of the EU Council and supervised by the Political and Security Committee and the Committee for Civilian Aspects of Crisis Management. It aims to achieve rapid deployment of civilian capabilities in support of monitoring missions and other civil missions in support of security-sector reform, disarmament, demobilisation and reintegration processes as well as reconstruction. Such capabilities should be deployable within 30 days, independently or in conjunction with military operations. A considerable amount of work has been done to prepare key planning assumptions and scenarios, and draw up a Capabilities Requirement list and a list of identified capability shortfalls based on an assessment of available national contributions. The process is being carried out in consultation with civilian crisis-management experts from the UN and the Organisation for Security and Cooperation in Europe (OSCE).

The Headline Goal 2010 addresses the development of Europe's military capabilities, underlining the need to rationalise Member States' respective defence efforts and promote multinational projects to reduce internal operating costs, as set forth in the European Capabilities Action Plan (ECAP) launched in 2001. Within this framework, Member States committed themselves to building the necessary capability by 2010 to respond rapidly and decisively, applying a fully coherent approach to the whole spectrum of crisis-management operations, namely through the concept of Battlegroups.

The EU Battlegroups meet jointly defined, agreed standards and will provide the EU with rapidly deployable forces capable of stand-alone operations. They complement and mutually reinforce the NATO Response Force. In a 'Global Approach on Deployability', the Member States also made a commitment to providing the assets and mechanisms required for strategic air and land transport, a key element in rapid response. Following a first capability generation in 2005/2006, the full operational capability is expected to be available in 2007/2008.

On the institutional side, the civil-military cell in the EU Military Staff (EUMS), originally limited to early-warning and strategic-planning tasks, has been upgraded to rapidly set up a command centre for operations conducted without reliance on NATO assets. The process is expected to be finalised in 2006.

The European Defence Agency has started work, focusing on defence capability development, armaments cooperation, research and technology, as well as the defence technology and industrial base and defence equipment market. Major tasks in the field of capability development include:

- Coordinating and implementing ECAP, Headline Goal 2010 or any future plan.
- Scrutinising, assessing and evaluating the capability commitments made by Member States through the ECAP process, and using the Capability Development Mechanism (CDM).
- Promoting and coordinating harmonisation of military requirements.
- Identifying and proposing collaborative activities in operational domains.

While two contracts are about to be issued for technology demonstration in the field of long-endurance Unmanned Aerial Vehicles (UAVs) for intelligence and surveillance, several critical technology areas were identified to be addressed by ad hoc projects that could be started at any time on the initiative of a group of Member States. Among others this covers Command, Control and Communication (C3), including secure communications and network-enabled operations. Carrying out some of these ad hoc projects will be central to EDA's 2006 work programme. While reviewing acquisition options such as joint procurement, EDA will also seek to explore innovative models such as the Private Financing Initiative (PFI).

Finally, EDA also dealt with the issue of a European Defence Equipment market to complement the Commission's efforts to broker an agreement on increasing cross-border competition in defence procurement and amend the treaties accordingly. EDA has framed a voluntary code of conduct to boost competition in defence procurement after agreement was reached by EDA's Steering Board at the level of National Armaments Directors of the 24 participating Member States. The Steering Board stressed that any code of conduct must contain provisions covering the security of supply for one Member State purchasing vital equipment from a company based in another Member State, the protection of classified information, and opportunities for Small and Medium-sized Enterprises (SMEs) with specialised capabilities.

Regarding ESDP operations, 2005 confirmed the increasingly global reach and wide spectrum of possible civilian security and defence missions. The EU carried out police missions in Bosnia and Herzegovina (EUPM), Macedonia (Proxima) and the Democratic Republic of Congo (EUPOL Kinshasa), contributing to the protection of State bodies and reinforcing the internal security apparatus. The EU also continued its EUFOR Althea operation in Bosnia, drawing on NATO assets and capabilities, making full use of the Berlin+ Cooperation Agreement between the two organisations. The EU also conducted several rule-of-law missions providing support to Georgia (Eujust Themis) and Iraq (Eujust Lex). Further ESDP operations were launched in 2005 in support of security-sector reform in the Democratic Republic of Congo (EUSEC DR Congo), civilian-military support action to the African Union mission in Darfur (Sudan), and a monitoring mission (AMM) for the peace agreement in Aceh, Indonesia.

2.2 International Partners

WORLD ECONOMIC TRENDS

After the strongest expansion in the World economy for three decades in 2004, global growth in 2005 was once again exceptionally vigorous with a 4.3% increase, despite Hurricane Katrina cutting US GDP growth by 0.5 points and global expansion by 0.1 points. In the same timeframe, global trade rose by some 7.3%.

Within this largely favourable picture, there are still disparities between different regions of the World with regard to the economic recovery. While the USA and most of Asia maintain strong economic momentum driving global expansion, Japan has just started consolidating firmer growth. Europe continues its gradual but still very timid recovery. The strong impetus given by the US and Asian economies, and the high revenues of oil-exporting countries are expected to pave the way for prolonged global expansion that may also benefit European economies in the short to mid-term. However, even if inflationary pressures on both sides of the Atlantic can be contained despite high energy prices fed by continuing strong demand for oil, substantial global imbalances in 2005 remain a cause for concern. Among the most prominent risk factors are the persistent volatility of energy prices, high deficits and current account imbalances with high US budget deficits and the risk of abrupt exchange rate alignments, despite the long-awaited re-valuation of China's currency in 2005.

In this context, the slow recovery in the Euro area has been facilitated by low long-term interest rates and strong export markets, even if the situation regarding domestic demand is still

critical. While demand in Spain has remained particularly high, French domestic demand dropped sharply in 2005 and Germany's internal demand remained low. In addition, the euro-dollar exchange rate evolved towards a slight re-valuation of the dollar in the €1.20 to €1.25 range, depriving Europe's economy of any protection from rising energy prices. High oil prices have consequently started impacting on corporate profit margins and the purchasing power of households. Coupled with the on-going need for structural reform, 2005 was characterised by low investment, stagnation in productivity gains, and labour market instability. To support the timid recovery while containing rising inflationary pressures, the European Central Bank raised long-term interest rates from 2% to 2.25% at the end of the year.

	Real growth	*GDP*	*Inflation*		*Unemployment rate*	
%	2005	2006	2005	2006	2005	2006
Euro Area	1.4	2.1	2.1	2.0	8.7	8.4
UK	1.7	2.4	2.0	1.9	4.8	5.1
US	3.5	3.3	3.1	2.8	5.1	4.8
Japan	2.4	2.0	-0.4	-0.1	4.4	3.9
China	9.0	8.2	3.0	3.8	N/A	N/A
Russian Federation	5.5	5.2	12.8	10.7	N/A	N/A
India	7.1	6.3	3.9	5.1	N/A	N/A

(Source: OECD/IMF estimates for 2006)

UNITED STATES

The United States has confirmed its position as the World's largest economy. The economic upswing that began in late 2001 has continued at a solid pace, driven by domestic demand that has apparently been little restrained so far by energy prices or interest-rate increases. The near-term outlook is favourable as the macro-economic effects of Hurricane Katrina are expected to be transitory and the fundamental factors supporting activity in 2005 should allow for an estimated growth in output of 3.25% per year. Potential risks include the bubbling US housing market, high oil prices potentially fuelling inflation and the US external commercial deficit, slated to exceed 7% of GDP in 2007. In the context of low taxes and high government spending, federal finances remain weak and the deficit is expected to rise to some 3% of GDP in 2006.

President Bush's second-term began with an ambitious agenda focussing mainly on overhauling America's economic institutions and 'spreading democracy in the Middle East'. The first part of his second term has been marked by setbacks on social-security reform and Iraq. In the second half of 2005, the Presidency, already challenged by the escalation of events in Iraq and rising oil prices, drew criticism over the Federal Government's response to Hurricane Katrina.

After a first term marked by a crisis in transatlantic relations surrounding the war in Iraq, the US President launched his second term with a diplomatic effort to overhaul relations with Europe, setting a new tone of cooperation and identifyng the promotion of democracy as the centrepiece of his foreign policy. In her first comprehensive foreign-policy speech since becoming Secretary of State, Condoleezza Rice, speaking in Paris, called on Europe to work with America and suggested that together they had a 'historic opportunity' to steer the World towards freedom.

A similar message was reiterated in June, at the first Summit between the US Administration and the European Commission under Mr Barroso's leadership. The US President characterised the United States and the EU as natural partners in efforts to 'spread freedom, democracy, security and prosperity throughout the World'. At the Summit, an initiative to enhance transatlantic

and economic integration was launched, and leaders adopted joint declarations on the promotion of democracy, the Middle East, UN reform, counter-terrorism and non-proliferation, and Africa. A new element to emerge from the EU-US Summit was a Declaration entitled 'Initiative to Enhance Transatlantic Economy and Growth', which included a section on space calling for the promotion of 'cooperation using civilian space-based technologies for sustainable development, science/exploration, and deepening the knowledge society'. On this basis, the European Commission initiated a 'dialogue on civil space cooperation' with the United States, setting up a dedicated EU-US Working Group.

In 2005, the Bush Administration also cooperated more closely with the United Kingdom, France and Germany on Iran's nuclear challenge, with the EU as a whole in efforts to restart peace talks between the Israelis and Palestinians, and with France in particular over both Lebanon and Syria. But as Europeans and Americans start to build a more positive agenda, other tensions remain unsettled, such as EU plans to lift its arms embargo regarding China. In February, Congress passed Resolutions that threatened to disrupt defence cooperation with European companies selling equipment to China.

Environmental issues are also a source of disagreement. At the UN Climate Change Conference in Montreal at the end of November, the US defended its decision not to sign the Kyoto Protocol. The treaty, which came into force in February, calls on the top 35 industrialised nations to cut emissions by 5.2% below their 1990 levels by 2012. The EU appears to be taking the lead, endorsing a plan in June to reduce greenhouse-gas emissions to 15% to 30% below 1990 levels by 2020. After lengthy negotiations, the UN Climate Change Conference closed with the adoption of more than forty decisions that will strengthen global efforts to fight climate change.

Overall transatlantic economic ties have grown strongly in recent years. The EU and the USA are each other's main trading partners – taking goods and services together – and account for the largest bilateral trade relationship in the World, making up about one-fifth of each other's bilateral trade. The EU and the USA are also each other's most important source of direct inward investment, with two-way investments totalling more than €1.5trn. Despite such an impressive record in economic integration, there are still some outstanding economic disputes such as subsidies to Airbus and Boeing for developing new civil aircraft. The case, which has now been referred to the World Trade Organisation, reflects strong transatlantic competition and the difficulty of moving towards less-protected markets.

RUSSIA

President Putin's leadership was strengthened by the nomination of Dmitry Medvedev, acting Chairman of the Gazprom Supervisory Board and former Head of the Presidential Administration, and Sergei Ivanov, Minister of Defence, as Vice-Prime Ministers. The authorities have focused their efforts on economic policies to gradually improve the investment climate. In November 2005, the European Bank for Reconstruction and Development underlined the positive trend in the flow of investment into Russia, partly due to the repatriation of Russian capital. During the first three quarters of 2005, investment grew by 9.9%, with accumulated foreign capital amounting to $91bn, 30% of which was invested in processing industries (mainly the fuel and energy sector) and 29% in trade.

Future growth will depend heavily on oil and gas prices. As a major energy supplier, Russia was able to maintain GDP at a high level, though slightly lower than 2004. This was partly due to rising energy prices. While the overall economic climate remains investment-friendly, disappointing domestic private consumption is a cause for concern.

Russia's trade surplus rose by 32.6% to $102.9bn from January through October 2005, against $70.3bn for the same period in 2004. Exports exceeded imports by a factor of more than two. Russia's foreign sales totalled $296.8bn from January to October, up 33.7% on the previous year.

Russia's federal budget surplus in the first 10 months of this year was RUR 896.3 billion (about $31bn). Federal budget revenues stood at RUR 4.149 billion, 15.3% higher than planned. The stabilisation fund accumulated by the Russian Government to cover the risks of an economy based on exporting raw materials, further increased, reaching $50bn.

JAPAN

Following early national elections to the House of Representatives on 11 September 2005, the LDP party of Prime Minister Koizumi had a landslide victory, winning 296 seats, the largest share in post-war politics. With its partner, New Komeito, the governing coalition now commands a two-thirds majority in the lower house, allowing it to pass legislation without the consent of the upper house and approve amendments to the Constitution with subsequent submission to the upper house and a national referendum. The opposition Democratic Party of Japan, which advocated a change of government during the campaign, suffered a devastating loss, winning only 113 seats compared with the 175 seats it held previously. Smaller parties made only limited gains or losses.

Prime Minister Koizumi favours more assertive foreign policy, even if his decision to deploy Japan's Self Defence Force in Iraq was deeply unpopular. Relations with North Korea and China are still subject to some tension over a wide range of political issues.

Japan's economy recovered from a drop in the second half of 2004 with strong growth picking up in early 2005 and the employment market reacting positively. Unlike Europe, expansion was led by strong domestic demand and solid growth in business investment. The Koizumi Government is expected to continue its policy of structural reforms coupled with the consolidation of public finances in 2006. This is due, in particular, to the fact that Japan has successfully absorbed rising energy prices, its type of industrial production being less energy-intensive that in other economies. In the long run, however, Japan needs to cut public spending and cope with a declining population and shrinking workforce. Japan's population is aging faster than that of any other country. According to official forecasts, one in four Japanese citizens will be 65 or older by 2015, and around 2010 Japan will have less than two workers for each retired person.

CHINA

President Hu Jintao is firmly in charge in China and the overall policy of national self-assertiveness is unchanged, and now increasingly apparent abroad. China is taking a tougher stand on various foreign-policy issues and is increasingly present in the Asia-Pacific region.

China remains open and favourable to closer ties with European bodies. The visit to ESTEC, late in December 2004, by the Chinese Prime Minister accompanied by his Ministers of Foreign Affairs, Science and Technology, and Trade and Agriculture, illustrates China's increasing interest in engaging in scientific cooperation with European bodies.

On the economic side, following international pressure, China took an important step by reforming its exchange-rate regime, moving to market-based floating exchange rates for a basket of currencies and replacing the fixed Yuan/US dollar peg. Continuing growth nevertheless depends a great deal on its currency being undervalued in relation to the US dollar.

China's GDP growth has averaged 9.5% annually for the last two decades. This has led to a tremendous increase in personal income, and far greater integration of the Chinese economy with the rest of the World. In terms of purchasing-power parity, China in 2004 was the second largest economy in the World after the USA, although in per-capita terms it is still poor. The net balance of Chinese exports versus imports in 2004 is $30.32bn. The trend is likely to be similar for 2005. China's largest export destination is the EU, and China is the EU's second largest destination after the USA. The EU trade deficit with China amounted to €78.5bn for 2004.

Although economically vibrant, China has many challenging problems to address, such as the 100–150 million surplus rural workers adrift between the countryside and urban areas. In addition, it has glaring environmental problems, which are likely to grow further in the near future. A corollary of China's rapid economic growth, they represent a global challenge.

INDIA

India's rapid economic development continues to attract international attention. The country is deregulating its economy and beginning to attract large foreign investment, with services being the major source of economic growth. But two-thirds of the workforce is still in agriculture, and infrastructure investment lags behind China at a similar stage of modernisation. The Government has committed itself to promoting economic reform and developing basic infrastructure to improve living standards and boost economic performance. Government control over foreign trade and investment has been reduced in some areas, but high tariffs (averaging 20% in 2004) and restrictions on direct foreign investment are still in force. The Government has indicated it will do more to facilitate investment in civil aviation, telecommunications and insurance in the near future. Privatisation of government-owned industries has proceeded slowly, and continues to generate political debate.

The economy has posted an excellent average growth rate of 6.8% since 1994, reducing poverty by about 10%. India is capitalising on the large number of well-educated people skilled in the English language, and may become a major exporter of software services and software workers. Despite strong growth, the World Bank and others are concerned about the combined state and federal budget deficit, running at approximately 9% of GDP. India is on course to become one of the World's four largest economies in the next 20 years. Growth of its population (first demographic power by 2030 with some 1.5 billion inhabitants) and its economy is making India one of the most buoyant markets.

As a nuclear power, India is looking for recognition as a major, responsible regional power and has tried, since the mid-1990s, to stabilise the regional scene by taking on more responsibility.

The 'Eneide' Soyuz mission to the International Space Station in April 2005

3

The Global Space Sector – Size and developments

Size and developments

While the figures for total annual space expenditure for civil and defence-related space put the United States far ahead of all other space powers with an estimated share of about 75% of World expenditure, the strength of a space power must also be gauged by its capacity to capture a large share of internationally competed for launches and the commercial market. Russia, which apparently accounted for an estimated 2% of World space expenditure in 2005, carried out the largest number of launches and ranks as the World leader for capturing internationally completed for launches. It is therefore important not to measure the performance of space powers such as China or India only in terms of their public expenditure, added to which it is often difficult to obtain detailed, reliable figures. Furthermore, they are often misleading due to distortions caused by currency rates and differences in purchasing power. The trends for launches carried out worldwide over the last five years provide an indication of the respective positions of each of these countries.

MEDIUM-TERM TRENDS 2000 TO 2005

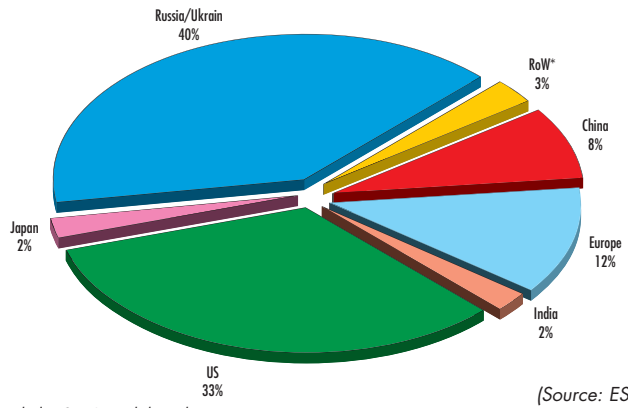
The recent evolution of space activity shows that between January 2000 and December 2005 a total of 382 launches – both institutional and commercial – were carried out worldwide, putting into orbit a total of approximately 540 payloads.

Russia and the USA account together for about 71% of the launches performed, with 55% of the payloads worldwide. Russia has maintained its ability to provide commercial launches at competitive prices and has clearly taken the number one position. The number of launches of US launch vehicles over the period follows that of Russia, marked clearly by a sizeable captive institutional market.

Europe ranks third, accounting for about 12% of total launches and 15% of all satellites put into orbit. The figures reflect the predicament of European industry, entirely dependent on conditions in the commercial market because it lacks a captive institutional satellite market comparable to the USA or Russia. European industry has been hit by a downturn in the commercial market, combined with a decreasing launch rate due to the Ariane-5 launch failure in 2002. This failure caused considerable delay in establishing the launcher on the market. However, 2005 was a successful year, with the European launcher once more demonstrating its reliability.

Asian powers continue to develop their capabilities in both the launch and payload business. China, Japan and India are the leading Asian space powers with national space programmes. Between 2000 and 2005, China accounted for about 8% of world launches and 7.2% of payloads. Japan carried out about 2.4% of the World's launches, with 6.2% of all satellites. India follows with 1.7% of launches and 2.4% of payloads.

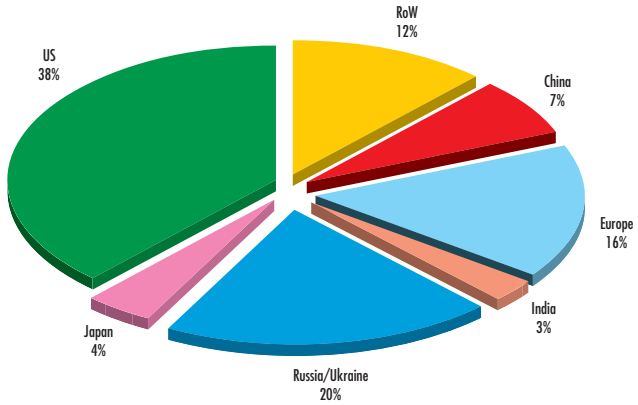
Worldwide launches by launch system origin 2000-2005



(Source: ESA)

** includes Sea Launch launches*

Payloads launched by payload origin
2000-2005



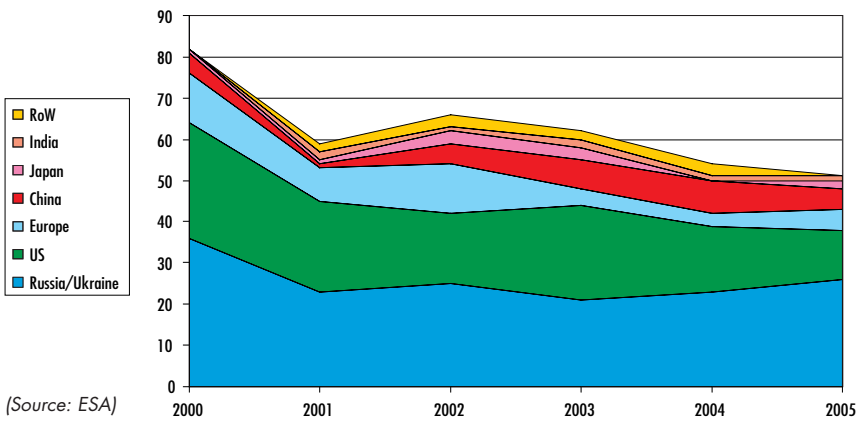
(Source: ESA)

Analysis of the origin of the operators of all payloads (including satellites, probes, recoverable capsules and other spacecraft) launched in the period under consideration, shows that a clear majority were manufactured for American operators, followed by Russia and Ukraine, and Europe.

