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Impact assessment of the European Space Policy

Accompanying document to the

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

European Space Policy

IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

This impact assessment accompanies the Commission's Communication on the European Space Policy, which has been elaborated under the Framework Agreement *(A)* between the European Community (EC) and the European Space Agency (ESA). This has as its aim

> "The coherent and progressive development of an overall European Space Policy. Specifically, this policy shall seek to link demand for services and applications using space systems in support of the Community policies with the supply of space systems and infrastructure necessary to meet that demand."

The latest stage in policy development follows the publication of a Green Paper *(B)* and White Paper *(C)* on European Space Policy as well as regular consultations with industry and Member States. Those consultations enabled the identification of the main issues faced by the European space sector, as well as the important contributions of space to various European policies: the Lisbon agenda for competitiveness, promoting the knowledge-based economy, sustainable development and security and defence. Those consulted identified the main issues as the budget limitations, the emergence of new space powers, the dependence of the industry on the institutional market, the uncertainties on the commercial market and the high dependence on technology of this sector.

By defining the problems faced by the sector, this impact assessment analyses these and other issues which a policy for space could address. It looks at these in terms of:

– the effect of strategic policies on investment;

– the high technology, long-lead times in research, technology and development (RTD);

– the highly cyclical commercial market.

Although the European Space Policy is a joint document of the Commission and the Director General of ESA, taking account of the views of the Member States of these two bodies, this impact assessment highlights the potential added value of the EU, in addition to looking at the overall sector. The assessment then identifies the objectives which an effective space policy should seek to achieve if it is as provide a vision to move forwards. These are:

– to foster innovation, industrial competitiveness and economic growth, through the promotion, development and delivery of sustainable, high-quality; cost-effective services, and be the market leader in commercial space;

– to meet Europe’s space security and defence needs, including all aspects of security such as environmental, health and energy security;

– to enhance the contribution of space research to the knowledge-based society, play a significant role in the international exploration endeavour and be the leading scientific research community in space; and

– to secure independent access to new and critical technologies, systems and capabilities.

A range of options for achieving these objectives is described and their potential impact assessed. These include:

– the zero option of no change;

– a step increase in coordination while retaining the current mix of national and non-EU intergovernmental framework for the majority of space activities in Europe, to create the conditions for organic growth in public sector investment;

– an option involving more significant change, bringing those intergovernmental activities into the European Union framework;

– an even more radical change option, to bring space activities into the European Community framework within a clearly defined period as an integral part of a political decision to boost space investment significantly.

It is considered that the first option would leave the identified problems to persist. The last two have significant potential benefits but political and possibly legal objections at this point in time, based partly on the high level of uncertainty about exactly what they might entail. One of these, however, is identified for more in-depth analysis possibly to become a goal in the longer-term. The second of the four options is the approach advocated in the European Space Policy and its potential impacts of are elaborated in greater depth than those of the alternatives.

In setting the policy framework for future developments, the European Space Policy does not itself entail specific new expenditure programmes or regulatory measures. This impact assessment, while being thorough, is also proportionate to the nature of the policy under consideration. Where the European Space Policy identifies scope for expenditure or regulatory actions, it also notes the need for full impact assessments to be conducted before proposals would be presented.

In addition to such assessments, the final section of this document proposes that the Commission should update the sectoral review at 2-3 year intervals as an indicator of the actual effects of the European Space Policy and the extent to which the identified problems have been ameliorated.

1. LEGAL AND POLITICAL CONTEXT

This impact assessment accompanies the Commission's Communication on the European Space Policy, which is a major element in the work programme of the European Commission and which has been elaborated under the following legal and political circumstances.

The aim of the cooperation established by the Framework Agreement *(A)* between the European Community (EC) and the ESA[1] is "The coherent and progressive development of an overall European Space Policy. Specifically, this policy shall seek to link demand for services and applications using space systems in support of the Community policies with the supply of space systems and infrastructure necessary to meet that demand."

The Competitiveness Council of the EU and the Ministerial Council of the ESA, meeting concomitantly under the auspices of the EC-ESA Framework Agreement as the 'Space Council' in June 2005, confirmed:

"In particular, that the European Space Policy should contain the following main elements

1. the European Space Strategy outlining the objectives,

2. the European Space Programme, listing the priority activities and projects to achieve the strategy and reflecting the costs and funding sources of these,

3. a commitment by the main contributors to their respective roles and responsibilities, and

4. key principles of implementation.

The European Space Programme will be the common, inclusive and flexible programmatic basis for the activities of ESA, EU and their respective Member States. Existing capacities will have to be used to their maximum extent and complementarity ensured."