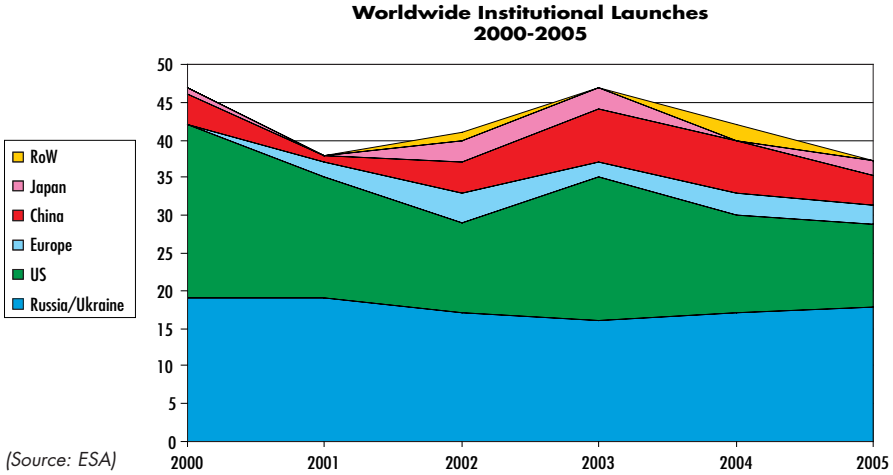
Putting these figures into a time perspective, the drop in global space activities after 2000 is clearly visible, caused by events and changes such as the failure of satellite companies or the unexpected drop in global demand for commercial satellites. However, not all space powers were affected to the same extent. Russia maintained a strong position for both institutional and commercial launches. In contrast the USA suffered from the decline in the commercial market but, thanks to its institutional launches, was still able to maintain a high launch rate. Lacking a captive market, Europe suffered the most and is only now poised to regain some of its strength. Despite the difficulties experienced by the USA and Europe, the situation seems to have been stable for Japan and India, both of which more or less maintained their levels of activity in terms of number of launches and payloads per year. Space activity is enjoying a particularly favourable trend in China, where rapid progress has been made. Attention now focuses on its ambitious manned space programme.

Globally, the launch activity has dropped with respect to 2000 by about 35%. Launches in 2005 totalled 55, compared with 85 in 2000.

Worldwide launches by launch system origin
2000-2005



(Source: ESA)

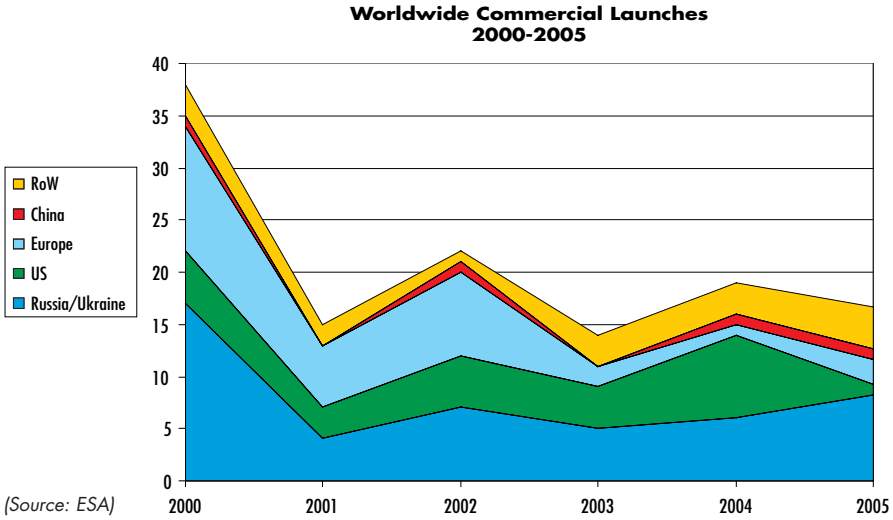


(Source: ESA)

A total of 252 institutional and non-commercial launches were conducted during the six-year period, representing about 67% of all launches worldwide.

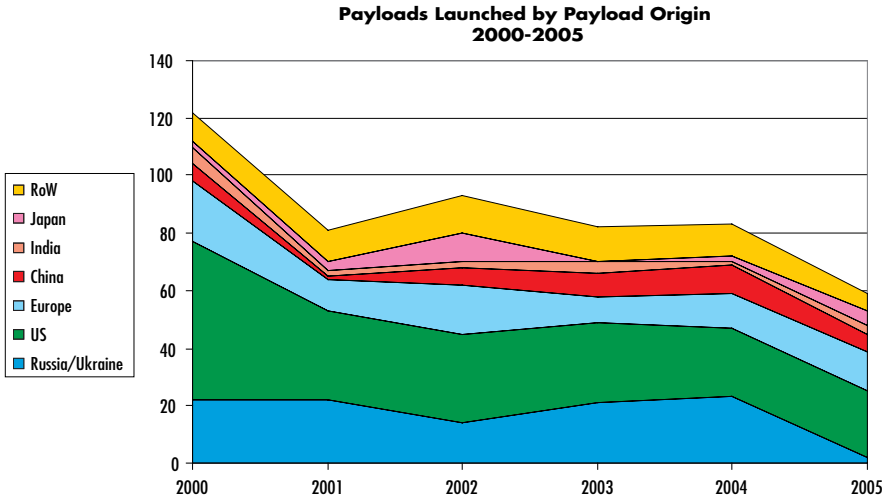
Over the same period, the number of commercial launches was 125, about 33% of the total. The accompanying graphs show the variations during the period and the downward trend, which is more acute in the global commercial launch service business.

There was a similar downward trend for payloads, with a drop of about 50% (77 payloads in 2005 against a record number of 117 in 2000). Furthermore, payloads manufactured for US operators have gradually decreased over the six years, while the payloads belonging to operators of other origins have fluctuated, with no clear trend emerging.

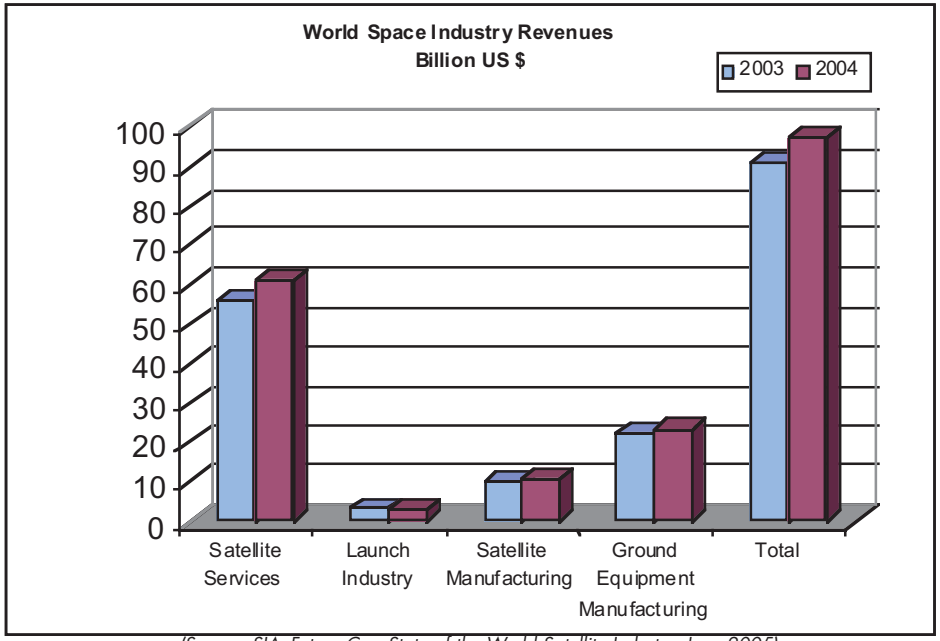


(Source: ESA)

In attempting to estimate the current size and importance of the space industry worldwide – satellite manufacturing, launch industry, satellite services and ground-equipment manufacturers – there are certain limitations. The true market value of satellites, launchers and services produced in some countries, such as China, Russia and other space-faring nations, is not available on a regular basis and may be underestimated.



(Source: ESA)



(Source: SIA- Futron Co.: State of the World Satellite Industry, June 2005)

According to data extracted from a recent survey *(SIA- Futron Co. - State of the World Satellite Industry – June 2005)*, global revenue for the space sector was valued at $97.2bn in 2004.

The satellite-services business includes subscription and retail services, such as Direct-to-Home TV, satellite radio services, transponder leasing, mobile telephone and data and remote-sensing activities. As regards the launcher industry, the downward trend continued in 2004 (–13%) after an even sharper drop in 2003 (–24%), compared with the previous year. This negative trend is due to the reduction in both commercial and institutional launches during the period.

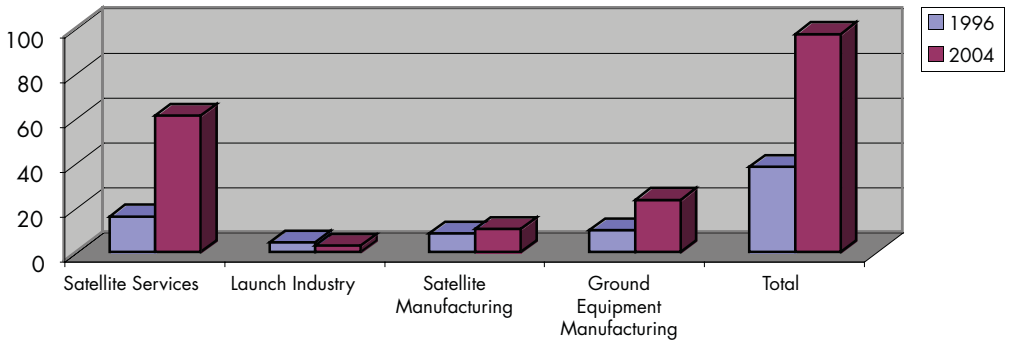
The moderate growth in global satellite manufacturing revenue in 2004 reflects the heavy drop in the US share (–15%), largely due to reduced Government spending and to a smaller number of satellite orders worldwide.

Ground equipment displayed moderate growth (5%) in 2004, with prices continuing to fall and major infrastructure investments virtually flat. Higher revenue was recorded in end-user equipment, such as Direct-to-Home TV, broadband internet, satellite radio services and mobile satellite services.

The report also shows that between 1996 and 2004 global space revenue increased on average by 13% a year. Total revenue therefore increased by a factor of 2.6 over that period.

Performance within each segment of the space business indicates that the most dynamic growth was recorded in the satellite-services business (from $15.8bn in 1996 to $60.9bn in 2004) and in the ground-equipment manufacturing sector (from $9.7bn to $23.3bn). In contrast, the launch industry registered a sharp drop in revenue (from $4.2bn in 1996 to $2.8bn in 2004) and satellite manufacturing only achieved moderate growth (from $8.3bn to $10.2bn).

World Space Revenues by Sector
1996 and 2004 (Bn US$)



(Source: SIA- Futron Co.: State of the World Satellite Industry, June 2005)

German Chancellor Gerhard Schröder celebrating '30 Years of ESA's at ESOC in 2005

4

The Space Sector in Europe

4.1 Public Policies and Strategies

In line with the findings of the Green and White Paper process in 2003, European public policies have continued to emphasise the need to develop a coherent European Space Policy, reconciling the European Union's demand for space assets to support its sectoral policies and ESA's technological and managerial skills of 30 years' standing. EU Member States are conscious of the strategic and socio-economic dimension of space policies in achieving wider policy goals and declared space a 'shared competence' between the EU and national Governments in the Treaty establishing a Constitution for Europe. Despite its ratification being suspended, cooperation between the European Commission and ESA has made progress. On the basis of the ESA-EC Framework Agreement of May 2004, the Joint ESA/EC Secretariat and the High-Level Space Policy Group, representing respective Member States, have continued work on the issue of an overall European Space Policy implemented through a European Space Programme. Over and above such ongoing cooperation, the major event for the European space sector was ESA's Council at Ministerial Level in Berlin in December 2005. Ministers took major decisions for the coming three years and prepared longer-term objectives, with in particular the definition of programme content backed by commitments on the necessary funding.

MILESTONES TOWARDS A EUROPEAN SPACE POLICY

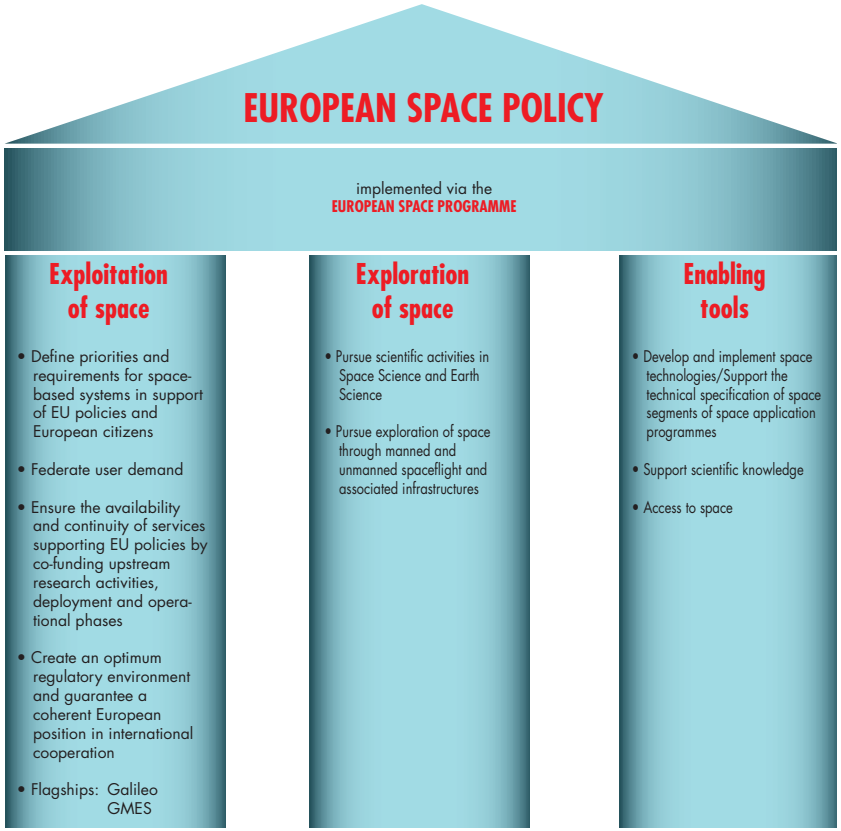
Definition of an overall European Space Policy hinges on the rapprochement between two institutions. On the one hand, ESA has been the leading player in European space activities for more than 30 years. On the other, the European Union is increasingly aware of the importance of space as a versatile tool for achieving strategic goals, such as non-dependence, and wider policy objectives in a growing range of sectoral policies, notably transport, the environment and security. The Space Council – a meeting of the ESA Council at Ministerial Level held jointly with the Council of the European Union – symbolises the combined efforts of the two organisations to create synergies and cooperate coherently. It is primarily a forum for the exchange of views and debate, in preparation for decisions taken jointly but in keeping with each organisation's rules. Three Space Councils have been held so far – in November 2004, June 2005 and November 2005. In preparation for these ministerial gatherings, background documents were drawn up. They outline the basis of a European Space Policy, they identify the respective roles and responsibilities of ESA, EU and other stakeholders, and they address industrial policy and other implementation principles.

In a first approach to framing a coherent European Space Policy, respective responsibilities have been defined as follows:

Exploration of space – encompassing space science, Earth science, space exploration through unmanned and manned spaceflight and infrastructures – and the **enabling tools** on which all space activities depend (access to space, scientific knowledge and space technologies) will continue to be driven by ESA and its Member States. Responsibility for **exploitation** of space should increasingly be shared with the European Union. This encompasses the use of space systems and infrastructures to deliver business and consumer services, such as telecommunications, navigation and positioning, meteorology, environmental monitoring and Earth observation. In particular the EU is expected to identify and collate user needs, while focussing the political will needed to support them. It will be responsible for ensuring the availability and continuity of operational services supporting its policies, and will contribute to the development, deployment and operation of the

corresponding dedicated European infrastructure, in particular Galileo and GMES. In addition in space, the EU will be in charge of optimising the regulatory environment to facilitate innovation, access to international markets and effective coordination with ESA of the European position in international fora.

A tentative model would consist of a structure with three pillars, forming a basis for future policy. It makes full allowance for the fact that space is a shared competence between ESA Member States and the European Union:



The Space Councils have emphasised that space systems and infrastructure have become strategic assets for Europe as a global player on the international stage. With society increasingly dependent on satellites and space-based technologies, it is essential to secure an autonomous and competitive capability to access space, to develop and manage space systems and infrastructures, and to collect and use information derived from these systems. Space is also an asset for European integration, through its technical capacities and through the global adventure and challenge it represents for Europe. The objective for the overall European Space Policy and Programme is thus to ensure that Europe makes full use of space technologies, infrastructure and services in support of its policies. Furthermore, European security policy is developing rapidly, and space-based systems providing situation awareness and reaction capability are expected to play a substantial role.

This change in governance, which should be associated with additional sources of funding for the European space sector, will be implemented in several steps. However, due to the current uncertainty affecting the EU budget, implementation of the first steps will take longer than expected at the time of the first Space Council.

The first Space Council established the broad lines of European Space Policy. Then the second Space Council, in June 2005, decided that for demand-driven applications the short-term priorities were Galileo and Global Monitoring for Environment and Security (GMES). In particular it confirmed that the European Space Policy should consist of the following elements:

- A European Space Strategy outlining objectives.
- A European Space Programme listing priority activities and projects to achieve the strategy, and reflecting the corresponding costs and funding sources.

- A commitment by the main contributors to their respective roles and responsibilities, and
- Key principles for implementation.

With regard to the latter, particular attention was paid to industrial policy and governance. The Space Council acknowledged that the European Space Policy requires industrial policy tailored to its specific needs to provide all Member States and stakeholders in Europe with an incentive to maintain or increase investments, thus preserving scientific and technological expertise and critical skills. Furthermore, the Space Council invited "the Joint Secretariat in close consultation with the High-level Space Policy Group to identify possible cost-efficient scenarios for optimising the organisation of space activities in Europe in the future and to initiate a wide-ranging appraisal of these in comparison to present processes, taking all relevant factors into account. It invites the Joint Secretariat to report back on the outcomes of this appraisal."

In November 2005, the third Space Council focused on the continuing development of GMES, reaffirming the programme's strategic dimension and underlining the Commission's intention to allocate a substantial part of the 7th Framework Programme's funding to space. It also supported a phased approach for GMES, starting with the development of three fast-track services on Emergency Response, Land Monitoring, and Marine Services to be operational in 2008, with other services to be developed in due course. The Space Council welcomed the formation of a group of experts – involving Member States, the Commission, ESA and other organisations – to consider the most appropriate structure for the longer-term governance and implementation of GMES.

The overall objective is to develop a fully fledged European Space Programme by 2007.

While European Space Policy will need to be updated and redirected regularly in line with new developments and requirements, upcoming issues include the further development of a coherent European governance model for space, including the future ESA-EU relationship, and adaptation of industrial-policy principles to suit a changing environment. In anticipation of EU enlargement, ESA set up the European Cooperating State Agreement in 2001 to involve new EU States in Agency programmes and activities and prepare them for possible future membership. Hungary, the Czech Republic, Poland and Romania are currently involved. Further adaptation of this model, opening it to States not considering direct accession to the ESA Convention, is currently envisaged.

DEVELOPMENT OF ESA POLICIES AND PROGRAMMES

In 2005, ESA played a leading role defining the future direction of European space activities, with two major milestones expected to shape Europe's space policies for many years to come. The **ESA Council at Ministerial Level** held in Berlin in December 2005 defined the programmatic priorities and associated funding for the coming three years. The development of an **ESA Long-Term Plan (LTP)**, placing the Berlin decisions in a 10-year perspective, constitutes a major tool for coherent planning of future space activities.

THE BERLIN MINISTERIAL COUNCIL

With the awareness that new development activities urgently needed to be started in Europe despite financial pressures, a compromise was sought to give the development and maintenance of scientific and industrial capabilities an affordable basis. Besides the completion of approved programmes and the need to continue Earth observation, telecommunications and launcher activities, ESA's Ministerial Council set the following programmatic priorities designed to reinforce the competitiveness of European industry and serve European citizens:

- Reinforce the scientific programme, while looking also for greater synergy with the relevant scientific component of the exploration initiative.
- Step up technology development and give it a coherent framework.
- Explore new opportunities in telecommunications thanks to new, advanced technology programmes and demonstrators, in order to develop innovative payload technologies and new demand-driven satellite telecommunications services, in particular the AlphaSat mission using the state-of-the-art AlphaBus platform.
- Initiate an Exploration programme with a robotic mission to Mars (ExoMars) and preparatory activities for a European contribution to international Moon missions.
- Define and develop the necessary GMES space component to ensure data continuity for existing services, and enable definition, preparation and operational capabilities for new services.
- Secure sustainable access to space for Europe and further consolidate the European launcher sector.

Decisions taken at the Ministerial Council provided a strong response to European industry's research and technology priorities. They also took account of industry's recommendations regarding continuous development of innovative telecommunications technology, and the launch of new technology developments such as formation flying or re-entry, descent, landing and rover technologies as part of robotic exploration. Lastly, the decisions reflected the need to focus on a new spin-in technology programme.[1]

[1] For more details on Space R&T priorities for Europe as identified by European industry, see Space R&T Priorities for Europe, Eurospace, October 2005.

The success of the Ministerial Council can be measured not only in terms of the level of overall programme subscription by Member States at over about 95%, but also by the strong political signal it issued. This is particularly true for the resolution on the Agency's Long-Term Plan and implementation of an ESA launch-service procurement policy.

The ESA **Long-Term Plan** (LTP) was drawn up in 2005 to give the various programmatic and non-programmatic elements a broader, more coherent policy framework. In particular, the Plan seeks to increase coherence between satellite and launcher development, science and exploration agendas, and technology development and subsequent applications. It also aims at taking into account horizontal issues such as the security dimension of space, international cooperation and industrial policy. Drawing on strategic analysis and short-, medium- and long-term priorities and objectives, the Plan establishes roadmaps for each of the key sectors (Science, Basic Activities, Telecommunications, Navigation, Earth Observation, Launchers, Human Space Flight and Exploration, Technology and Ground Infrastructure, Security) and an overall roadmap for ESA strategies and policies up to 2015. Closely linked to the development of a separate but concurrent Technology LTP, it explicitly makes security a part of prospective planning, considering it an opportunity for future growth for Europe's space industry. The further development of ESA programmatic objectives and priorities will consequently follow the rationale underpinning the six strategic guidelines. It will thus secure the availability and reliability of the space-based services and applications required to achieve Europe's overall objectives, be they strategic, economic, social, cultural, scientific or technological, while improving the daily lives of its citizens.

Strategic Guidelines

- *Focus on science and discovery.*
- *Consolidate European competitiveness and technological excellence.*
- *Promote and extend the use of space infrastructures and services in current and future application fields.*
- *Secure the maintenance and unrestricted availability to Europe of critical capabilities, components and technologies.*
- *Enhance coherence in the development and growth of all European space capacities.*
- *Maintain a coherent approach in international relations.*

The decisions taken at the Berlin Ministerial Council in 2005, which marked the first milestone in ESA's Long-Term Plan, can be summarised as follows:

FOCUS ON SCIENCE AND TECHNOLOGY

As a key element supporting increased knowledge and future innovation, ESA's Science Programme is designed to enable Europe to play a role commensurate with its economic, industrial and scientific potential in the exploration and understanding of the Universe. The Programme thus contributes to human knowledge, sustains a creative industry and inspires society. European scientists have selected the scientific questions that need to be addressed as part of the 'Cosmic Vision' initiative, a coherent science and technology plan. Stretching from now to 2025, it raises four main questions for science activities, with respect to missions that have already been or soon will be implemented, and others yet to be funded.

Cosmic Vision Plan and Associated Missions

1. What are the conditions for life and planetary formation?
   - *1.1 From gas and dust to stars and planets - ISO, HST, Herschel, Astro-F*
   - *1.2 From exo-planets to bio-markers - Hipparcos, GAIA, Corot*
   - *1.3 Life and habitability in the Solar System - all Solar System missions, in particular Giotto, Huygens, Cluster, Mars-Express, Rosetta, Double Star, Venus Express, BepiColombo*
2. How does the Solar System work?
   - *2.1 From the Sun to the edge of the Solar System - Ulysses, SOHO, Cluster, Double Star, Solar-B, Solar Orbiter*
   - *2.2 The building blocks of the solar system - Giotto, Rosetta, SMART-1, Chandrayaan-1 and planetary missions*
3. What are the fundamental laws of the Universe?
   - *3.1 Exploring the limits of contemporary physics - Microscope*
   - *3.2 The gravitational-wave Universe - LISA PF, LISA*
   - *3.3 Matter under extreme conditions - HST, JWST, Newton, Integral*
4. How did the Universe originate and what is it made of?
   - *4.1 The early Universe - Planck*
   - *4.2 The Universe taking shape - Planck, HST, JWST*
   - *4.3 The evolving violent Universe - HST, JWST, Newton, Integral*

Member States acknowledged the importance of giving new impetus to science and decided on a 2.5% annual increase in the ESA science budget, which protects the Programme from loss of purchasing power due to inflation.

A Technology Development Plan covers the underlying technological challenges linked to successful implementation of the Cosmic Vision package. By mastering various technologies, it will be possible to limit the risks inherent in project development, find solutions to complex challenges, improve industry's competitiveness in commercial markets, and avoid European dependence on critical capabilities. A new end-to-end ESA technology process is being set up to meet these objectives and guarantee the overall definition, implementation, harmonisation and evaluation of ESA technology programmes and activities.

The new process complies with resolutions stemming from the Ministerial Council in Edinburgh in November 2001, which reaffirmed "the need for a strong technology base as the key to the worldwide competitiveness of European industry and the success of future space missions and the central role of the Agency in coordination and harmonisation of European strategy and policy for space technology".

The ESA Technology Strategy marks the start of an inclusive technology process. It points the way to where ESA aims to be in the next decade in terms of technology to secure Europe's role as one of the World leaders in space activities and programmes, dividing technology efforts into sectoral strategies supporting specific programmes, and horizontal efforts applicable to all technology programmes and fields. It also addresses synergies (e.g. for Earth observation, science and exploration) and new needs. In the latter case, a new technology programme 'NewPro' has been proposed that is particularly relevant to EU demands for civil-security technologies, non-dependence and greater allowance for the multi-use and spin-in dimension.

NewPro Technology Programme

- *European non-dependence:* the need to have free access to technology in order to develop, use and export European space systems. This element will address components from a low level of integration to a high level of qualification. It is the natural continuation of the European Component Initiative (ECI).
- *Multi-use technologies (spin-in):* innovation for space design must benefit from progress in non-space technology sectors, adapting and using these technologies; this element will pursue the systematic adaptation for space of high-performance multiple-use technologies.
- *Security and space:* space can provide solutions to increased concerns about global security at a European level. This element aims to characterise and develop the required technologies.

These three elements will be implemented in steps, depending on their maturity, starting with non-dependence, for which there is already a full understanding of the tasks involved, and moving on to multi-use technologies, for which priority areas will be identified in 2006. The final element will be civil security, for which the requirements are being defined. This element also demands ESA participation in specific architecture studies. The proposed activity covers design, development and in-flight operation of a set of small satellites for full-scale testing and validation of formation-flying mission architectures, techniques, technologies and design and verification tools. Formation-flying technologies hold the promise of new opportunities, boosting the performance of future science, Earth-observation and application missions. The full programme will be preceded by the three-year NewPro interim phase, implemented under an existing ESA programme (GSTP-4) and leading to a fully fledged proposal in time for the 2008 Council at Ministerial Level.

A dedicated Technology Long-Term Plan ties together all existing and new technology programmes and activities, and provides guidance for technology planning activities. It summarises the Agency's future plans to support the evolution of technology maturity and harmonisation in the different domains, to:

- Prepare and enable future European space programmes by guaranteeing a coherent technology-development schedule for maximum use by projects.
- Foster innovation in new space architectures, identify disruptive technologies, and develop new concepts.
- Support the competitiveness of industry in global commercial markets.
- Secure European sources for critical technologies with unrestricted availability.
- Leverage technological progress and innovation from outside the space sector, to adapt and use them to design new space systems.

A NEW EXPLORATION PROGRAMME

Progress in space exploration is both dependent on and a contributor to science and technology. Europe continues to be involved in exploitation and utilisation of the International Space Station, in particular thanks to the Columbus module, which will presumable be launched in early 2007. But Europe is also about to embark on a preliminary space exploration programme. Notwithstanding the fundamental desire to lead exploration and discovery of the Universe, interest in space exploration has increased all over the World since the announcement of the new US vision for space exploration, which shifts the focus of the US space programme towards exploration goals. Within this broader picture, it is up to Europe to participate and find its place in this global exploration effort in cooperation with other space-faring powers such as the USA, Russia, China, Japan and India.

The European Space Exploration Programme *Aurora* is the continuation of the Preparatory Space Exploration Programme initiated in 2001 and consists of two elements. The *Core Programme (2006-2009)* covers the preliminary definition of future robotic and human exploration missions, in particular to the Moon and Mars, preparing potential European contributions to such missions by flight demonstrations, development of enabling technologies and long-term scenarios and priorities through stakeholder consultations. This preparatory work will enable Europe to play a significant part in framing and implementing the international space-exploration agenda, while leaving scope for adaptation to future global developments to be considered at the next Ministerial Council, scheduled for 2008. Aurora also includes Europe's first robotic exobiology mission to Mars (ExoMars). The latter will provide Europe with new enabling technologies thanks to the development of the Entry Descent and Landing System (EDLS) and Rover technology, both establishing Europe as a qualified partner for future exploration missions such as the Mars Sample Return mission. On the scientific side, the ExoMars mission will search for traces of past and present life and improve our knowledge of Mars' environment and geophysics. The target date for launching the mission is 2011. In this context, Germany has joined the Aurora Exploration Programme, giving additional support to the ExoMars mission.

In addition, the Russian Federal Space Agency is starting work on Clipper, a partly reusable transportation system (to replace the Soyuz spacecraft) for exploration purposes. Roskosmos has offered ESA an opportunity to participate in the system's development and operation. Member States did not commit themselves at the Berlin Ministerial Council to detailed appraisal of the content and modalities of such cooperation, but subscriptions remain open for corresponding funding potentially to be raised during 2006. The current aim is to prepare a decision on a joint programme to prepare development and future operations at the Ministerial Council in 2008, working closely with Russia (Roskosmos) and other possible partners such as Japan (JAXA).

BRINGING ABOUT INNOVATIVE APPLICATIONS

Each application-driven programme gives rise to generic technology development and activities, while contributing to technological innovation through dedicated programme-specific lines of activity. In **telecommunications**, for instance, the main purpose of activities is to maintain and improve the capability and competitiveness of industry and participating countries in the World satellite communications market. ESA's long-standing *ARTES* telecommunications programme (systems, equipment, technology and applications) is continuing. However, Europe also needs to pursue demonstration activities and qualify new equipment and technology, promote new systems and services and provide necessary infrastructure. ESA Member States consequently decided in 2005 to support the implementation of demonstration missions. They will give European industry an opportunity to fly and qualify innovative technology and products in orbit and promote new services enabled by new satellite systems, preferably based on partnership with operators and/or service providers. *AlphaSat* is the most ambitious mission. It will demonstrate in orbit new services in broadband multimedia to fixed installations and broadcasting to mobiles, while enabling full in-orbit qualification of the AlphaBus platform and relevant payload and system technologies and equipment.

In the field of **Earth observation**, the key event was the decision on a *GMES Space Component Programme* to provide Europe with fully operational satellite data for GMES services, and in particular the three pilot services already discussed. The

Programme, which covers the 2006-2013 period, also considers access to complementary missions by ESA Member States, Eumetsat, Canada and third parties. It will be implemented in two segments: Segment-1 (2006-2012) will be funded through ESA, with scope for incorporating a European Commission contribution as it becomes available; Segment-2 (2008-2013), to be decided in early 2008) is expected to be co-funded by the Commission and ESA. To secure short-term data continuity while preparing the ground for the full-scale GMES system, Segment-1 will develop a set of missions to fill the most urgent data gaps, conduct preliminary activities for successive spacecraft and missions and carry out the design and initial development of the required ground segment, including the flight operations system and payload ground segment.

Equally important to ESA's Long-Term Plan are developments regarding **navigation** and **Galileo**, another European flagship programme. A decisive step forward was made at the end of 2005 with the launch on 28 December of the first Galileo test satellite GIOVE-A (Galileo In-Orbit Validation Element). The GIOVE-B launch is expected to go ahead in the second half of 2006. With the launch of the first Galileo satellite, Europe confirmed its right to use the frequency. The final constellation, scheduled to be operational by 2010/11, will consist of 30 satellites operated by a private consortium formed by iNavsat and Eurely. The Galileo Joint Undertaking is expected to sign the operator's final contract by the second quarter of 2006. A new Galileo Supervisory Authority has been approved to secure the system's sustained operation and use.

LAUNCH-SERVICE PROCUREMENT POLICY

In order to have a more flexible offering, Europe will soon have three different launchers in operation: Ariane-5, Vega and the Soyuz launcher operated from CSG (Kourou).

Another political highlight of the Berlin Ministerial Council was the decision by Member States to implement a launch-service procurement policy designed to guarantee access to space and ensure coherence between the ESA satellite and launcher programmes. A preferential system will be implemented for ESA-developed launchers and the Soyuz launcher operated from CSG for appropriate payloads, providing this does not present an unreasonable disadvantage compared with other launchers […] in respect of cost, reliability and mission suitability (Art. VIII of the ESA Convention). However, as a prerequisite, ESA satellites must be made compatible with ESA-developed launchers or the Soyuz launcher operated from CSG.

To that end, the legal framework for the exploitation of ESA developed launchers should be based on the principle that any new ESA mission will:

- be designed to be compatible with at least one ESA-developed launcher or the Soyuz launcher operated from CSG, as far as technically feasible
- plan for a back-up solution.

Looking to the future, the Future Launchers Preparatory Programme (FLPP) for activities to be undertaken in Period-2 Step-1 (2006-2009) focuses on preparation of Next-Generation Launchers (NGL) and developing European technological capabilities to enhance the long-term competitiveness of European launchers. The Future Launchers Programme will help to prepare decisions in 2008 on evolution of the launcher sector. Furthermore, it provides for gradual restructuring of the launcher industrial sector and contributes to safeguarding the necessary industrial R&D capabilities.

NEW FRAMEWORK FOR THE LAUNCHER EXPLOITATION PHASE BEYOND 2008

The Ariane Production Declaration has governed exploitation of the Ariane launcher from CSG since 1980. ESA accepts its mandate under the Declaration, which was extended until the end of 2008 at the Berlin Ministerial Council by the States party to the Declaration. But ESA also acknowledges the need to prepare a common framework for launcher exploitation beyond that date. From 2008 onwards Vega, another ESA-developed launcher, will be operated from CSG, marking a turning point in European access to space.

The Ministerial Council established a set of principles as the basis for the intergovernmental agreement to be concluded by the end of 2006 and for the exploitation agreements for Ariane and Vega, which will be concluded within the framework of the Agency.

In particular, such principles relate to the main elements of guaranteed access to space, the terms for the operation of non-ESA developed launchers from CSG, the use of ESA-developed launchers and of the Soyuz at CSG for European institutional missions, and the international liability regime for ESA-developed launchers other than Ariane.

SPACE SERVING EUROPEAN SECURITY NEEDS

Acknowledging the need to increase awareness of security issues and develop the **security dimension** of its programmes and activities in the medium to long term, ESA has specified its policy with regard to security-related technology development (as outlined in NewPro). In this context, the Agency has also been actively involved in setting up preparatory activities for security research on the EU side. It is committed to greater cooperation with the Commission and the European Defence Agency to place its space and ground-segment expertise and know-how at the service of security-related EU policies.

- ESA and the SPASEC process

In March 2005 the European Commission released a report produced by a panel of experts in Space and Security (SPASEC), comprising 150 delegates from the civilian and military community, including ESA. The SPASEC report considers issues related to both civil and military security, responding to terrorism and natural disasters. It shows that space technologies can play a key role helping the police, the emergency-response services, the armed forces and agencies managing humanitarian relief, to respond more effectively to natural disasters (earthquakes and tsunamis) and terrorist attacks.

The panel recommends the urgent creation of a forum for the continuous identification of security-related needs for space technologies in the short, medium and long term. It also calls for support from the Commission to achieve greater interoperability between current national space systems in Europe. The panel notes that it would be unrealistic at this stage to propose a common approach to providing Europe with a comprehensive system for global situation awareness, and acknowledges the importance of national support for security-related space activities. The experts recommend setting up a European framework initiative designed to contribute to the space elements of such a global situation-awareness system. This framework should be able to propose top-down dedicated projects complementing national and intergovernmental actions. Particular attention should be given to data-relay systems, and network and service interoperability. In parallel, efforts should also concentrate on the protection of critical infrastructures based in space, essential to space services that contribute to the well-being of European society. This may require services and capabilities for surveillance of space-based assets as well as protection of terrestrial infrastructures.

In 2005, ESA continued implementing the measures and actions specified in a 'Position paper on ESA and the Defence Sector', presented at the March 2004 meeting of the ESA Council. More specifically, a number of meetings with Ministries of Defence and National Armament Directors of Member States were organised, to present ESA as a competent actor capable of delivering added-value. ESA is currently assessing the scope for launching a preparatory space surveillance activity (space- and ground-based options), capitalising on the results of a set of studies carried out by the Agency. In line with the above-mentioned SPASEC recommendations, the European Commission, supported by ESA, is currently analysing options to establish a forum or platform capable of collecting and aggregating demand expressed by Europe's fragmented security and defence communities, prior to offering them space-based solutions. This type of activity was included in the ESA Long-Term Plan 2006-2015. Ideally, a platform of this sort could also contribute to defining technological and preparatory activities (as well as trade-off and architectural studies) to be carried out as part of existing or newly proposed ESA technology programmes.

- PASR and ASTRO PLUS

In 2004, the European Commission started development of a European security research programme. A group of selected personalities from industry, government and academia, including the ESA Director General, gathered to define a European agenda for security research and spearhead the development of a research programme by 2006. In a preliminary phase, the group advised the Commission on implementation of a preparatory action for security research (PASR) with approximate funding of about €65m for a two-year framework (2004-2006). The preparatory action and the future programme should enhance the EU's scientific and technological capabilities for ensuring the security of European citizens. It should also boost European industry and research.

The Preparatory Action on the 'Enhancement of the European industrial potential in the field of Security Research 2004-2006' is the Commission's contribution to the wider EU agenda for addressing key security challenges facing Europe and its partners. It focuses in particular on the development of a security research agenda to bridge the gap between civil research, as supported by EU Framework Programmes, and national and intergovernmental defence programmes. Security research will thus be part of the 7th Framework Programme (2007-2013).

Space capacity is recognised as a complementary and essential technology to make Europe more secure for its citizens. As access to space is expensive, it is necessary to optimise its use and efficiency. The ASTRO+ contract (Advanced Space Technologies to support security operations) was consequently one of the seven projects funded by the Commission in 2004 under the Preparatory Action on 'Enhancement of European industrial potential in the field of Security Research 2004-2006' with an overall budget of €3m, €2.2m of which is funded by the Commission.

- European Security and Defence Policy (ESDP) and the Space Roadmap

The EU Council has framed a draft initial roadmap on 'ESDP and Space'. The document outlines how space could support the European Security and Defence Policy. The roadmap that describes the sequence, actors and status of achievement with respect to each of the above-mentioned steps, was established in consultation with the relevant European Commission departments, the EDA and the EU Satellite Centre, as part of the 'Inter-pillar dialogue'. The initial roadmap is based on the assumption that the civilian and military needs for all actions addressing the use of space assets for ESDP purposes are either identical or at least compatible. The 'Report of the Panel of Experts on Space and Security' (SPASEC Report) of March 2005 confirmed this assumption.

ESDP requirements were specified on the basis of the Headline

Goal 2010 and the initial study by the Military Committee. The resulting Requirements Catalogue 2005 (RC 2005), submitted to the GAERC in December 2005, contains a detailed list of Required Capabilities. Space-based ESDP requirements will be extracted from this catalogue and refined. Allowance will also be made for requirements related to the civilian aspects of ESDP, building on ongoing work on the implementation of the Civilian Headline Goal 2008. The space-based ESDP requirements are expected to be presented to the Political and Security Committee in early 2006. In a final step, the ESDP requirements in terms of space should be submitted to the Commission and Member States to allow for the identification of possible multiple-use capabilities inherent to civilian systems under development.

The development of a global EU Space Policy, including the agreed ESDP requirements, complies with the provisions of the Framework Agreement between the European Community and the European Space Agency, as approved by the EU Council on 26 April 2004. Harmonisation of military requirements through the European Defence Agency will allow for more dedicated cooperation in the conception, design and development of future programmes. EDA will carry out this work as part of its Long-Term Vision (as mentioned in EDA's 2005 work programme), which will include long-term R&T objectives and programmes in the broader context of ESDP requirements and space. EDA will then study financial proposals on a case-by-case basis. Exploratory work has been initiated in 2005 with an initial appraisal of the appropriate space-based assets with third parties. Subsequently, the Political and Security Committee will provide guidance on identifying suitable third parties with whom to seek agreement(s).

While waiting for the identification of new requirements and the effective planning of new space capabilities, ESDP-related needs in terms of imagery are governed by the 'Arrangements for EU to access existing and planned military systems or data originated from such systems belonging to Member States', and in particular by the Memorandum of Understanding (MoU) between the Helios-1 Member States (F, I, E) and the EU for access to Helios-1 data.

Talks have been initiated between Helios-2 Member States (F, B, E) and the EU Council Secretariat for access to data from Helios-2. Preliminary talks have been initiated between Germany and the EU Council Secretariat for access to data from SAR LUPE, in April 2005.

Similar talks have been held between Italy and the EU Secretariat for access to data from Cosmo-SkyMed, in October 2004. The corresponding MoU is expected to be agreed by March 2006.

Furthermore, ongoing contracts with image providers are being renewed on a case-by-case basis, to provide the European Union Satellite Centre (EUSC) with appropriate imaging. EUSC, which is also an Agency of the EU Council, is dedicated to the exploitation and production of information derived from primarily Earth-observation space imagery for EU decision-making. In the past, it has also relied on ESA Envisat and ERS data.

- ESA and EDA

The first official meeting between the Chief Executive of the European Defence Agency, Mr Nick Witney, and ESA's Director General was held on 19 April 2005 in Brussels, initiating a dialogue between the two organisations. Notwithstanding the fact that EDA's high-level priorities are currently focused on more fundamental policy issues (the European Defence Procurement system and interpretation of Article 298 of the EU Treaty), it is expected that space capabilities will be one of the major issues in the near future.

The EDA Research and Technology Directorate is now fully staffed and currently integrating the Research and Technology activities of the former Western European Armaments Group. In addition, EDA has initiated three space-related technology studies, in particular an assessment of SatCom capabilities.

Meetings between ESA and EDA executives are now taking place regularly at an operational level. The aim is to exchange information on upcoming technological and system issues in the European space-security domain. In this respect, an ESA delegation was also invited to the EDA Information Day presentation of the Unmanned Aerial Vehicle Programme.

EUROPEAN SPACE POLICY INSTITUTE (ESPI)

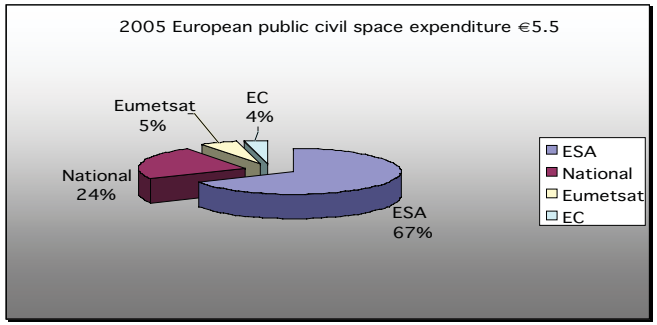
Given the many milestone decisions taken every year, the rapid changes in the global space arena and the need to think ahead regarding future governance and international cooperation, ESA Member States have keenly advocated setting up a network of think-tanks to carry out strategic analysis of and research into space-policy matters. At the heart of this system is the newly created European Space Policy Institute (ESPI). Founded by ESA and the Austrian Government, it has been operational since 2005. ESPI's core task is to develop networking between space-relevant institutions and create synergies, while providing in-depth research, strategic analysis and scenario-development in support of European space activities. Its activities will give greater visibility to space issues, thanks to the publication of multidisciplinary studies and the organisation of workshops and seminars for space experts from all over Europe and beyond. ESPI is also a source of information for scholars, scientists and professionals.