In line with this mandate, the European Space Policy is being published as a Communication from the European Commission to the Council and the Parliament and presented in parallel by the Director General of the ESA to the ESA Council. It should be seen in the context of the continuing development of EC-ESA relations and against the background of a series of Member State resolutions and orientations[2]. The latest stage in policy development follows the publication of a Green Paper *(B)* and White Paper *(C)* on European Space Policy and a Communication of the European Commission 'European Space Policy - Preliminary Elements' *(E).* It is therefore part of

[1] The ESA is an intergovernmental organisation, established by Convention. Its Member States are currently the EU-15, Norway and Switzerland. It has a long-standing cooperation arrangement with Canada.

[2] See for example: Council Resolution of 22 June 1998 on the reinforcement of the synergy between the European Space Agency and the European Community (98/C 224/01); Council Resolution of 2 December 1999 on developing a coherent European space strategy (1999/C 375/01); Council Resolution of 16 November 2000 on a European space strategy (2000/C 371/02); and references *A* and *M*

a continuing process which has already influenced programmatic decisions in the EU in the GALILEO programme and the GMES initiative, amongst others.

1.1. Procedural issues

The production of this impact assessment has been supported by a parallel factual study *(K)* led by consultants Risk & Policy Analysts Limited (RPA), appointed by DG-ENTR under a framework contract. The RPA team includes sub-contractors with expertise in space markets and space legal issues. The terms of reference of that study and its interim report have been followed in the Commission's interservice Space Task Force. A small steering committee for the study was established, chaired by DG-ENTR and consisting of representatives of DG-TREN (responsible for navigation), DG-INFSO (responsible for communications) and the ESA. DG-SG subsequently joined.

The consultants were instructed to draw on existing studies, wherever possible, such as the benefits studies conducted for individual programme proposals: eg GALILEO, GMES, FP7. The main focus of their original research has been possible future market scenarios and governance scenarios for the institutional framework. In addition to identifying the elements and implications of each, they have been instructed to analyse the extent to which the market scenarios might influence the attractiveness of institutional scenarios.

1.2. Stakeholder Consultations

During the consultation phase on the Green Paper, a total of ten workshops were organised by the EC-ESA Joint Task Force or by Member States. Each took place in a different EU Member State capital and each was themed in order to target different sectors of the space community: industry, science, commercial applications, government etc. The views received during this consultation process are summarised on the Commission's website *(D)*. Briefly these were:

– space should be introduced as a specific EU competence in the Constitutional Treaty, then under discussion;

– the EU should increase its involvement in space, both funding applications and harmonising the regulatory framework, including that which applies to data policy;

– European industry needs access to an increased institutional market if it is to compete successfully worldwide in commercial markets;

– independent access to space is of strategic importance for Europe and for European space;

– space policy should be addressed at the highest political level and should receive greater recognition as an important tool for the European Space and Defence Policy;

– European investment in space, including in science and technology research, should be doubled;

– satellites have the capacity to bridge the digital divide between rural and urban areas and ensure universal access to broadband;

– Member States are keen for early involvement in space-related activities.

Regular contacts have been maintained with industry subsequently. These intensified during 2006, in order to ensure that the interests of industry – extending along the whole value chain – are fully considered in the European Space Policy. Those consulted in this period, including at a high level meeting with Vice-President Verheugen, include manufacturing industry through the industrial association EUROSPACE (part of the Aeronautical, Space and Defence association, ASD), the European Satellite Operators Association (ESOA) and value-adding service companies, including SMEs.

Additional points arising from these later meetings include:

– the ESP should give adequate coverage to satellite operator interests, including the importance of an operational body being established for GMES-related satellites;

– satellite systems are integrated with terrestrial systems in "system of systems" configurations.

The European Space Policy and the European Space Programme have been compiled in a continuous process of consultation with the High-level Space Policy Group (HSPG), which consists of representatives of key government stakeholders: Member States of the EU and of the ESA, the European Defence Agency, the EU Satellite Centre and EUMETSAT[3]. Throughout 2006 the HSPG received papers on key modules of the Space Policy for comment and have been consulted on the basis of drafts of the full document.

In addition to taking up themes from the earlier public consultation, Member States have emphasised that the goal of industrial efficiency should not lead to the neglect of political motivations for investing in space, which are usually based on a desire to develop industrial capability in a high technology, sometimes high profile, industry. They have also emphasised that any formal movement of the ESA in the direction of closer association to the EU framework would be examined very closely by their governments and decisions taken only on the basis of a thorough analysis of all available options and their impact. One Member State has argued that European Community procurement policies for space systems should follow an element of geographical return in the allocation of contracts, irrespective of other factors. Some Member States have proposed the adoption of a strong European preference, to counter the effects of the Buy American Act, which closes off the huge US institutional market to European suppliers. The policy as set out in the joint Commission-ESA proposal takes into account almost all of the views received in these various consultation processes. Exceptions are:

– the ESP does not in itself propose changes in budget allocations but is intended to create the conditions against which individual decisions can be taken in the coming years for the

[3] EUMETSAT is an intergovernmental organisation established by Convention. It currently has 20 members and 10 cooperating states

development and exploitation of space technologies and systems, each of which would normally be subject to an impact assessment if it involved significant, dedicated EU funding;

- the ESP commits to a deeper analysis of the regulatory framework before the Commission would be in a position to propose specific harmonisation measures;
- amendments of EC procurement rules or EU procurement law raise much wider issues than space and they are not addressed at this time.