4.2 Assessing the Institutional Market

The institutional market in Europe explains some of the particularities of its space industry compared with other major space powers. It is not large enough to counterbalance the dependency of Europe's space industry on the commercial space market. This disadvantage, compared to other powers which remain committed to a powerful, closed captive institutional market, is due in particular to low European investment in defence-related space programmes. More than 90% of European funding has been devoted to civilian space in past years. This makes competition with US firms more difficult, the latter enjoying the benefit of large Department of Defense contracts. Other space powers support their space industries with vigorous dual-use programmes. Not only is the European institutional market limited in size, it is also fragmented. It may be split into several segments consisting of ESA programmes, national space programmes of varying ambition, space funding by the European Commission and Eumetsat activities. But the sheer volume of public expenditure is not the only factor in the relative strength of European space at a global scale. Internal coordination between the various stakeholders, coherence between national and European initiatives, and European interoperability between national space assets are equally important.

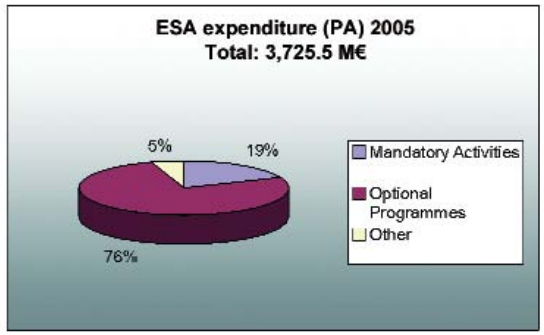
CIVIL SPACE EXPENDITURE

ESA accounted for the largest share of European space expenditure in 2005, representing about two-thirds of an estimated €5.5m overall European civil space expenditure, including Member States, the European Commission and Eumetsat. In comparison to past years there is a general trend towards a decrease in civilian space expenditure by individual nations and an increase in ESA expenditure compared to 2004, by about €250m. Space expenditure by the Commission amounted to an estimated €210m in 2005, with key instruments for delivery being the Framework Programme for Research and Development (FP6), the Trans-European Network Programme, and the Competitiveness and Innovation Programme.



(Source: ESA)

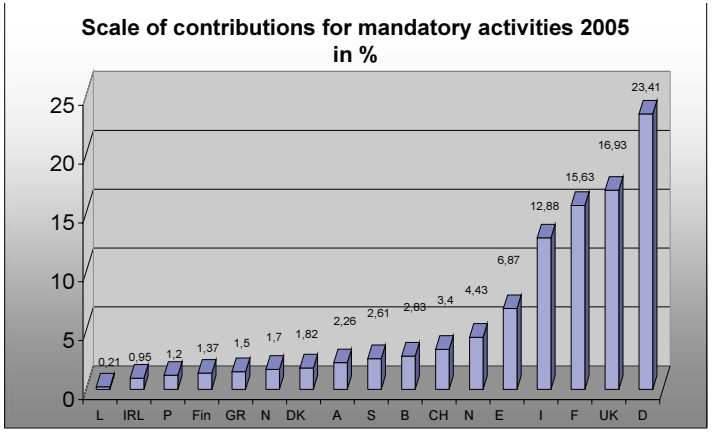
Based on contributions by its Member States of about €2643m, income from the European Union of about €173m, and other income and third-party programmes, ESA's overall expenditure amounted to €3725.5m in 2005. Of that total, €2844m was spent on Optional Programmes, with Mandatory Activities accounting for some €696m.[2]



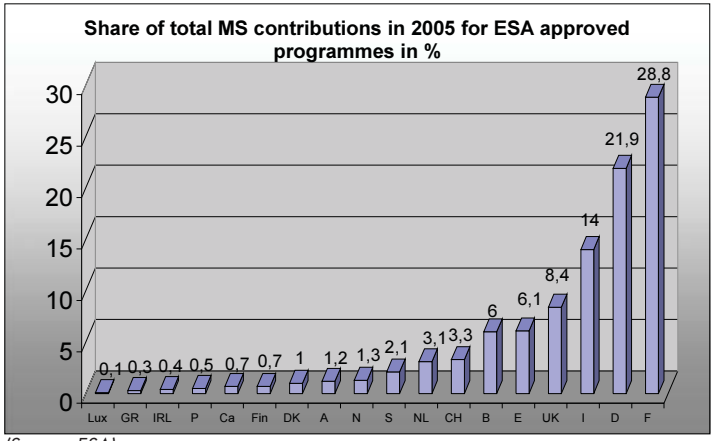
(Source: ESA)

[2] Figures based on the 2005 Autumn budgetary revision, ESA/AF(2004)7, rev. 5.

While their contribution to Mandatory Activities based on a fixed, GDP-linked scale makes Germany, the United Kingdom and France the biggest contributors, overall involvement and support for ESA programmes should be measured by taking into account contributions to Optional Programmes. Alongside the three large contributors (F, D, I), countries such as Spain have recently increased their commitments, with Belgium, Switzerland and Sweden making particularly substantial contributions, considering their GDP.

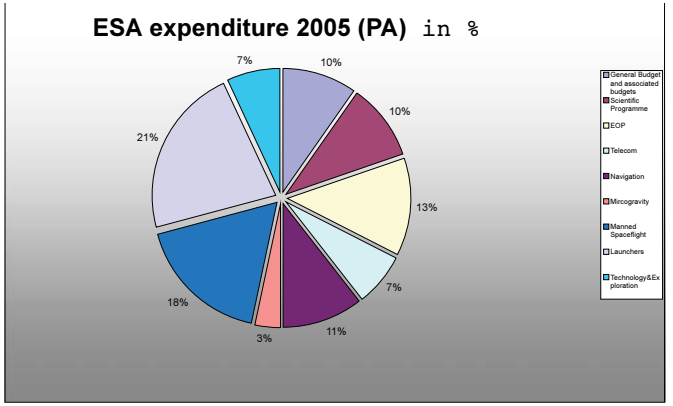


(Source: ESA)



(Source: ESA)

If ESA expenditure is split into sector-related fields in respect of 2005 payment appropriations, Launchers and Human Spaceflight remain the two largest items of expenditure, with respectively €785m and €627m in 2005. The Science budget saw another loss in purchasing power, in real terms, with overall expenditure of €349m. This trend has, however, been stopped, thanks to the decision at the Berlin Ministerial Council to increase the Science budget by 2.5% a year. The overall breakdown of ESA expenditure, which has been fairly stable in recent years, is as follows:



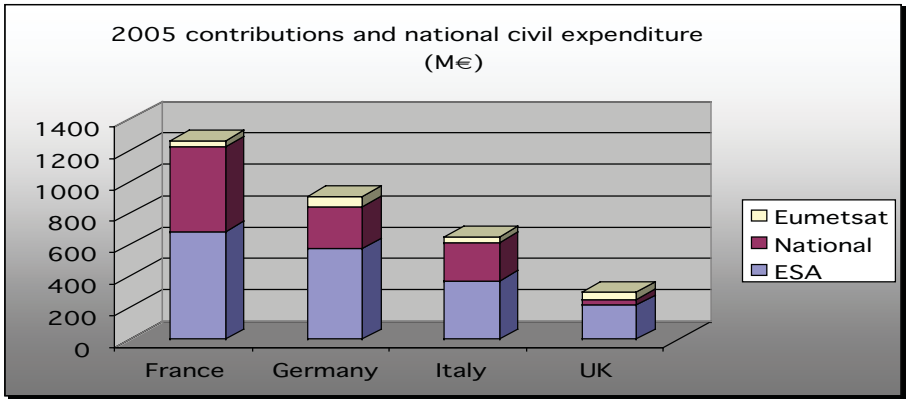
(Source: ESA)

After the ESA Council at Ministerial Level, Member States made commitments to mandatory activities for the 2006-2010 period, the continuation of optional programmes, and the proposal of new activities. Subscriptions by Member States amount to some €8.3bn, coming on top of €4.6bn in existing commitments for approved programmes.

Member States provided the Agency with a level of resources for 2006-2010 of €3.1bn, with a sustained commitment to the Science Programme in particular. Subscriptions for the

continuation of optional programmes, including Earth Sciences, Telecommunications, Human Spaceflight and Microgravity and the Launchers Programme amounted to over €3.5bn. Proposals for new activities included Earth-observation applications (GMES Space Component Segment-1, Phase-1), space exploration (Core Programme and ExoMars) and new technology activities in telecommunications (AlphaSat and small GEO missions), the future launchers preparatory programme, and preparatory activities for in-orbit technology demonstrations and the NewPro programme. Total subscriptions amounted to €1.6bn.

In addition to contributions to ESA, nearly all Member States have a national space programme. The corresponding activities amounted to an estimated national civilian space expenditure of some €1300m in 2005. However, the size of specific national programmes differs widely, and most countries channel the majority of their investments through ESA. Only three Member States (France, Germany and Italy) have an autonomous programme spanning a wide spectrum of activities. They account for more than 80% of overall national civil expenditure in Europe, with France contributing about 42% of the total. These figures do not include security-related space programmes that are still driven by Member States' national investment.



SECURITY-RELATED SPACE EXPENDITURE*

All security-oriented space capabilities so far developed in Europe are the result of national initiatives, with five countries (France, United Kingdom, Germany, Italy, and Spain) having dedicated space programmes.

To avoid as much as possible of the duplication and redundancy that already exists, some key players have concluded bilateral agreements for the exchange of data from their national programmes. Pooling resources in exchange for shared data or satellite-tasking time enables European countries to expand their satellite capabilities without increasing expenditure.

There are also a limited number of multilateral cooperation agreements, particularly regarding telecommunications and observation.

*This sub-Chapter is based on figures provided by a Consultancy produced under ESA RFQ3-11292-05: 'The Future Evolution of the European Security/Defence sector, FACTEA, May 2005.

Telecommunications Multilateral Agreements:

UK (Skynet-5), France (Syracuse-3) and Italy (Sicral)
>>> Nato Milsatcom V

Observation Multilateral Agreements:

France in cooperation with Belgium and Spain (Helios-2) and Germany (SAR-Lupe)
>>> E-SGA cooperation

France in cooperation with Belgium, Spain and Sweden (Pleiades) and Italy (Cosmo-Skymed)
>>> Orfeo cooperation

Though such efforts are fairly limited, their scope is expected to increase in the near future. In the absence of a truly European Space Defence Programme, security-related satellite applications are nevertheless likely to develop, all the more so as the major European countries have been pressing for EDA to include the identification of common space requirements in its work programme in the near future.

Several activities are therefore likely to be launched for the 2005-2014 period, with total expenditure amounting to €9.6bn:

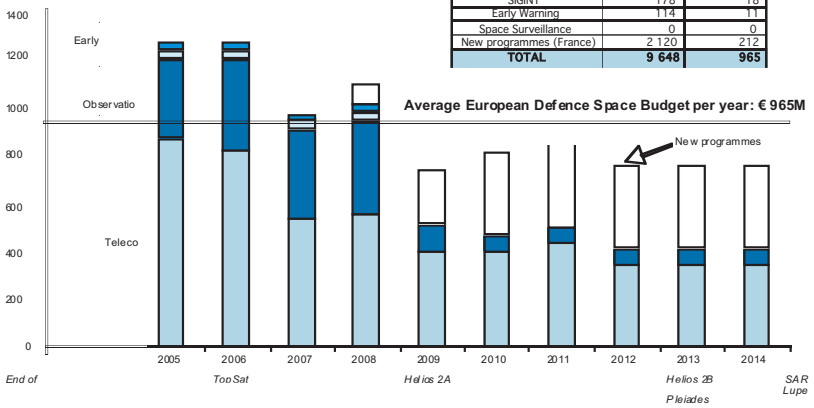
- Telecommunications: launch of at least 11 satellites.
- Observation, SIGINT, early warning and space surveillance (demonstrators): launch of 16 satellites.

This rough forecast represents a slight increase in annual spending by European States on security-related programmes, from an average of €750m in recent years to about €965m over the next 10 years. Expenditure for 2005 and 2006 is exceptionally high due to the realisation of programmes such as TopsSat (UK), the Cosmo-Skymed (I) contract and the effective launch of satellites such as Helios-2 (F) and Xtar EUR (E). As to the share of expenditure according to countries, the French defence space budget is expected to remain the largest in Europe (at least €450m annually), even if the British, German, Italian and Spanish budgets have significantly increased. Before 2005, the British, German, Italian and Spanish defence space budgets amounted to an average total of about €200m a year, a figure expected to rise to about €500m a year with the realisation of programmes such as Skynet-5 and TopSat (UK); Satcom BW Stufe-2 and SAR Lupe (Germany); Sicral-1B, 2A and Cosmo-Skymed (Italy); Spainsat and Xtar Eur (Spain).

Analysis of the foreseeable share-out of expenditure reveals various gaps. Firstly, no specific funding has been provided for work harmonising standards and operating procedures (standardised ground-segment architecture and interoperability). Secondly, there are no specific SIGINT, early-warning or space-surveillance application programmes.

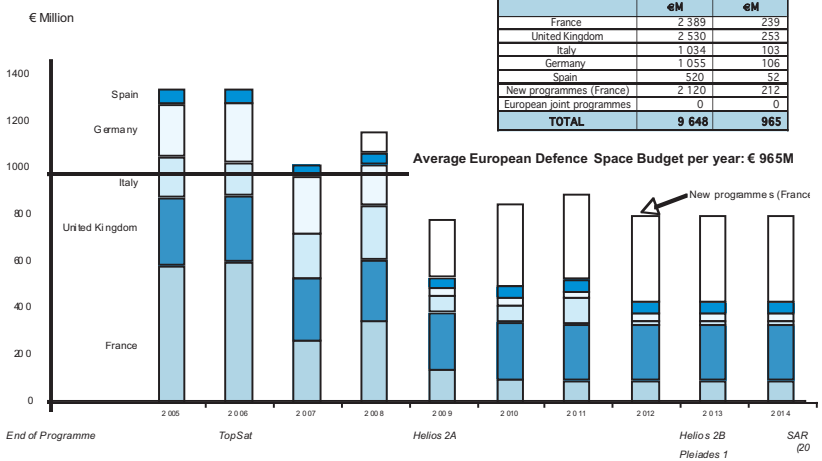
European defence satellite programmes: 2005-2014 per application type

Application	Total budget 2005-2014 €M	Average Budget p.y. €M
Telecom	5 237	524
Observation	1 999	200
SIGINT	178	18
Early Warning	114	11
Space Surveillance	0	0
New programmes (France)	2 120	212
TOTAL	**9 648**	**965**



European defence satellite programmes: 2005-2014 expenditure by country

Country	Total budget 2005-2014 €M	Average Budget p.y. €M
France	2 389	239
United Kingdom	2 530	253
Italy	1 034	103
Germany	1 055	106
Spain	520	52
New programmes (France)	2 120	212
European joint programmes	0	0
TOTAL	**9 648**	**965**



4.3 European Space Industry Evolution

4.3.1 The European aerospace industry in context

Data on the European aerospace and defence industry released by the Industries Association includes activities in the aeronautical, defence (land and naval) and space sectors.

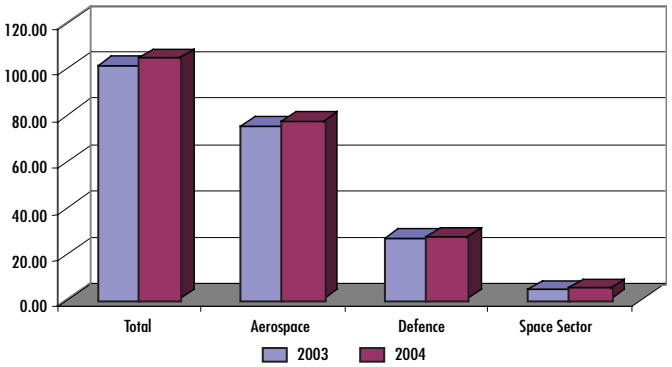
In 2004, the total revenue of the European aerospace and defence industry amounted to €104bn, a €3bn increase over 2003. The aerospace sector accounted for €77bn, with the space sector contributing €5bn and defence accounting for the remaining €27bn.

The aerospace sector achieved a 3% **growth rate** in 2004, compared with the previous year. The increase in revenue in the space sector alone was about 18.6%, a satisfactory gain which shows that the overall trend is towards recovery after several years of sluggish performance.

Overall **employment** increased by about 3% in the aerospace sector in 2003, whereas jobs in the defence and space sectors dropped, by 0.6% and 3.4% respectively. The total number of workers in the European aerospace and defence business was about 601 000 in 2004. The decrease in the number of jobs in the defence and space sector reflects the restructuring process in both sectors, which is significant in the space business.

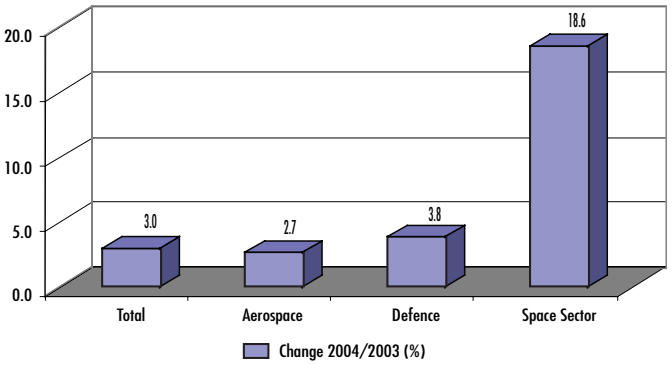
Turnover per employee can be estimated at about €173 000 per worker in the aerospace and defence industry as a whole. Productivity in the space sector is lower than the average for aerospace, at about €157 000.

Aerospace Turnover 2003-04 B Euros



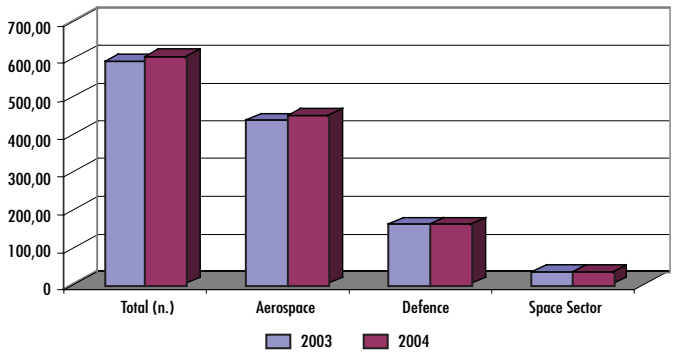
(Source: Aerospace and Defence Industries Association of Europe: 2005)

Aerospace and Defence Growth Rate



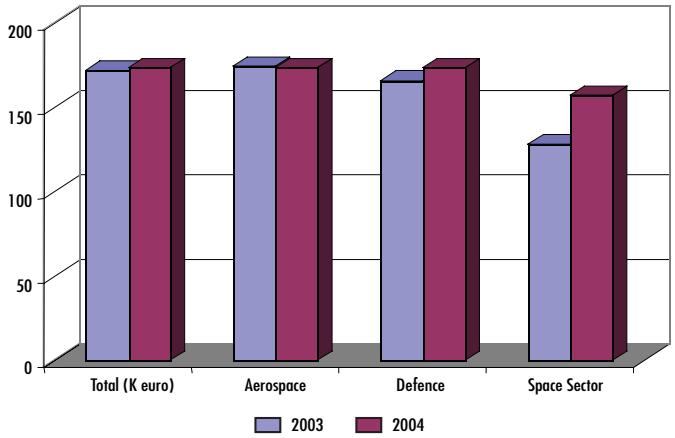
(Source: Aerospace and Defence Industries Association of Europe: 2005)

Aerospace and Defence Employment



(Source: Aerospace and Defence Industries Association of Europe: 2005)

Aerospace and Defence Productivity



(Source: Aerospace and Defence Industries Association of Europe: 2005)

4.3.2 The European space industry*

Statistical data on the European space industry is compiled by an annual survey carried out by ASD Eurospace. The survey is consolidated in such a way as to avoid counting the same activities twice (when shared between several sub-contractors). Some activities, such as the revenues of satellite operators and consumer ground systems, are not included. In addition to the ASD Eurospace survey, ESA regularly compares ASD Eurospace statistical data and its own data on the space industry. A recent assessment, covering the last five years, shows that on average ESA data is underestimated in Eurospace statistics by about 35%. The difference seems to be essentially due to contracts awarded by ESA to suppliers outside the ASD Eurospace definition of the space industry, and in particular contracts with laboratories, research centres, national space agencies, small- and medium-sized enterprises, service and support contractors.

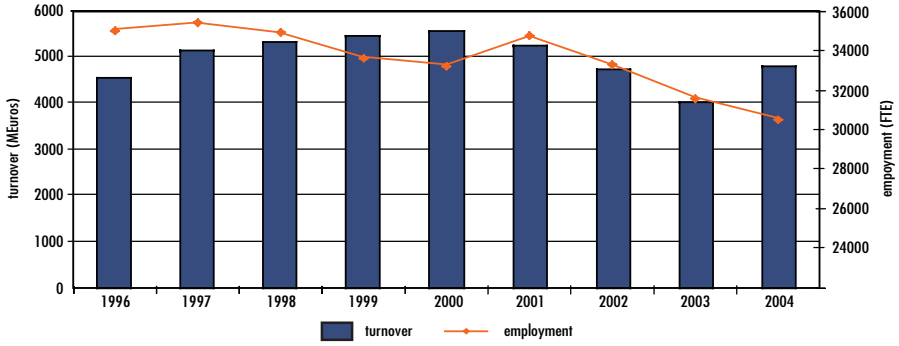
Despite these differences, ASD Eurospace data can be used as it has the advantage of being consolidated for the whole of Europe. It is collated from, and thanks to, Europe's largest space firms. The differences highlight the fact that ESA supports research and development activities and any kind of space initiative considered as being beneficial to society.

The **turnover** of European space industry in 2004 is estimated at €4.8bn, a 19% increase over 2003. The space sector is showing signs of recovery after several years of steadily decreasing turnover. The current figure is, however, still about 20% lower than the level reached in 2000.

On the **employment** side, the total number of people working in the European space sector is estimated at 30 524 employees, a decrease by 3.2% over 2003, marking a continuing trend towards reduction compared with previous years.

Total employment in the European space sector has significantly decreased over the last eight years. About 5000 jobs have been lost, with a 17% drop in the overall number of employees, equivalent to a 2% average annual decline since 1997. Data on employment, as well as on total turnover, shows that major restructuring of the space sector has occurred in Europe in recent years. This has led to improved performance at home and enabled the industry to maintain its position in World markets.

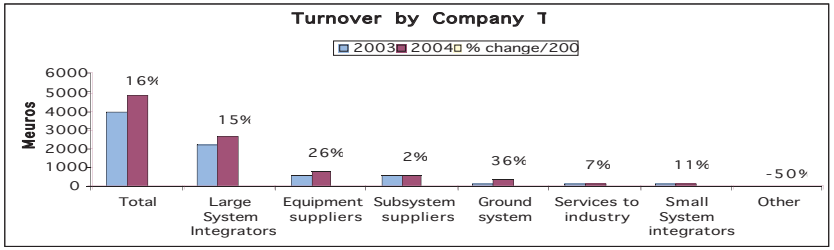
European Space Industry
Employment and Turnover

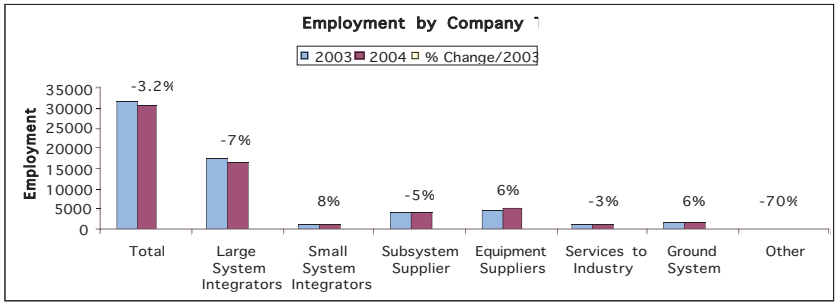


(Source: ASD EUROSPACE – June 2005)

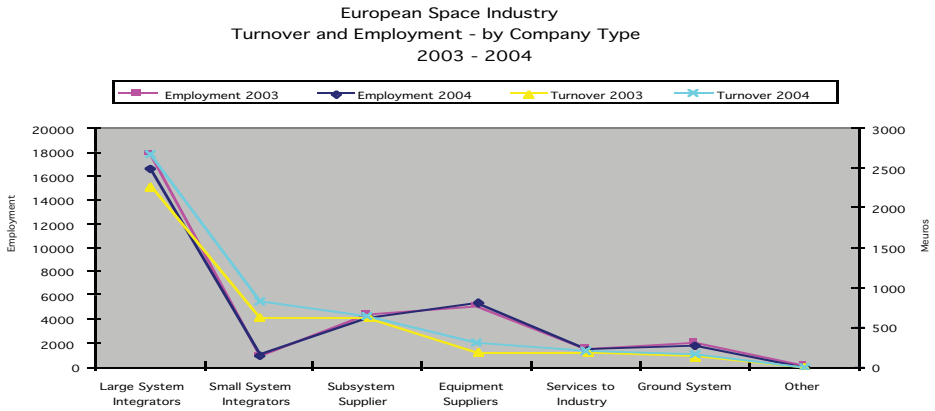
Despite the recent restructuring, Europe's space manufacturing industry is still fragile, in a domestic environment which is slowly recovering after several years of negative trends. Further restructuring is expected to occur, with the international market facing delays in some institutional programmes and the commercial component of global demand less dynamic than in the past.

*The present chapter analyses consolidated figures for the period up to 2004. Indications about latest industry data for 2005 (issued by ASD in May 2006) are provided in Chapter 5.2: Industry and Markets – Europe's competitiveness on a global scale. A more thorough analysis of these figures will be provided in the next edition of this report.





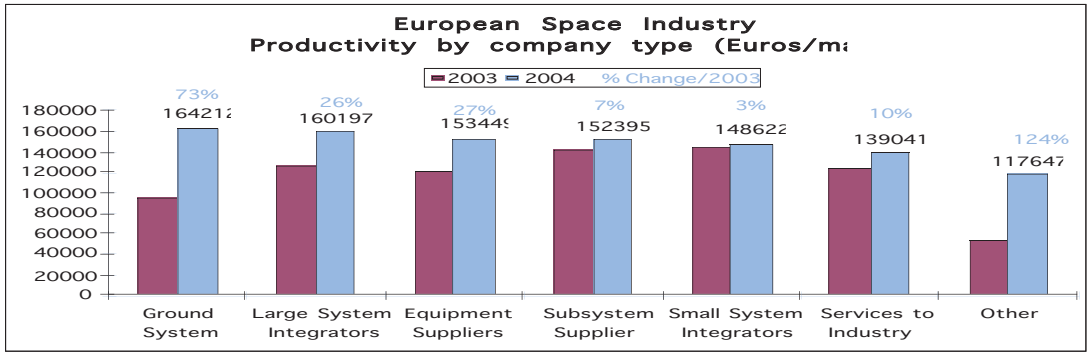
(Source: ASD EUROSPACE – June 2005)



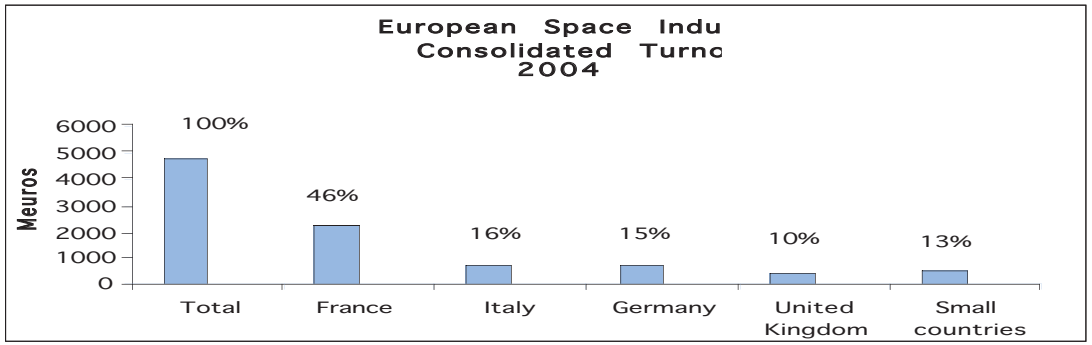
(Source: ASD EUROSPACE – June 2005)

The graphs below show recent performance during 2003 and 2004 with respect to turnover and employment in each of the main **segments of activities** which make up the European space sector.

The two indicators of turnover and employment have a similar relative weight in each branch. Recently, however, turnover has increased in all branches, whereas employment has decreased in the major branches.



(Source: ASD EUROSPACE – June 2005)



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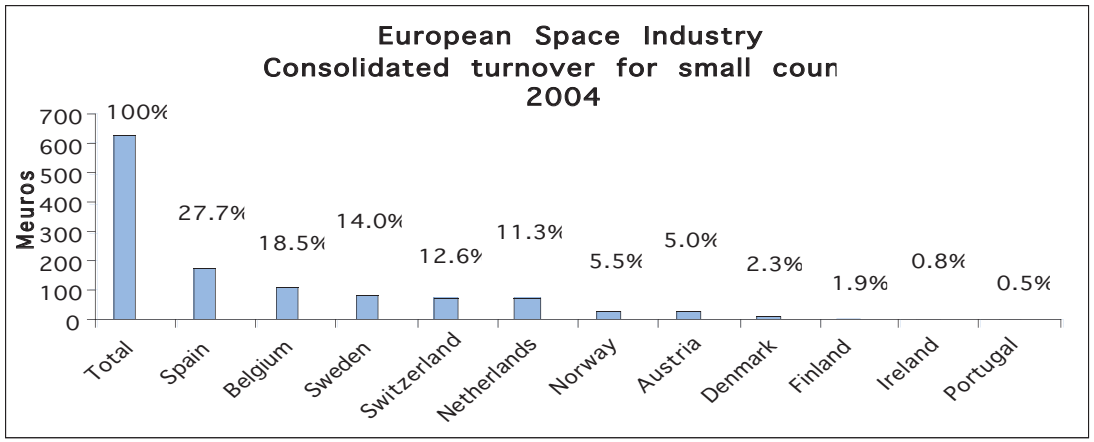


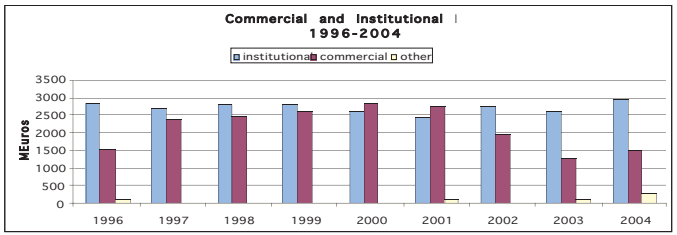
(Source: ASD EUROSPACE – June 2005)

Productivity per employee in the space sector is on average €157 000, below that of the aerospace industry (see related graph in Chapter 4.3.1). Productivity within each segment of the space activity and its variation in 2003 and 2004 is shown in the graph below. Good performance was recorded in ground systems, with a 73% increase in productivity in 2004 over the previous year. However, it should be borne in mind that the overall upward trend comes after three years of steadily declining productivity, compared with 2000 (€167 000 per employee).

The **breakdown by country** of the European space sector's total turnover shows the predominance of France, which contributes about 46%, followed by Italy (16%), Germany (15%) and the United Kingdom (10%). Together the four largest European states account for about 87% of the total. The remaining 13% represents the participation of space industry from smaller states.

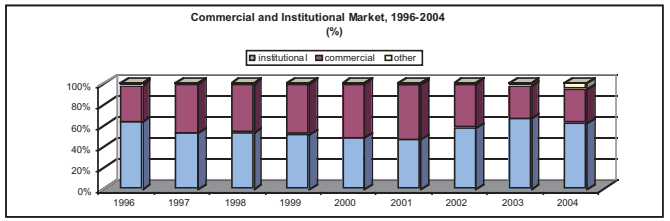
The **breakdown of smaller countries** shows that Spain, Belgium, Switzerland, Sweden and the Netherlands together account for about 84% of the 13% share of the total. The remaining States have only a small fraction of total turnover, given their modest participation in ESA programmes, the lack of a national space activity, the smaller size of their space firms or their more recent participation in ESA as new Member States (Finland, Portugal and more recently Luxembourg and Greece).

The European space market can be divided into two main components: the institutional market and the commercial market. The institutional market includes ESA, national space agencies, military or other Government bodies, and publicly owned satellite operators. The commercial market includes privately funded activities by commercial launch and satellite operators. In recent years, the overall demand from the institutional market has been more or less stable, ranging from €2.5bn to €2.8bn annually. The commercial market expanded between 1996 and 2000, rising from €1.5bn to €2.8bn. The positive trend then stopped and went into decline, particularly in 2002 and 2003. The commercial market now seems to be recovering, having reached its 1996 level in 2004.



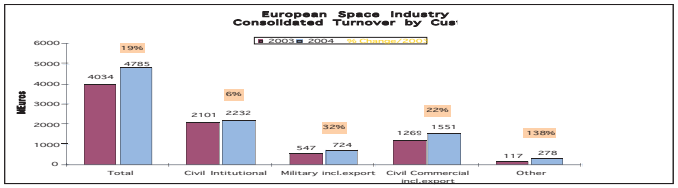
(Source: ASD EUROSPACE – June 2005)

The following graph shows changes in the relative contributions of institutional and commercial markets to total turnover.



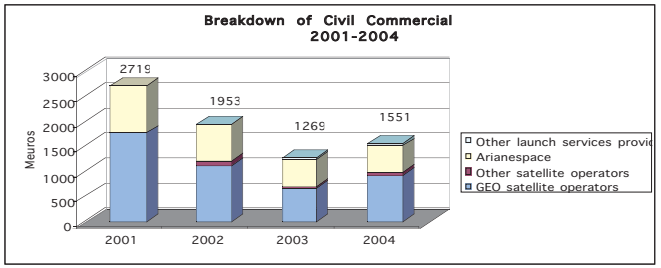
(Source: ASD EUROSPACE – June 2005)

The space sector's main customers and recent trends are shown in the graph below. The civil institutional market remains the top customer, at a relatively steady level, followed by the civil commercial and military markets.



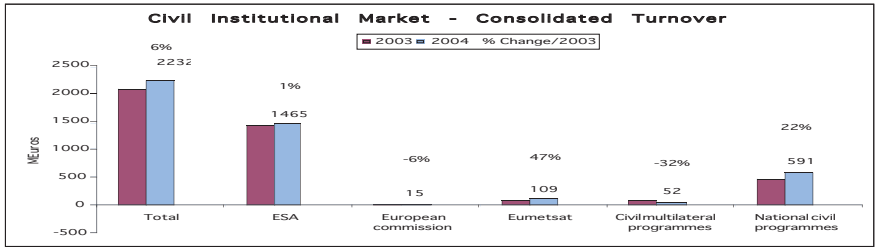
(Source: ASD EUROSPACE – June 2005)

As mentioned above, the **civil commercial market** recorded a peak in sales in 2000, followed by a downturn starting in 2001. The graph below shows the trend between 2001 and 2003, characterised by considerable reductions in both satellite and commercial launch activity. 2004 was a year of recovery (22% increase) from the previous downward trend. Business for commercial satellites and launchers is also slowly recovering. The ESA programme of guaranteed access to space obviously remains very important for the European launcher industry.



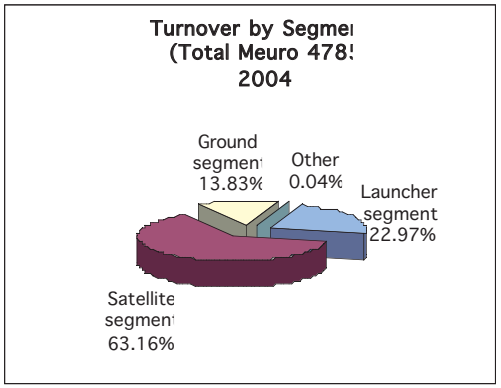
(Source: ASD EUROSPACE – June 2005)

The **civil institutional market** recorded a 6% growth rate. The graph shows a reduction in civil multilateral programmes (-32%), but this is only a statistical effect due to the transfer of part of the data to the national civil programmes (+22%). Eumetsat, the publicly owned satellite operator, recorded a significant increase (+47%). The position of ESA (+1%) and the Commission (–7%) remains more or less stable.

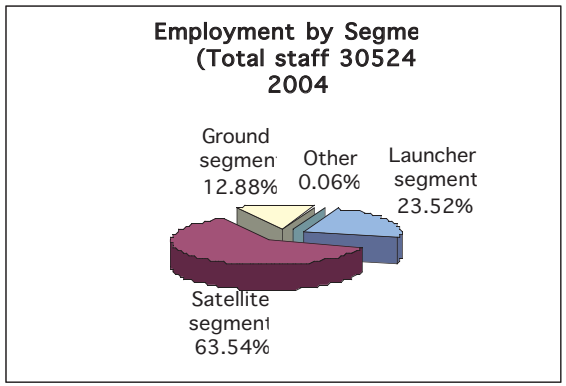


ASD EUROSPACE – June 2005

The breakdown of **turnover by industrial segment** shows the relative weight of the satellite segment (63%), followed by the launcher segment (23%) and ground segment (14%). A similar structure can be noted on the employment side.



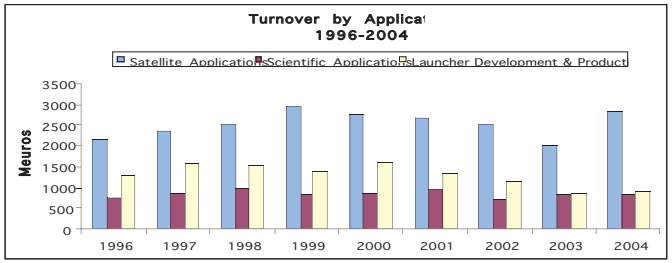
ASD EUROSPACE – June 2005



ASD EUROSPACE – June 2005

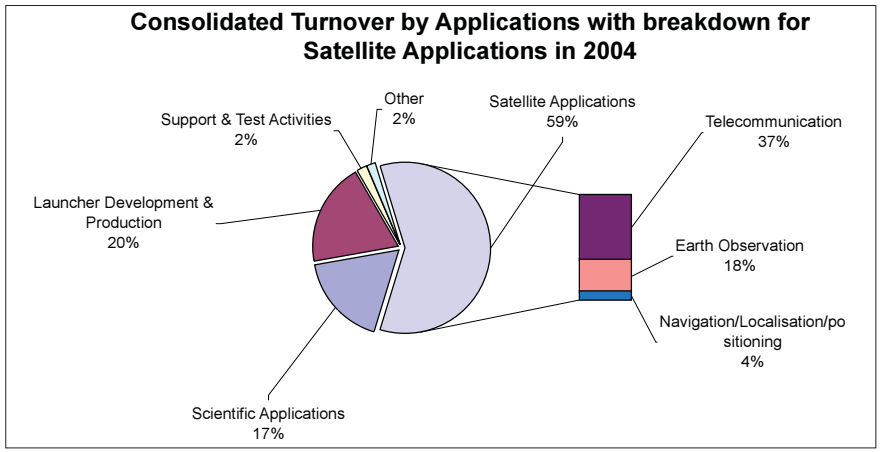
The following graphs provide more detailed information on the evolution and breakdown of satellite applications and launcher development in the global space business.

Turnover in **satellite applications** steadily increased between 1996 and 1999, and then went into a slow but steady decline between 2000 and 2003. Sales recovered in 2004, returning to their level of 2000. Turnover trends in the **launcher development** business and **scientific applications** are more irregular, with marked ups and downs from one year to the next. The situation in both activities showed signs of improving in 2004, but the launcher business in particular is still below its 1996 level.

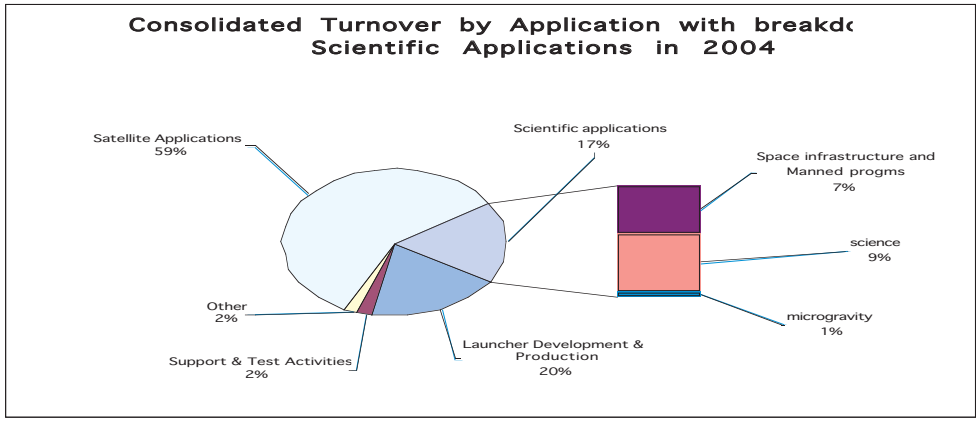


ASD EUROSPACE – June 2005

The following graph shows the breakdown of consolidated turnover in **satellite applications** for 2004.



(Source: ASD EUROSPACE – June 2005)



(Source: ASD EUROSPACE – June 2005)

Satellite applications represent about 60% of the total European space business. They include mainly telecommunications, Earth observation, navigation, localisation and positioning.

Scientific applications account for about 17% of the total space business and include scientific research related to space infrastructure and microgravity.

5

European Parameters in Perspective

5.1 Between Partnership and Competition – Europe's potential in international relations

The arrival of new powers, joining the small group of space-faring nations capable of undertaking almost the full gamut of space activities, has a far-reaching impact on both cooperation and competition, which are the two sides of the same coin in terms of international relations. Although this trend represents an opportunity for greater diversification and international cooperation in space, it also means stiffer competition from countries such as China or India, which offer low production and service costs for the manufacture of space hardware and the provision of launch services.

It is vital for Europe to establish a position in this new, more complex 'space world'. It must promote its overall policy principles, based on international cooperation for the benefit of all partners, but without losing its competitive edge. It can build on a long track record of international cooperation, with ESA leading various cooperation programmes including science missions, which are particularly suitable for cooperation with international partners such as the USA, Russia or Japan, and China and India in the future. This applies as much to specific missions as it does to ISS assembly and utilisation, which would not have been possible without the involvement of the various partners. Building on this heritage, Europe's future Scientific Programme 'Cosmic Vision' will be an opportunity for further international cooperation. In the field of space applications, Europe has been at the forefront of global cooperation, in both navigation and observation. Galileo is not just the first global civil satellite positioning, navigation and timing system; it also involves partners such as Israel, China and India. Additional talks with several other countries are underway at different levels. Just as Galileo contributes to the setting up of a Global Navigation Satellite System, so Europe's Global Monitoring for Environment and Security (GMES) programme should be seen in the broader context of creating a Global Earth Observation System of Systems (GEOSS). European satellites such as Envisat and ERS are already playing a leading role, providing timely satellite imagery as part of the International Charter on Space and Major Disasters. ESA's participation in this year's UN Montreal summit on a post-Kyoto Protocol strategy is a measure of the effort it is making. Future international-cooperation projects in the field of applications may also involve telecommunications as a way of supporting development in African countries and closing the digital divide. Similar contributions can be envisaged within the EU-led AMESD initiative (Environmental Monitoring for Sustainable Development for Africa) – a potential African element of the GMES system. Therefore further coherence between the European Space Policy and the Commission's development policy is envisaged in 2006 via the Commission's communication 'EU Strategy for Africa'.

Europe has also started assessing the openings offered by the new US vision for space exploration. It means defining a new global architecture for exploration and Europe will have to continue its work carefully to select the areas in which it wants to contribute on an affordable basis while taking part in the development of critical technologies. In addition to long-standing cooperation with the USA and Japan, Europe has extended the scope of its partnership with Russia in two main fields: exploitation of the Russian Soyuz launcher from Europe's Spaceport in French Guiana, and cooperation on research and development in preparation for future launchers. Working on the development of future space-transportation systems, Europe and the Russian Federation will collaborate in developing the technology needed for future launchers.

During the visit to China by ESA's Director General in late 2005, the Agency signed a Framework Agreement with the Chinese National Space Administration (CNSA), taking cooperation to a new level. China and ESA are already cooperating on science projects such as the Double Star Programme and a data-analysis centre for Cluster. Another important project is the Dragon Programme set up by ESA and the National Remote Sensing Centre of China. This focuses on using data from ESA's ERS and Envisat missions for science and applications development. The Dragon Programme proved useful during China's rainy season, in early 2005, when imagery of flooding acquired by Envisat's Advanced Synthetic Aperture Radar sensor enabled the Chinese authorities to swiftly assess affected areas and plan their response accordingly. Now that the Framework Agreement has been concluded, ESA is looking forward to further cooperation with China. Alongside the Chinese National Space Administration, other major interlocutors include the Ministry of Science and Technology and the Academy of Sciences.

Going beyond the hitherto very limited cooperation in exchanging Earth-observation data, ESA has also initiated closer ties with India, namely through a joint effort on the future scientific Chandrayaan lunar mission. It is intended to substantiate the partnership with reciprocal provision of instruments, data applications and data exchange.

In more general terms, continuing international cooperation can help to open up new markets for European products and services, as well as leading to outsourcing of the manufacture of non-critical items. This is consistent with efforts to safeguard Europe's competitive edge, which means positioning industry so that it can capture its share of the commercial market and stay at the forefront of scientific and technological R&D spending, which in turn promotes European innovation. An important issue is Europe's attitude to US export-control regulations such as ITAR (International Traffic in Arms Regulation), and the definition of a coherent European approach towards protecting its own sensitive technology.

With regard to commercial markets, worldwide competition is indeed increasing. While in the USA the institutional market (DoD and NASA vision for space exploration) may compensate for shortfalls on the commercial side, Europe lacks a comparable captive market. In addition, Russia remains an important source of reliable technologies, while India and China are developing technologies at a lower cost than their European counterparts in all fields of space activity (launchers and satellites).

In such a context it is difficult for European industry to invest in technology at the level needed to maintain and increase its competitiveness. In Europe, the bulk of the funding for space research and technology comes from specific national programmes, industry and ESA programmes. In all, about €400m are invested yearly through ESA Member States in space-technology programmes, corresponding to about 7% of the total European investment in civil space activities.

Given the increasingly complex picture and the balance to be struck between cooperation and competition, early awareness of the plans adopted by other international players in space – their strategies, capacities and ambitions – will be even more important.

5.1.1 United States

BUDGET

The US space programme continues to be funded at an unparalleled level. The total budget of the combined US defence and civil government space activities is estimated at $37.3bn

for Fiscal Year (FY) 2006. This budget is allocated as follows: approximately $20bn to the US space defence programme, $16.4bn for NASA, and $900m for NOAA's space-related activities. As in previous years, the US Department of Defense (DoD) is the largest space organisation worldwide. It is, however, not possible to obtain precise figures for all of the DoD and intelligence space-programme accounts, since they relate to classified programmes. The size of the NASA total budget for FY 2006 is a case in point, the Agency receiving strong support at a time when public budgets in Washington were otherwise restricted due to the cost of the operations in Iraq and Afghanistan, the cost of recovery after hurricane Katrina, and the rising public deficit.

Two budgetary factors affect the future of several DoD space programmes. First the surge in US defence spending following the 11 September 2001 terrorist attacks is now expected to stabilise and possibly decrease starting in FY 2007. The Pentagon's procurement, research and development budget, which funds most US weapon systems, has certainly increased, to $148bn in FY 2005 from $103bn in 2001. However the US Under Secretary of Defense, Gordon England, recently ordered all US military services to find $32.1bn in budget savings over the next five years. The Pentagon is currently undertaking a review of all of its programmes, in particular those with significant cost overruns. In that context, several high-profile DoD space projects such as the Space Based Infrared System - High (SBIRS-High), the Future Imagery Architecture (FIA) and the National Polar-orbiting Operational Environmental Satellite System (NPOESS) are several billion dollars over budget and several years late. These programmes face restructuring measures.

A second factor, which is a consequence of the first, is that Congress appears to be critical of DoD space procurement. Consequently it is hesitant about allocating funds for new developments such as the Space Radar or the Transformational Satellite (T-SAT) constellations. Congress cites several reasons contributing to the cost overruns on these DoD space systems: lack of systems engineering, poor cost estimation and budgeting, lack of skilled procurement officers, and difficulties in monitoring the way prime and sub-contractors manage the technology content of such systems. The Under Secretary of the Air Force, who is responsible for military space applications, is expected to present a plan of action in the first part of 2006, detailing cost-control measures for DoD space projects.

During a hearing of the US House of Representatives' Science Committee on 3 November 2005, the NASA Administrator stated that NASA will have a Space Shuttle budget shortfall of $3bn to $5bn for the period 2007-2010. The Administrator insisted on the fact that without a steady increase in the total NASA budget over this period, he would be unable to deliver the programmes attached to the new NASA priorities: development of a Crew Exploration Vehicle and a Crew Launch Vehicle to succeed the Shuttle; completion of the International Space Station involving 18 Shuttle flights; continuation of the NASA science programme (mainly space and Earth science) and aeronautics programme. With the adoption of new NASA Authorisation legislation, Congress is showing signs of support for bringing the NASA total budget to $17.9bn for FY 2007, and $18.7bn for FY 2008.

POLICY

Over the past three years, the White House has carried out an intensive sector-by-sector revision of policy, leading to the publication of four policies for space: the commercial remote-sensing policy of 23 April 2003; the vision for space exploration of 14 January 2004; the space-based positioning, navigation and timing policy of 15 December 2004; and the space-transportation policy of 6 January 2005.

The White House is currently leading an interagency exercise to review the content of national space policy, which dates back to 1996, and aims to publish an update in the coming months. It will indicate how the US administration is translating the new sector-by-sector directions into a more general framework, as well as highlighting potential new US priorities in space. For example, the DoD has in recent years initiated a series of steps to implement space control measures, but a space control doctrine has yet to be formalised. The latter will call for the surveillance of space to protect the nation's space assets and implement temporary or permanent denial of access to space to an enemy. In that context, the US Missile Defence Agency (MDA) is developing a Space Tracking and Surveillance System (SSTS) for missile detection and space-based surveillance services. MDA plans to launch the first two SSTS satellites in spring 2007. Another example is DoD development of the Counter Satellite Communications System, a ground-based jamming capability to temporarily deny access to telecommunications satellites. It remains to be seen whether the US will move further in the implementation of these space control measures.

REORGANISATION

Several major developments are currently affecting the US defence and intelligence space sector, and could potentially influence this sector's strategy and programmes in the years to come. The first change relates to recent organisational decisions. From 2001 to mid-2005 the Under Secretary of the Air Force had three main missions: managing space procurement strategy for all DoD space programmes (a function called Executive Agent for Space), managing US Air Force (USAF) space programmes, and heading the US National Reconnaissance Office (NRO). In mid-2005, the Pentagon decided to separate these functions. Now the Under Secretary of the Air Force is still the DoD Executive Agent for Space and general manager of the Air Force's programme, but the Director of the NRO is now a stand-alone position. The US administration clearly considers it a full-time position, involving daily operational decisions that cannot be constrained by other general DoD responsibilities. Furthermore, the position of Director of National Intelligence (DNI) was created in 2005 to coordinate all US intelligence activities – a function suggested following the review of the intelligence sector after 11 September 2001. The DNI is responsible, among others, for coordinating the activities of several US intelligence agencies managing space projects and/or using satellite data, such as the NRO, the National Security Agency (NSA), the Central Intelligence Agency (CIA) and the National Geospatial-Intelligence Agency (NGA). The DNI has recently started considering several important space-related decisions such as reform of procurement for the Future Imagery Architecture (FIA) and the next generation of optical/radar intelligence satellites.

NASA reorganised itself following the arrival of the new NASA Administrator, Mr Michael Griffin, in April 2005. A new management team has been formed with a new top-level structure. The Administrator is assisted by a Deputy Administrator, responsible for general issues such as NASA's external relations, and an Associate Administrator, in charge of NASA centres. The management of NASA programmes has also changed, with greater devolution of certain functions. Each programme retains a reduced leadership at NASA Headquarters, for general guidance, whereas programme integration and project implementation are assigned to specific NASA centres.

PROGRAMMATIC AREAS

The US space-transportation sector is evolving rapidly. With restrictions on the USAF budget for space in recent years, in particular for work on the two Evolved Expandable Launch Vehicles (EELV), further consideration has been given to merging EELV operations to reduce fixed costs. On 2 May 2005, Boeing and Lockheed Martin announced the creation of a 50-50 joint venture, called United Launch Alliance (ULA), to combine the production, engineering, test and launch operations associated with the US Government launches of Delta and Atlas launchers. In particular, this announcement was designed to emphasise that ULA joint operations would save the US Government from $100m to $150m on use of the two EELVs, namely Delta-4 and Atlas-5. On two occasions between September and November 2005, Boeing and Lockheed Martin had to withdraw their filing for approval before the US Federal Trade Commission (FTC), to answer Government requests for more information and guarantees of fixed-cost savings. The ULA announcement also attracted European interest. Following an investigation initiated in July 2005, the European Commission decided on 18 August 2005 not to oppose the ULA joint venture under the EU Merger Regulations, stating that ULA "does not increase the risk of coordinated behaviour compared to the situation pre-merger". Although the scope of ULA operations is restricted to selling launch services to the US Government market, it remains to be seen how this joint venture will affect marketing of commercial Delta and Atlas launchers. The European Commission will therefore continue to monitor ULA developments and any further consolidation effects of ULA activities.

US space transportation has also changed following decisions in the US civil space sector. On 19 September 2005, the NASA Administrator announced the results of the Exploration Systems Architecture Study (ESAS), commissioned on his taking office earlier in the year. ESAS outlines the content of the new NASA human space-transportation architecture, slated to succeed the Space Shuttle. NASA decided to take a 'go-as-you-can-pay' approach to initiating accelerated development of the Crew Exploration Vehicle (CEV) and a Crew Launch Vehicle (CLV) based on Shuttle-derived developments. NASA's goal is to deploy the CEV no later than 2012, thus leaving a gap of only two years between the end of Shuttle operations in 2010 and the arrival of the CEV. Although the CEV will make its first flights to the ISS, its primary goal is to support week-long missions to the Moon starting in 2018. Several measures were taken this year to redirect funding for longer-term research and technology within NASA's Exploration Systems Mission Directorate to allow the Agency to award a prime contract for the CEV by mid-2006. This is now NASA's top priority. Looking further ahead, NASA plans to develop a Heavy-Lift Launch Vehicle to support future Moon missions. This decision, and the CLV decision, was taken after NASA and DoD reached an understanding on the use of launchers. NASA would use Air Force EELVs for its scientific missions, while NASA would retain full authority over its own CLVs and HLLVs.

At the same time, in the summer of 2005, NASA announced that it would be undertaking 18 Shuttle flights until 2010 to complete the International Space Station (ISS), with a possible flight to repair the Hubble Space Telescope.

In the field of satellite navigation, the DoD and the US Department of Transport (DoT) are reviewing options regarding the development of the GPS III constellation. The main purpose of this review is to define the civil role of the future GPS III and investment coordinated by the DoT. The resulting decision will certainly be of prime importance, in view of the implementation of the Galileo-GPS cooperation agreement. The USAF is targeting the first launch of a GPS III satellite for 2013, and is currently planning to issue a Request for Proposals for the next phase of the GPS III architectural definition by mid-2006.

AIR FORCE SPACE COMMAND STRATEGIC MASTER PLAN

The USAF, generally considered to be the World's largest space agency, deserves specific attention. Its Space Command produces regular updates of the Strategic Master Plan, which forms the keystone of the Command's Integrated Planning Process. It presents the USAF vision, outlines a strategy to implement that vision, and defines a 25-year plan, integrated across the various mission areas to provide the space capabilities required to achieve the vision.

Drawing on the classified Threat Capabilities Assessment, the USAF pinpoints three key conclusions regarding future access to space and associated threats:

- The US military depends on national and commercial space systems operated by domestic and foreign organisations (or international consortiums). Offensive operations to disrupt or deny access to these systems could seriously affect US ability to fight a war.

- Space systems are potentially susceptible to offensive counterspace (OCS) operations

- Potential adversaries could challenge US access to space by taking advantage of a range of OCS capabilities within their technological means.

These offensive capabilities could include: denial and deception, ground-station attack and sabotage, electronic attack, and direct attack on the satellites themselves.

Finally, as commercial space capabilities mature, many areas may be useful to the military. However, the core or distinctive capabilities must remain as military capabilities, while other limited needs may be satisfied through the purchase of services or partnerships with civil and commercial entities. Effective military use of civil and commercial space capabilities will require new partnerships and an understanding of the capabilities and operating constraints of commercial firms and consortiums, perhaps leading to new policies for sharing civil and commercial space information.

As the USAF implements its vision fully to exploit space as a space combat command, the Space Command will become a significant force provider of Counter Space, conventional and strategic prompt global strike capabilities with even greater force enabler capabilities.

Default space control will not continue in the future as potential adversaries come to better understand the great advantages that space capabilities provide and recognise how increasing US dependence on space represents a vulnerability they need to exploit. The challenge is then to strengthen the base of space capabilities with operationally responsive spacelift, robust launch, satellite control and Space Situational Awareness.

TRANSATLANTIC SPACE COOPERATION

Science and the ISS remain the backbone of ESA-NASA cooperation. Regarding space science, continued communication and coordination with NASA provide for close project-by-project monitoring and implementation. In 2005, the highlight of ESA-NASA cooperation in this field was the spectacularly successful Cassini/Huygens mission. Regarding the ISS, the US took several steps to meet its obligations. The Iran Non-Proliferation legislation of 2000 was amended to allow NASA to procure ISS-related goods and services from Russia. In July 2005, NASA completed the first part of the Shuttle return-to-flight exercise with STS-114. It is now preparing a new Shuttle flight (STS-121) for 2006 to confirm the vehicle's

return-to-flight status. This step, which includes extended work on the Shuttle's external tank, in conjunction with NASA's budgetary planning for the next five years, is critical for the future of the European contributions to the ISS itself and the ISS partnership as a whole.

The Galileo-GPS Agreement of June 2004 led to the setting up of several working groups to follow up its implementation. Some of them have started meeting regularly to discuss technical issues.

ESA and NOAA are closely coordinating aspects related to establishing a Global Earth-Observation System of Systems (GEOSS). This process is now expected to include a review of potential synergies between GMES and the US Integrated Earth-Observation System (IEOS), which is the US contribution to GEOSS.

On several occasions, the NASA Administrator has spoken about its approach to international cooperation on future lunar missions. He has made it clear that the USA is committed to building an 'interplanetary highway' consisting of the CEV and CLV, a Heavy-Lift Launch Vehicle, transfer stages and lunar landers. NASA does not want non-US participation in the development of this space-transportation infrastructure. However, it would welcome cooperative undertakings for lunar-surface activities. The NASA Administrator has indicated that these could include "lunar research stations of international design and construction, possibly in much the same fashion as occurs in Antarctica today, habitats, power and science facilities, rovers, fuel depots, communications and navigation systems, in-situ resource utilisation equipment and back-up life-support systems".

During the last EU-US summit, on 20 June 2005, both sides agreed to initiate a dialogue on civil space cooperation as part of the "European Union and United States initiative to enhance transatlantic economic integration and growth". This dialogue is expected to start in the early part of 2006, and will encompass an exchange of information on respective space policies and discussions regarding several areas of cooperation.

Export-control regulations continue to constrain transatlantic space cooperation. Changes to US legislation are not expected in the short-term and discussions continue on how best to support continuing cooperation.

5.1.2 Russia

The 15th EU-Russia Summit was held in May 2005. President Putin hosted the meeting. Prime Minister Juncker, in his capacity as President of the European Council, represented the EU. At the summit the two sides reviewed work on establishing various 'Common Spaces': the Common Economic Space; the Common Space of Freedom, Security and Justice; the Common Space of External Security; and the Common Space on Research, Education and Culture. To ensure they are smoothly implemented, specific roadmaps were adopted for each of the above-mentioned common spaces. The Common Economic Space covers space matters.

At the 16th EU-Russia Summit in London, on 4 October 2005, President Putin underlined the technical and economic potential of working closer together on space-transportation systems/launchers and satellite navigation (Galileo/Glonass).

THE BUDGET OF THE FEDERAL SPACE AGENCY (ROSKOSMOS)

The Russian Government finally approved this year the new 10-year Federal Space Programme (FSP) for the period 2006-2015, which was ratified by the State Duma. The new plan

foresees a total of €9.2bn to be allocated over the next ten years. The FSP sets the following targets:

- Complete development, modernisation, and commissioning of a new generation of space telecommunications and broadcasting systems.
- Upgrade meteorological Earth-monitoring data provided by geostationary satellites to real-time mode.
- Increase resolution of Earth-observation satellites to 1 metre and observation frequency to once every eight hours.
- Implement 11 national and five international fundamental space-research projects.
- Complete assembly of the ISS Russian segment.
- Continue operation of the upgraded Soyuz and Proton launchers and commission the new Angara launcher.
- Extend the service life of GEO satellites to 15 years, and that of LEO satellites to five to seven years.
- Start development and construction of a new generation space-transportation vehicle to serve the ISS programme and take part in future manned missions to the Moon and beyond (Clipper).

Federal Space Programme (FSP) – implementation expenses in 2004-2006 (M€)

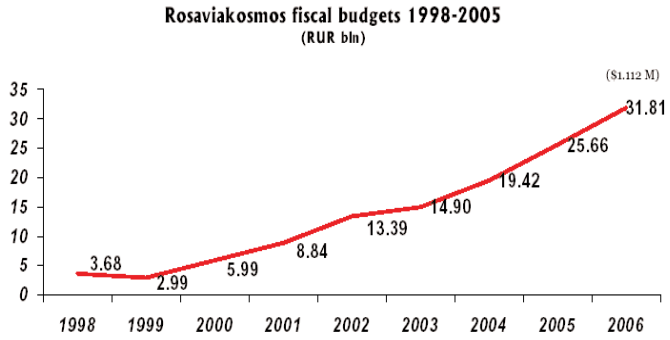
	2004	2005	2006
FSP total	**411**	**548**	**690**
Procurement of special space equipment, organisation of launches and spacecraft control functions	34	38	93
Government support to space activities to meet Federal needs	30	50	55
Government R&D contract expenses	314	424	498
Construction facilities to meet the needs of the industry	33	36	44

R&D expenditure has always been specifically identified in the FSP. These expenses will exceed €490m in 2006, accounting for about 72% of the total, some 18% higher than in 2005[3]. A further €90m will be spent on procurement of special space equipment, organisation of launches and spacecraft control functions (2.5 times more than in 2005).

With respect to space science, some funding has been awarded to the ambitious projects listed in the 2006-2015 FSP (the budget for space science is growing steadily every year), but not enough to fully implement all the projects announced. The scientific community, in conjunction with Roskosmos, is eager to find support from international partners, and if not from Europe and the USA, then from other countries (China, India). This is true also of the future manned-spaceflight programme, including missions to the Moon and Mars.

[3] In comparison, Russia plans to allocate €108m to R&D in aviation in 2006 under three Federal Target Programmes.

The total 2006 budget is estimated at approximately RUR 23 billion, equivalent to €950m, of which €690m is earmarked for FSP-2015. At this level of spending, Russia can carry out 21 to 23 launches a year. This confirms Russia's level of efficiency in some areas, such as launch services, thanks to considerable experience and lower payroll costs than in the West. However, according to Roskosmos, 62 out of the 96 spacecraft in orbit are well past the end of their service lives and need to be replaced, as is also the case for production equipment and operational control facilities.



*includes Rosaviakosmos/Roskosmos

Russia has increased international cooperation with Europe on launcher development and offered ESA the chance to participate in development of the manned Clipper vehicle. It has extended similar invitations to Japan and China. More particularly, Russia has sought in recent years to increase cooperation with India on space matters. With regard to its Glonass positioning, timing and navigation system, Russia has made it a strategic priority, the aim being to increase the number of operational satellites, since their number fell from 26 in 1995 to only seven in 2001. According to sources in Russian space industry, Russia intends to work closely with India on a new generation of Glonass satellites. In accordance with the Intergovernmental Agreement for cooperation and development of the navigation system Glonass signed in December 2004, there should be 18 satellites operational by 2007 and a fully operational constellation by 2011. With the launch of three Glonass satellites at the end of December 2005, the Russian system will be competing directly with the US GPS and European Galileo systems. The Russian Government has consequently passed a law obliging Russian consumers only to use Glonass-compatible terminals from 2006. As dual-system equipment is permitted, the law seeks to prevent the market being flooded with equipment receiving exclusively GPS and Galileo signals. Further cooperation with India was agreed at the end of 2004, encompassing intellectual-property rights and technology safeguards, exploration activities and the use of outer space for peaceful purposes.

5.1.3 Japan

Since the 1970s, Japan's main partner in space cooperation has been the United States, but the policy framework that governs the two countries' interaction on space policy has evolved in the past few years to reflect new conditions. New threats and uncertainties have emerged in East Asia, altering Japan's outlook on national security. North Korea's efforts to develop or acquire weapons of mass destruction has forced the USA to refocus its attention on East-Asian security and reminded Japan of the need for US involvement in the region. Both the USA and Japan are wary of China's long-term ambitions. These perceived threats have major implications for space policy. Even after the launch of its own reconnaissance satellites, Japan still remains dependant on the USA for high-grade space imaging. This mutual dependency will probably lead to a shift in priorities for US and Japanese policies on space cooperation, with greater focus on security issues. Another change in relations between the two partners concerns the issue of export control and technology transfer. It has been established that a large proportion of the components in North Korean missiles were

smuggled through Japan, which might make the USA even more reluctant to transfer technology to Japan.

Although Japan will continue space cooperation with the United States on a large scale, it seems increasingly to be seeking to diversify its relations and strengthen links with the Asia-Pacific region and Europe, a trend it would be a mistake to ignore. Europe should foster strategic links with Japan. There are several cooperation possibilities for ESA and Japan, particularly in the fields of Earth observation and space science.

Several factors have prompted lively debate inside JAXA: the launch of the US lunar and Mars exploration initiative; China's recent successes in manned spaceflight; discussion of ambitious space projects in Europe. It was in this context that JAXA published, in March 2005, its Long-Term Vision, which outlines the main objectives for JAXA activities for the next 20 years. The document highlights five main objectives. Firstly, to contribute to building a secure and prosperous society through the utilisation of aerospace technologies. JAXA intends to develop new satellite systems for natural-disaster mitigation, which Japan would share with countries of the Asia-Pacific region. Secondly, to contribute to advancing our knowledge of the Universe and broadening the horizon of human activity. JAXA plans to launch various missions to observe the Milky Way, black holes, Venus and Mercury, and pursue exploration beyond the Solar System. Thirdly, to develop the capability to carry out autonomous space activities using the best technologies in the World. It is crucial for Japan to develop reliable manned and unmanned space transportation to be able to carry out autonomous manned space activities. The current uncertainties concerning the future of the ISS are likely to strengthen JAXA's determination to develop autonomous space transportation. Fourthly, to facilitate growth of the space industry with self-sustainability and World-class capability. JAXA wants to support the private sector by developing competitive, dependable launchers and satellites. Lastly, to facilitate the growth of its aviation industry and seek a technological breakthrough in future air transportation.

To implement its Long-Term Vision, JAXA intends to actively promote cooperation with the USA, Russia, Europe and Asia-Pacific countries. The aim of increased cooperation with the first three partners is to increase the efficiency of Japanese space projects. Thanks to cooperation with the Asia-Pacific region on disaster management and environmental protection, JAXA hopes to promote the image of Japan as a reliable partner for its neighbours, while presenting itself as a prime regional space agency.

5.1.4 China

China is increasing investment in its space programme, in line with the country's economic development. It can no longer be considered an emerging space power, having established itself as a fully fledged player. Several organisations in China are undertaking space projects, although they are not always perfectly coordinated. In 2005 many bodies, reporting to various ministries, submitted space projects to the State Council in preparation for the 11th Five Year Plan for the period 2006-2010.

After the first manned spaceflight in 2003 and the successful launch of the second Shenzhou capsule in October 2005, carrying two astronauts, China has become the third nation after Russia and the USA to put men into space. It has recently announced plans to launch another Shenzhou mission in 2007, to carry out extra-vehicular activities.

In discussions with Chinese space authorities, different views are expressed on what comes next. While no-one seems to dispute the political importance of the Shenzhou programme in demonstrating China's scientific and technological excellence,

some seem to feel that only an international manned space endeavour makes sense. There is also concern that continuing the Shenzhou programme would take substantial resources away from other application-oriented space programmes needed for the country's further development.

A visit to the newly developed CAST facility just outside Beijing provides an indication of China's political determination of China regarding space. Equipped with the latest technology, the facility has several parallel integration channels.

Prior to the launch of China's 11th Five Year Plan, 2006-2010, the following space plans are being discussed:

- A new series of modular Long March launchers, with increased capacity, but with decreased non-toxic pollution (GTO 14 ton, LEO 25 ton).

- Development of a new EO system similar to GMES for meteorology, and monitoring marine and natural resources. It will also establish a new reception and ground station and a processing centre.

- Modernisation of its telecommunications satellite fleet thanks to an updated DFH4 satellite bus.

- The Shenzhou programme will continue with a launch in 2007, on which the astronauts will carry out extra-vehicular activities.

- China will also develop its Chang'E lunar programme consisting of three phases by 2020. In the field of space science, China will concentrate on interactions between the Sun and Earth. It plans to launch a hard-X-ray modulation telescope in 2010. France and China are discussing possible cooperation on a high-energy detection mission (SMESE) to study space weather. China is also planning to develop a Space Solar Telescope and the Kua Fu mission – for the study of the magnetosphere. All of these missions will form part of a Chinese Space Science System that CNSA is currently developing with the relevant specialist organisations.

- Microgravity and life-science missions will be carried out using recoverable capsules.

The first Chinese satellite was launched in 1970, with some 75 satellites following since then. The research budget increased by some 20% from 2003 to 2004 (to €18bn, or 1.35% of GDP). In all, technology companies employed more than 55 million people in 2004.

Further plans include putting three taikonauts into orbit in the next two years. China also plans to launch a space-station module by 2012, establishing an interim station as early as 2007, with the prospect of a manned flight to the Moon.

China is currently discussing cooperation with Russia on various projects such as a joint orbital station, robotic and manned Moon flights and landings, and a possible Mars orbiter in 2008-09 and a lunar orbiter in 2012.

5.1.5 India

India's space programme is moving forward steadily. The Government set up the Space Commission and the Department of Space (DOS) in June 1972 with the primary objective of promoting the development and application of space technology and space science to accelerate the nation's social

and economic development. Indian space-programme policy is framed by the Space Commission and implemented by DOS through the Indian Space Research Organisation (ISRO), the National Remote-Sensing Agency, the Physical Research Laboratory, the National Mesosphere-Stratosphere-Troposphere Radar Facility, and other agencies. Both India and Europe are at the cutting-edge of research in the field of space technology, and there is considerable scope for promoting collaboration and building an appropriate environment for fruitful cooperation in the space sector (Earth observation and remote sensing to monitor natural resources and the environment, communications, meteorology, navigation, life and material sciences under microgravity conditions, space exploration, space science and any other area relevant to respective space programmes).

The year 2005 ended for ISRO with the successful launch, by an Ariane-5, of INSAT-4A, the most advanced satellite intended for direct-to-home television broadcasting services. The launch of the highly sophisticated remote-sensing satellite, CARTOSAT-1, along with a micro-satellite, HAMSAT, and the commissioning of the state-of-art Second Launch Pad at Satish Dhawan Space Centre SHAR, Sriharikota were other major events during the year. The space-application programme continued with the start of several programmes using EDUSAT, further expansion of the Telemedicine network and the establishment of Village Resource Centres. Design work on a Deep-Space Tracking Network Station near Bangalore was completed in 2005 and construction started.

Cooperation between Europe and India has increased considerably in recent years. India has concluded an Agreement with the European Union on cooperation in Galileo.

In June 2005, following approval by ESA Council, the Agency's Director General and ISRO's Chairman signed an Agreement, in Bangalore, on cooperation on India's Chandrayaan-1 lunar mission. This will be India's first scientific mission to the Moon. Three European experiments, out of a total of seven, will be flown on the mission, due for launch in 2007: a low-energy X-ray spectrometer, a near-infrared spectrometer, and a sub-keV atom-reflecting analyser. Unfortunately, some of the contributions in-kind Europe was supposed to be making under the Agreement will not be ready in time to meet ISRO deadlines, and ESA has informed ISRO of this setback. The Chandrayaan-1 probe will also include a lander to test conditions for future manned missions to the Moon.

ESA and ISRO have also discussed exchanging IRS P6 data for Envisat data as part of ESA's Third-Party Missions programme.

As for other partners, India and Russia signed four Agreements on space and defence cooperation during Indian Prime Minister Manmohan Singh's visit to Russia in 2005. Mr Singh joined the annual summit that is part of the India-Russia strategic partnership. Proposed agreements include a tie-up between the space agencies on joint use of Russia's space-based Global Navigational Satellite System (Glonass). Similarly, the US State Department has actively sought to develop space cooperation with India over the past year, and several large delegations have visited Bangalore to identify possible cooperation projects. In the civil space area, both sides have discovered a realm in which their respective abilities and talents can be showcased without either nation having to put any of its core interests and principles at risk. Early reports indicate that India is willing to work closely with the USA on its Chandrayaan-1 Moon probe.

Indian Space Budgets

	Actual 2003-2004	Revised Estimates 2004-2005	Budget Estimates 2005-2006
Space Technology	269,39M€	308,98M€	397,70M€
Space Applications	39,17M€	56,36M€	62,49M€
Space Sciences	12,24 M€	26,91M€	44,95M€
INSAT (Operational)	88,69M€	63,99M€	58,08M€
Direction and Administration	10,34M€	13,92M€	19,40M€
Total	419,85M€	470,19M€	582,64M€

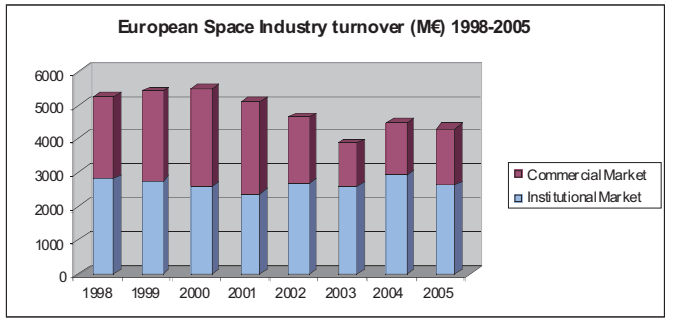
5.2 Industry and Markets – Europe's competitiveness on a global scale*

In contrast to captive institutional markets, the commercial market attracts strong competition for international launch services and the manufacture of space hardware. The two main manufacturing components are the satellite and launcher sectors. It also comprises the launch services industry and, further down the value chain, private operators offering satellite capacity to the value-added market.

The performance and competitiveness of European industry in the global commercial marketplace is all the more important as commercial revenue accounted for about 50% of the total between 1997 and 2001. With little recent growth in institutional civil or defence-oriented revenue, relatively modest at the best of times, European industry is particularly fragile when faced with a commercial downturn. Consequently, it is at an immediate disadvantage to its US counterpart, for which commercial revenue accounts for less than 15% of the total. High Government spending on defence-related space activities counteracts cyclical dips in the market by sustaining demand for space systems. Similar trends are apparent in Russia, which is strengthening its institutional market, with China and India following suit.

In addition, the US DoD is the World's single largest purchaser of commercial satellite services. For instance, more than 80% of military satellite communications from the Persian Gulf area are transmitted via commercial satellites.

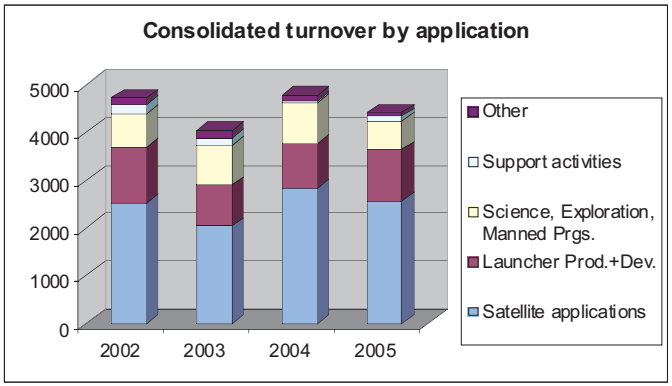
After the sharp decline in commercial markets in recent years, with a market slump in 2003, the overall picture started to improve slightly in 2004. Yet, after a 18.9 % increase in 2004, the situation as to the overall turnover of the European space industry has worsened again in 2005. Figures indicate that overall turnover has fallen from 4785 M? in 2004 to 4415 M? in 2005. Mostly affected was the satellite business, i.e. system integrators and equipment suppliers, the former showing a business reduction by some 13.1.%.



(Source: ASD/Eurospace)

With some 2573 M? of turnover (as opposed to 2840 M? in 2004) satellite applications accounted for over 50% of the overall industrial turnover in 2005, including RTD programmes and operational systems/parts. Telecommunications represents

*Latest figures presented for 2005 are based on ASD-Eurospace Fact and Figures 2006 (released May 2006).



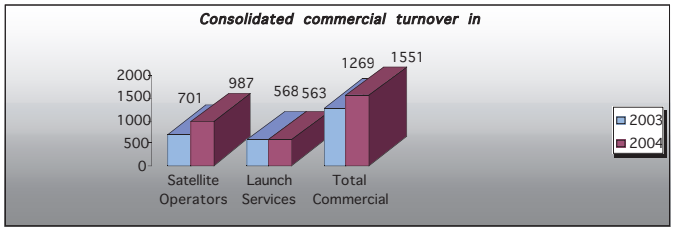
(Source: ASD/Eurospace)

the largest part with some 1561M€, followed by Earth Observation applications (804M€) and Navigation (207.6M€).

Overall revenue levels are thus still far below those for 1997-2002, with commercial revenue barely reaching its 1995 level. Furthermore growth in commercial revenue is heavily dependent on increased revenue from services, rather than hardware sales. Consequently, and despite productivity gains, employment figures dropped further in 2004 to 30,523 staff and 27,884 staff in 2005, i.e. a drop of some 8.6% within one year and some estimated 20% in loss of employment from 1997 to 2005. While there is reduction of employment at nearly all levels of the supply chain in 2005, 2044 out of 2640 jobs have been lost at the level of system integrators.

Competition for commercial contracts is expected to increase further with countries such as China, India and Russia restructuring their firms, to make them more competitive. The commercial market will continue to see stiff competition, cyclical and abrupt changes, and fluctuating global demand.

Looking more closely, the commercial market is supported by private funds managed by commercial operators. It consists of two segments: the satellite segment, primarily GEO satellite sales; and the launcher segment, mainly sales of Ariane launcher hardware.



(Source: ASD/Eurospace)

The GEO satellite business is slowly recovering after a dramatic downturn in 2003, but is still fragile with global demand for new commercial satellites still low. In this already difficult context, Europe must cope with strong US competition. The satellite manufacturing industry there can lower its prices for commercial sales thanks to protected access to the strong US institutional market for GEO satellites. Similarly, their R&D costs are better covered. Consequently, the launcher production business was also hampered by the commercial downturn, aggravated in Europe by the failure of the qualification flight of the Ariane-5 heavy-lift version in late-2003. After the successful re-qualification of Ariane-5 in 2005, the prospects for 2006 are looking much better. Arianespace, which has launched 60% of the communications satellites currently in orbit, will be able to fully exploit the launcher, which should spearhead European launch services over the coming 15 years. It will be helped by the Ministerial decision in Berlin ensuring that European missions are always compatible with at least one ESA launcher, including the future Soyuz at CSG and Vega launchers. But there are still many risks, in particular a lack of institutional launches on the European side, despite the Galileo and GMES initiatives, and the Dollar-Euro exchange rate differential, rockets being bought in Euros and sold in Dollars, making them 15% less competitive. Production costs are still very high too, due to higher wages than in Russia, Ukraine, India or China, and it is difficult to maintain skills due to the lack of large-scale development programmes.

While there has been progress towards reducing launch costs, and flexibility has been maintained to decide on a possible Ariane-5 evolution after a reappraisal of the commercial market in 2008, reliability and costs will have to be improved further and kept down in comparison to direct competitors, in particular the Russian launchers (Proton, Sea Launch). Developments in Asia are equally challenging, with India – formerly a dependable Ariane-5 customer – planning to launch its first communications satellite on a national launcher in 2006, and aiming to also have a heavy-lift launcher operational by 2008.

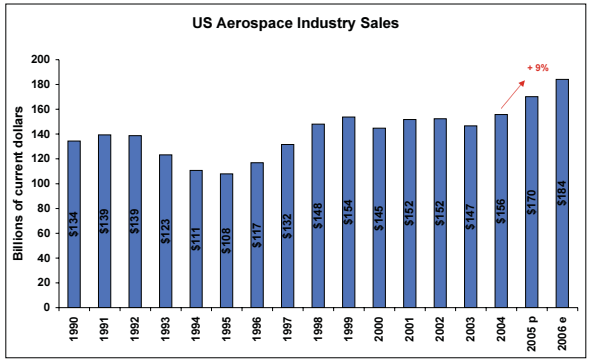
India would then be able not only to launch its own satellites, but to compete in the already restricted global commercial market. China, though hampered by US ITAR regulations, can launch some non-ITAR satellites and has mastered the full gamut of launchers, with a substantial number of launches every year.

Until recently, Japan purchased its communications satellites on the open market and generally used Ariane to launch them. But in October 2005 a Japanese operator placed an order for a commercial satellite with Japanese firms, and JAXA has signed an agreement with MHI to commercialise the H-2A national launcher. In the medium-term, Japan may succeed in lowering production costs and roll out a heavy launcher in 2008. Further competition can be expected from other countries seeking autonomous access to space, such as Brazil, the two Koreas or Iran, looking even further into the future.

5.2.1 United States*

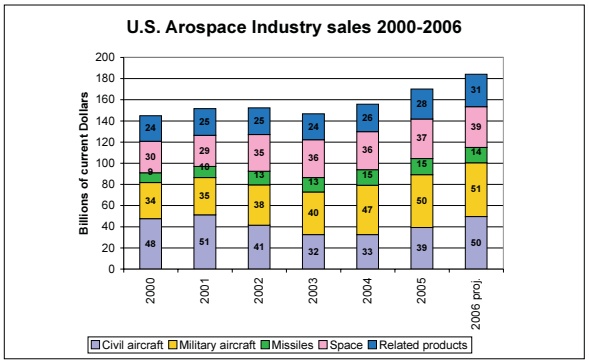
In 2005, the United States aerospace industry generated a record $170bn in sales, up 9.2% from $156bn the previous year. Profits rose in 2005 to an estimated $11bn, the highest level ever. Aerospace-industry profit margins increased too, to 6.2%. Profit margins for the US manufacturing sector as a whole (7.5%) exceeded the aerospace industry's performance.

The US aerospace industry's three main sectors – aviation, defence and space – all showed strong growth. The civil-aviation sector gained in strength, with US airlines buying new planes, the Vision for Space Exploration gave new impetus to space technology, and Department of Defense purchases logged their eighth successive year of growth. In a remarkable reversal from just a few years ago, civil aircraft pushed up 2005 sales, whereas military aircraft revenue levelled off after several years of robust increases. Aerospace industry sales to NASA and other governmental US Agencies increased by about 9% in 2005.

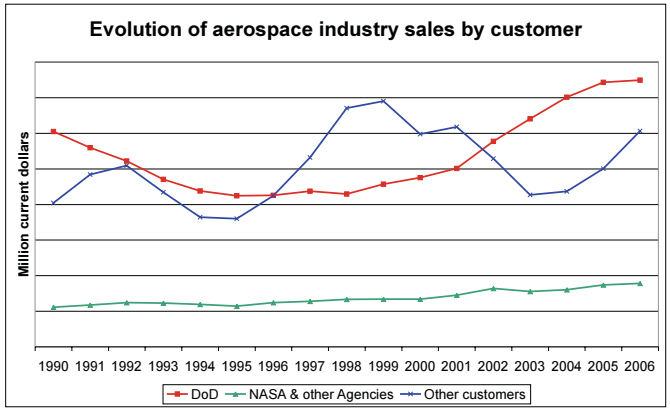


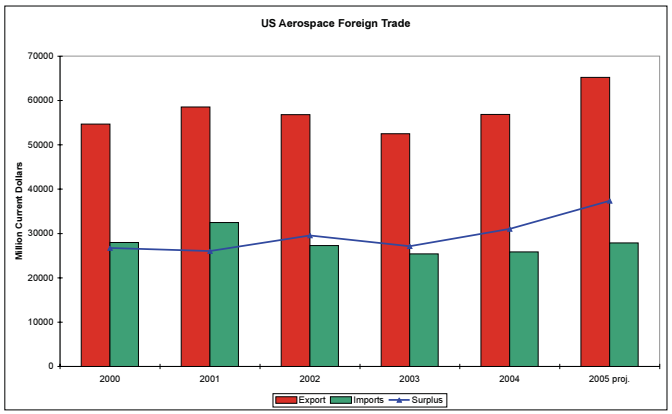
Forecasts suggest that 2006 will be another record year. The US aerospace industry's recovery is still on course, but real sales growth is expected to slow as the surge in civil-aircraft revenue is partly offset by lower military-aircraft sales. Aerospace sales to NASA and other non-defence federal agencies are expected to grow to a record $17.8bn.

Looking at the evolution of US aerospace industry sales by product (Graph 2), sales of civil aircraft enjoyed the highest growth in 2005 (+20%), while rising DoD procurement and record RDT&E (Research, Development, Test, and Evaluation) spending was largely responsible for sales growth in the military-aircraft sector during the year.



*All figures in this sub-chapter are provided by the 'Aerospace Industries Association's 2005 Year-End Review and 2006 Forecast.

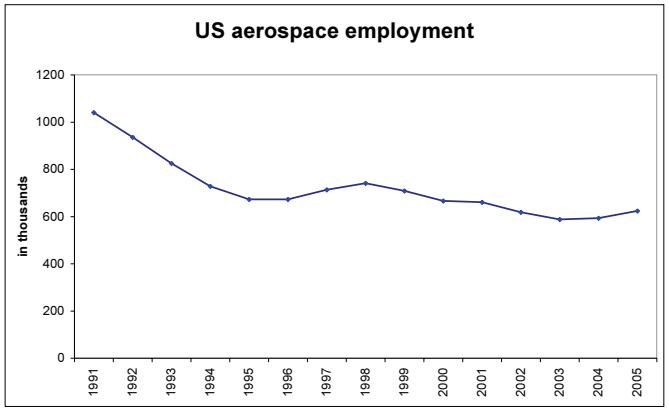




Space-sector sales increased by 3.8% to a record $37bn in 2005. NASA and other non-DoD federal agencies accounted for the entire increase. Though DoD space spending increased, it was offset by declining commercial space sales. Next year the space sector is expected to achieve sales equivalent to 2005.

Aerospace remains one of the most important sectors in the US economy, registering a positive trade balance of $37bn. This reflects a $6.4bn increase on last year's surplus. Aerospace is one of the economy's few manufacturing sectors that consistently shows a foreign-trade surplus, posting the highest positive balance of all US industry categories in 2004. Specifically, civil aerospace exports increased by about 18% to $55bn after ending a two-year slide last year. On the other hand, space-related exports declined $206m to an estimated $390m. Imports increased by 8% after two years of decline.

The industry's rebound has helped boost overall US employment levels. After reaching a 50-year low a year earlier, total employment, on an annual average basis, totalled an estimated 623 900 in 2005. Space and missile sector employment grew by 2500 to 72 900.



5.2.2 Russia

Data obtained from several reports made available to ESA's Moscow Office indicate that Roskosmos is currently engaged in forming 11 large integrated organisations (holdings) in the space and missile industry. Only some of them are identifiable at the present stage of formation:

- Rocket Engines: almost established, led by Energomash and KB Khimavtomatiki.
- Military Space Equipment: NPO Mashinostroyeniya.
- Satellite Information Systems: led by NPO PM and regrouping several State-owned satellite builders in Moscow, Omsk, Tomsk, Rostov-on-Don and Zheleznogorsk. The Government Defence Commission endorsed its incorporation in July 2005.
- Space Transportation Systems: to be led either by RSC Energia or Khrunichev Centre.
- Aerospace Equipment: already established, with some of the Roskosmos companies participating.
- Space Instruments: RNII KP with its partners and suppliers in Russia.

Several joint ventures involving Russian and foreign firms have been launched:

- EADS, Astrium and Tesat, and the Space Instrument Building Research Institute (RNIIKP) formed the Synertec joint venture at this year's Paris air show. Its prime aim is to promote synergy between European and Russian technologies, deliver payloads for

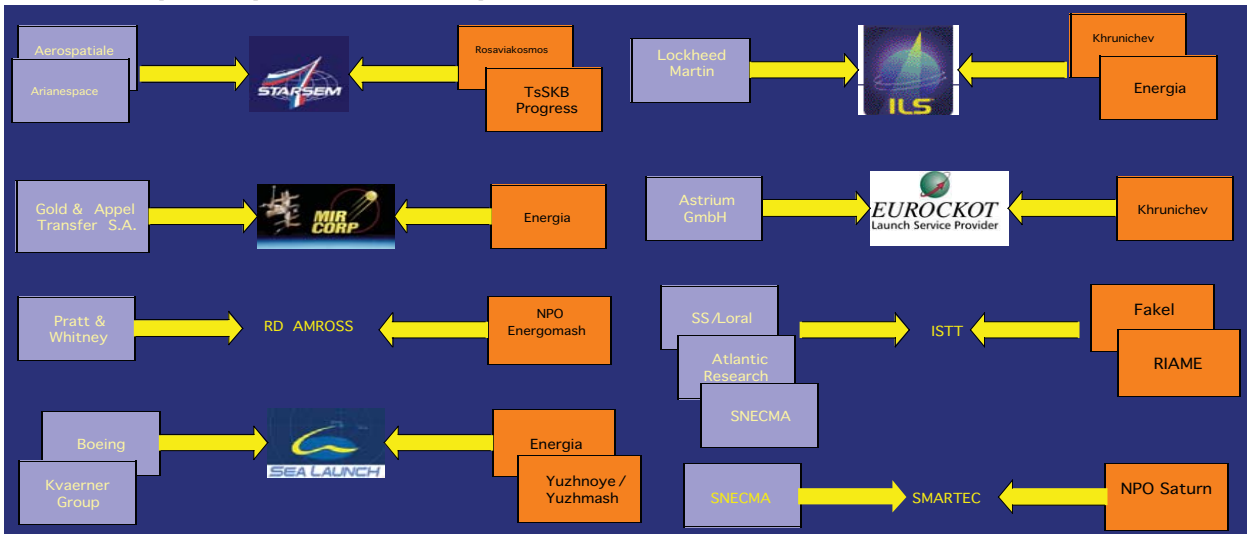
remote Earth monitoring satellites, train Russian specialists in Europe, and harmonise space-technology standards.

- KBTM and TsENKI, KB Yuzhnoye and Yuzhmash, RSC Energia and OAO Energoaviakosmos formed the Space International Services (SIS) Joint Venture for the implementation of a Land Launch Project to launch geostationary satellites from Baikonur with the Zenit launcher.

- NKAU, Yuzhnoe, YuMZ, Khartron, TsNIIMASH, ASKOND, Rosobshchemash, KBSM, KBTM - exploitation of Russian-Ukrainan Dnepr.

Discussions are also underway to set up other space joint ventures involving Russian and European firms.

Some examples of joint ventures in space



The following are among the Russian space industry's achievements in 2005:

- Approval of the Federal Space Programme for the period 2006-2015, thanks to contributions from industry, the first sign of strategic planning for a period exceeding five years in the Russian space sector.

- Russia is now recognised as the leader for manned spaceflight. Nations are queuing up to fly their astronauts to the ISS onboard Russian space vehicles. In 2005 Russia signed agreements to fly Brazilian and South Korean astronauts, backed by national funding, and a Japanese space tourist. The success of the Chinese manned space programme, largely based on Russian technology, offers further proof of Russian leadership in this field. Japan has expressed its willingness to join the Clipper project.

- The Soyuz launcher programme is making good progress, upgraded with a digital system and a larger fairing (Soyuz-2). The first launch of Soyuz-2 was successful and the next one will carry MetOp in mid-2006. A steady launch rate using the Soyuz-Fregat composite is providing Russian industry with a steady supply of work. Work on the Soyuz launch pad at Kourou is nearing the start of construction.

- The Russian telecommunications space segment has been upgraded with Express-AM, with Express-2000 now in development. Yamal-300 is at the Preliminary Design Review stage with RSC Energia.

- Glonass will be operational with 18 satellites by 2007, and fully deployed with 24 satellites by 2010.

- Scientific experiments onboard the ISS, though scaled back due to the inadequate number of crew members, are continuing, and construction of the new Russian scientific module is in progress.

Overall, given its showing in the first five years of the 21st century, the Russian space industry is looking much stronger than in the late 1990s. Positive steps have been taken to restructure the industry and increase efficiency. The negative impact of the financial crisis in 1998 has been completely overcome, largely due to international cooperation in space. In 2000, the vast majority of space activities were funded by earnings from contracts with the USA, Europe and other countries. The current situation is very different, with State orders accounting for about 50% of income, as part of a growing trend.

5.2.3 Japan

Japan's aerospace industry reported about JPY 1,148 billion yen of revenue for 2004, with JPY 907 billion for the aircraft industry and JPY 241 billion for the space industry. In the space industry, spacecraft (rockets and satellites) accounted for about 77% of total production. As for the underlying trends, the decline in space-industry revenue was mainly due to the failure of the H-IIA launcher in 2003. The space industry employs 5840 people and its sales are roughly equivalent to half those of the aerospace industries of the United Kingdom or France, and one tenth of US sales in that sector. More specifically, space sales associated with the satellite industry totalled JPY 140 billion, as against JPY 45 billion for launchers, JPY 15 billion for software, and JPY 41 billion for ground facilities.

In the space sector, Japan sees development of the H-IIA launcher as a top priority, but has yet to improve its reliability and competitiveness. To be competitive on the World market, the cost of H-IIA must be reduced, which means it may be a long time before it is commercially viable. An organisation has yet to be set up to manage the efficient production and commercialisation of the launcher. Following recommendations by the Space Activities Commission to achieve private leadership for launching activities, Mitsubishi Heavy Industries (MHI) will be the main contractor for H-IIA, taking responsibility for all activities, including production, commercialisation and launch services.

However, the transfer of H-IIA (launcher production and integration, launch services) from the public (JAXA) to the private sector (MHI), scheduled to occur on 1 April 2005, was delayed by the H-IIA launch failure in November 2003.

Japan is currently the fourth most prolific satellite-launching country after the USA, Russia and France. It has launched a total of 33 scientific and experimental satellites, under JAXA control. By the end of 2005, the total number of application satellites developed or launched will be 48 (meteorology, communication, broadcasting, resource exploitation, technological experiments, etc). Japan's space industry is also actively committed to the International Space Station Programme.

The Japanese space industry is facing a serious problem regarding the components used for its satellites and launchers. Production of more than half the components used by JAXA has stopped, because the Japanese companies producing them complain that the cost of production is too high for such low volumes. The problem is even more serious for semiconductors, with production of 120 out of 122 circuits having been halted. The main reasons cited by industry are its difficulty in forecasting future demand, given the uncertainty affecting Japanese space policy, the high cost of maintaining an adequate level of equipment, and the low productivity and profit margins

associated with small production volumes. For the time being, JAXA can rely on its existing stocks, but in the long run this predicament will become very tricky. Several Japanese firms have joined forces to find an answer to the problem of component provision for the Japanese space sector.

The USA has also threatened to interrupt export of some US components used for the H-IIA, reinforcing Japan's sense of fragility and dependency in this field. Japan has consequently turned to Europe in search of closer cooperation on components.

5.2.4 China

It is sometimes difficult to measure Chinese space expenditure exactly, as the figures are not completely transparent. It is widely believed that China's annual space budget amounts to about €1bn, excluding the manned space programme. Yet despite limited resources the recent achievements of the top Chinese space organisation, the Chinese Academy of Space Technology (CAST), which belongs to the Chinese Aerospace Corporation, are quite impressive.

CAST presents itself as a state industry. It was formerly part of the Chinese Government structure and it has maintained strong links with the Chinese National Space Administration (CNSA). Revenue in 2004 amounted to RMB 3.81 billion, rising to RMB 4.99 billion in 2005. The main technical centres and headquarters, with approximately 9000 workers, are located in the Beijing area. The recently built facilities have all the latest equipment in the various laboratories. Integration facilities are large enough to allow the integration of several satellites in parallel. CAST's main activities are spacecraft system design and manufacture, subsystem development and production, and atmospheric interceptor technology, environmental monitoring and ground-segment equipment. CAST is also involved in application-development and support activities.

CAST has been responsible for all the major space hardware produced in China. Since 1970 it has launched 72 spacecraft, with another 40 satellites and three manned spacecraft under development. It has developed all of China's telecommunications satellites too, as well as its recoverable satellites, space-science missions, manned spacecraft, Earth-observation satellites and meteorology satellites.

Recently, CAST has started selling telecommunications satellites abroad. Nigeria has bought a satellite that will be launched in 2007, with a design life of 15 years. It is equipped with 14 Ku-band, four C-band, eight Ka-band and two L-band transponders. An Agreement was recently signed between China and Venezuela for Venesat-1, a telecommunications satellite to be launched in 2008. It will also have a design life of 15 years and be equipped with 14 C-band and 12 Ku-band active transponders.

The other leading space industry is China Aerospace Science and Industry Corporation (CASIC), previously known as China Aerospace Machinery and Electronics Corporation. It focuses mainly on missiles and weapons systems, aerospace components and equipment.

For its access to space, China has developed the Long March (Changzheng) vehicle thanks to the China Academy of Launch Technology (CALT). Again, this is not really a private entity, but more of a State industry. It is presently developing the CZ-5, which will be China's next-generation heavy-lift launcher. The CZ-5 will meet requirements for delivering large payloads to LEO and GEO for the next 20 to 30 years. The launcher should be ready in 2010. The new generation CZ-5 will have a

modular design, with three primary modular core stages of 2.25, 3.35 and 5.0 metres diameter. Launchers with various capabilities will be assembled from the three modular core elements and strap-on stages. Once operational, the launcher's performance will be comparable to that of Ariane-5. The CZ-5 will most likely be used to put heavy modules into space and to send manned or unmanned probes to the Moon.

5.2.5 India

The Indian Space Research Organisation (ISRO) enjoys a strong partnership with Indian industry for the implementation of its space programme. Over 500 small, medium and large firms assist ISRO, supplying hardware, carrying out manufacture and establishing production and test facilities. ISRO has carried out several technical consultancy projects for firms, and more than 200 ISRO-developed technologies have been transferred to industry for commercial use.

The Antrix Corporation – an offshoot of the Department of Space (DOS) – handles marketing of Indian space capabilities to international customers. Commercial agreements cover a wide range of products and services, including: reception of IRS satellite data by ground stations in Dubai, Germany, Japan, the Republic of Korea and the USA; lease of transponders on INSAT-2E to Intelsat; provision of telemetry, tracking and command support; and the launching of scientific instruments on sounding rockets. The Republic of Korea's Kitsat-3 satellite and Germany's DLR-Tubsat were launched on India's PSLV in May 1999 under commercial contracts.

On 20 June 2005, Antrix and EADS Astrium, France, signed a Memorandum of Agreement to jointly address the commercial market for communications satellites in the mass range of 2 to 3 tonnes. The Agreement envisages optimising ISRO's INSAT platform along with EADS Astrium communications payloads.

6

Looking to the Future

6.1 Programmatic Orientations

The future direction of European space activities should comply with the strategic guidelines set forth in ESA's Long-Term Plan and respond to the overall trends that may reasonably be expected. In the international context, this means first and foremost monitoring US space policy and reacting to any changes. It also means adjusting position with respect to more recently established space powers, such as China and India, and intensifying the strategic partnership with Russia in space. While international cooperation may be expected to increase, Europe will have to preserve critical competences, despite flat funding figures and an overall context that makes it difficult for the space industry to remain competitive.

Science will play a fundamental role with another 'Cosmic Vision' 10-year plan to be started in 2015. With regard to technology and exploration programmes, major decisions are going to be taken in 2008 for the 2015 time horizon. This may include a decision on a Mars sample-return mission, the concrete demonstration of a manned exploration transport vehicle involving European participation, and full participation in robotic and/or manned Moon missions. In addition, efforts on the development of multiple-use technologies should be stepped up to respond to newly emerging user needs identified at EU level. This is expected to go along with an overall increase in the European Commission's share of funding in this field.

As for applications, Europe will also have to think well in advance about designing the second-generation Galileo system, to stay at the forefront of satellite PNT services. As for the other flagship programme GMES, following the definition of three fast-track services, further GMES-related satellites corresponding to an increase and diversification of user needs for new services will have to complement this effort in line with the financial contributions proposed by the Commission. Within the GMES services, it seems likely that security-related services will be extended. In the long term, progress may reach beyond the search for improved interoperability between national EO systems, and favour the building of pan-European space segments complementing national efforts in the security domain. In telecommunications, which is expected to remain the most important commercial space market in the foreseeable future, new post-AlphaSat telecommunications demonstration missions will have to be implemented by seeking a closer partnership with operators and service providers. A particular focus will be increased mobile interactivity with smaller terminals and at higher frequencies for the most advanced multimedia satellite applications.

In line with the activities to be expected in science, exploration, technology and applications development, guaranteed access to space for Europe will continue to be a core principle – all the more so as the security dimension of space technology and space applications is expected to increase. Building on ESA's Future Launchers Preparatory Programme, the development of a next-generation launcher will have to be completed by about 2020. Europe will have to consider its needs in terms of a coherent set of unmanned and manned spaceflight capabilities.

The effectiveness with which Europe increases coherence between user demand and space solutions, while extending the funding of European space-technology development and subsequent applications, will largely depend on the future relationship between ESA and the European Union. What happens beyond the current Framework Agreement will therefore be crucial, and possible governance scenarios need to be assessed well in advance. In doing so, particular attention must be paid to accounting for the specificity of the space sector

and policy principles developed within ESA, while recognising the full potential of its technical and managerial skills.

6.2 Food for Thought – Potential future developments in space

TOWARDS MINI- AND MICRO-SATELLITES

At the 56th Astronautical Congress (IAC 2005) in Fukuoka, the global rise of mini/macro-, nano- or pico-satellites was one of the issues discussed. The low-cost and off-the-shelf approach to satellites has prompted interest from several universities and research institutes in the United Kingdom, Germany and Japan, but also Italy, South Korea, Canada, Sweden and Brazil. While Japan's JAXA created a dedicated R&D division for micro-satellites in 1998, similar developments can also be observed in Europe. Besides the United Kingdom, Germany has made major efforts, namely to promote agile and compact low-cost satellites for GMES to increase efficiency and flexibility in monitoring the environment and risk zones by employing constellations of mini-satellites. EADS Astrium has made further proposals for the rapid, low-cost development of micro-satellites for the GMES programme in particular.

Surrey University/Surrey Satellite Technology Ltd. (UK) is the reference in this domain, deploying a 'Disaster Monitoring Constellation' with micro-satellites. Other universities, for example in South Africa, are considering creating private companies to embark on similar developments.

PRIVATELY DEVELOPED LAUNCHERS

Some reports indicate that launcher development itself could one day increasingly be taken over by private entities. The most emblematic player among the pioneers is the US Space Exploration Technology Corporation (SpaceX). With the development of a private launch business and the announcement of extraordinarily low launch prices, some analysts predict a real paradigm shift. SpaceX's Falcon launcher is the second launcher to be developed using private funds, after Orbital Sciences' Pegasus. The Falcon is designed to carry 680 kg payloads into LEO for a price of $5.9m. SpaceX has announced that it has received an order to launch a Malaysian satellite by the end of 2006. According to the company, similar orders have been taken for several US commercial satellites for 2008. However, the reliability of privately developed launchers must first be proven. The business is still one of very high risk, as indicated by the explosion of Falcon-1 on its maiden flight in March 2006 some 30 seconds after lift-off.

SPACE TOURISM

Linked to the development of privately funded space transportation is the issue of space tourism. While currently limited to some rare flights to the ISS on Soyuz for prices around $20m, there have been growing signs in 2005 that a small market for commercial space tourism might emerge. Efforts in space-tourism market research multiplied in 2005, trying to outline what could become an entirely new industry. Firms like Virgin Galactic have begun by focusing initially on suborbital space travel, and its possible extension to LEO at a later stage. In this context, the price is a variable to consider, yet not the only one as regulatory and safety considerations are equally important. Sub-orbital flights could become available from 2007 or 2008 onwards for prices around $200 000. The package would include three hours of training and a two-hour trip, which would allow passengers to view the Earth from an altitude of 130 kilometres and experience about four minutes of weightlessness.

Over time, these developments call for the definition of a common European position towards what could become a new space market. Should the private development of relevant technologies and innovative applications be fostered, Europe might think about organising competitions such as the Ansari X-Prize. In the meantime, a new America's Space Prize has been created in the USA that will award $50m to the developer of a vehicle capable of orbital flight.

7

Acronyms

AECMA	European Association of Aerospace Industries
CEV	Crew Exploration Vehicle (NASA)
CFSP	Common Foreign and Security Policy
CNES	Centre National d'Etudes Spatiales
CSG	Centre Spatial Guyanais
DoD	Department of Defense
DoE	Department of Energy
EC	European Commission
ECAP	European Capabilities Action Plan
ECB	European Central Bank
ECCP	EU Climate Change Programme
EDA	European Defence Agency
EELV	Evolved Expendable Launch Vehicle
EGAS	European Guaranteed Access to Space Programme
ELINT	Electronic Intelligence
ELV	Expendable Launch Vehicle
EP	European Parliament
ESA	European Space Agency
ESDP	European Security and Defence Policy
ESP	European Space Programme
ESRP	European Security Research Programme
ETS	Emission Trading Scheme
EUMETSAT	European Meteorological Satellite Organisation
EUMS	European Union Military Staff
FAA	Federal Aviation Administration
FLPP	Future Launchers Preparatory Programme (ESA)
FP	Framework Programme for Research and Development
GAERC	General Affairs and External Relations Council
GDP	Gross Domestic Product
GEO	Geostationary Earth Orbit
GEO-Initiative	Group on Earth Observation
GEOSS	Global Earth Observation System of Systems
GLONASS	Global Navigation Satellite System
GMES	Global Monitoring for Environment and Security
GNSS	Global Navigation Satellite Services
GPS	Global Positioning System
IGC	Inter-Governmental Conference
ISS	International Space Station
ICT	Information and Communication Technology
LEO	Low Earth Orbit
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
NOAA	National Oceanic and Atmospheric Administration
OCCAR	Organisation Conjointe de Coopération en matière d'ARmement
OECD	Organisation for Economic Cooperation and Development
OPEC	Organisation of Petroleum Exporting Countries
PNT	Positioning, Navigation, Timing
PRS	Public Regulated Service
R&D	Research and Development
RLV	Reusable Launch Vehicle
RTD	Research, Technology, Development
S&T	Science and Technology
SDS	Sustainable Development Strategy
SME	Small and Medium Sized Enterprises
SPASEC	Space and Security Panel
TEC	Treaty Establishing the European Communities
UAV	Unmanned Aerial Vehicle
WEU	Western European Union
WTO	World Trade Organization

ESA's Envisat, launched in 2002, continues to make a major contribution to global environmental monitoring

8

Annex

ESA missions in progress

Status end-December 2005

Spacecraft	Purpose	Launch
	Science	
Hubble Space Telescope	Astronomy	1990
Ulysses	Solar Observation	1990
SOHO	Solar Observation	1995
XMM-Newton	X-Ray Astronomy	1999
Cluster	Magnetosphere Study	2000
Integral	Gamma-Ray Astronomy	2002
Mars Express	Mars Study	2003
Smart-1	Scientific Technology Demonstrator	2003
Double Star	Magnetosphere Study	2003/04
Rosetta	Comet Study	2004
Venus Express	Venus Study	2005
Astro F/AKARI	Infrared Astronomy	2006
Microscope	Fundamental Physics	2009
Herschel/Planck	IR Observatory/Cosmic radiation observation	2008
LISA Pathfinder	Technology Demonstration	2009
GAIA	Astronomy	2011
JWST	Astronomy	2013
BepiColombo	Planet Observation	2013
LISA	Gravitational waves	2013
Microscope	Fundamental Physics	2009
Corot	Astronomy	2006
	Earth Observation	
Meteosat-5/6/7	Meteorology	1991/93/97
ERS-2	Earth observation	1995
Envisat	Earth observation	2002
MSG-1	Meteorology	2002
MSG-2	Meteorology	2005

MSG-3/4	Meteorology	2009/2012
MetOp-2	Meteorology	2006
MetOp-1/3	Meteorology	2010/2015
CryoSat-2	Polar ice observation	2007
GOCE	Earth Gravity Observations	2007
SMOS	Soil Moisture and Ocean Salinity Observations	2007
ADM-Aeolus	Global Wind Observations	2008
SWARM	Study of the Earth's Dynamic Magnetic Field	2010
GMES Sentinels-1a/2a/3a	SAR and interferometry	2011–2014
GMES Sentinel-1b/2b/3b	Superspectral imaging	
	Ocean/land observation	
	Telecommunications and Navigation	
Artemis	Telecommunications	2001
AlphaBus	Telecommunications	2009
GIOVE-A and B	Galileo In-Orbit Validation Element	2005/2006
IOV-I / IOV-II Galileosat	Navigation	2008/2009/2010
	Human Spaceflight, Microgravity and Exploration	
ATV(Jules Verne)	Automatic Transfer Vehicle/ ISS	First launch in 2007
Columbus	ISS module	2007
ExoMARS	Mars biological environment	2011
	Launchers	
Ariane-5/ECA	Heavy launcher	2005
Soyuz at CSG	Medium-class launcher	2008
Vega	Small launcher	2007

Frontispiece:
World cloud map for 1 February 2005, compiled using Meteosat-5, Meteosat-7, GEOS-9, GOES-10 and GOES-12 imagery (© Eumetsat)

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