2. PROBLEM DEFINITION

2.1. A high risk sector needing sustained technology investment

The space sector is highly dependent on technology. Space technology cycles are longer than the average high-tech cycles. From concept validation to actual implementation and qualification in orbit may take 10 years, before exploitation of the technologies can begin. This implies very high technological and financial risks. Left to itself, it is unlikely that the private sector would be able to bear these risks.

Space technology development requires important investments in industrial facilities (including test equipment). It is also sensitive: space technology is dual use (military and civil) and space activities and space technology exports are therefore highly regulated. Today, space technology remains excluded from the WTO agreement. Industry's freedom to exploit investments is also constrained.

2.2. A strategic sector relying on public investment across the globe

Space systems are strategic assets. Initially developed as defence, scientific and prestige projects, they now provide commercial infrastructures on which the economy depends. The 'Space Council' has emphasised that space systems and infrastructure have become strategic tools for Europe in pursuing its global role. This perception drives the investment policies of most of the countries which have significant space activities. Governments therefore compensate for the market failure which would lead to underinvestment in new technologies. As a result, space is an institutionally driven industry. The technological evolution is driven by institutional programmes based on public sector needs or anticipated commercial requirements

The paradigm case of this behaviour is the United States, which has a stated objective to have pre-eminent space capabilities. It invests as much as the rest of the world put together in civil space (Figure 1); its defence space expenditure exceeds its civil expenditure (Figure 2). Euroconsult estimates that the US invests 21.25bn USD annually on military space, out of a worldwide total of USD 22.5bn. It is anticipated that US military space investment will continue to grow.

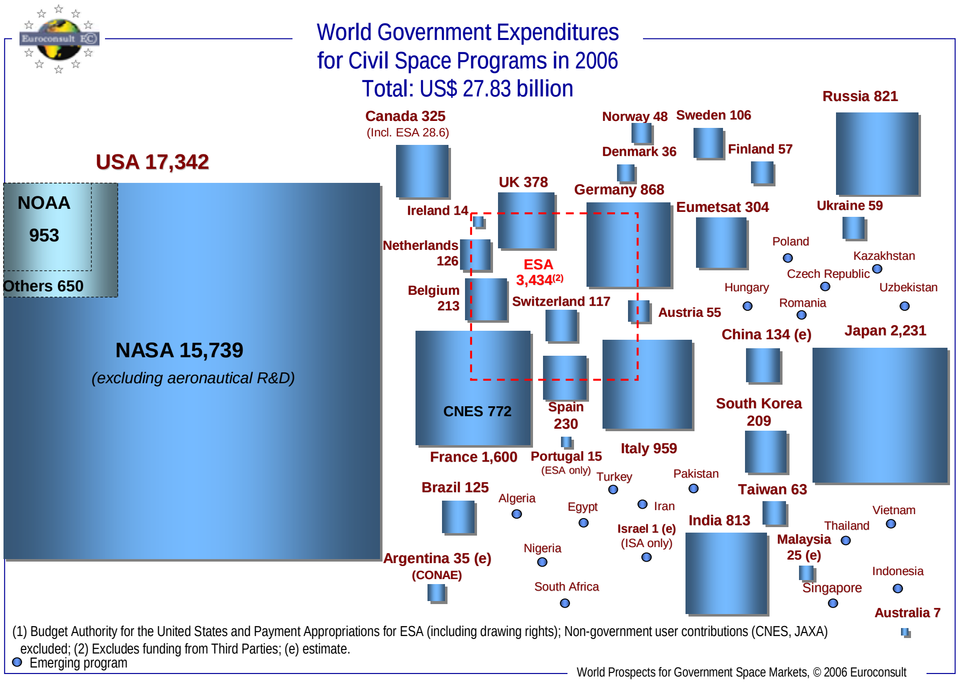


Figure 1: Global Space budgets 2006 *(L)*

The US issued a new national space policy in 2006 *(Q)*, highlighting that the conduct of US space programmes and activities shall be a top priority, since the US considers space capabilities – including the ground and space segments and supporting links – vital to its national interests. This has implications for Europe: approximately 60 per cent of components and equipments on every European satellite are procured outside Europe, primarily from the US. US supplied components, parts and equipments are used in all spacecraft subsystems, platforms and payloads, both institutional and commercial, and are now subject to the International Traffic in Arms Regulations (ITAR). Even if an export license is obtained, it may induce costly delays into a project.

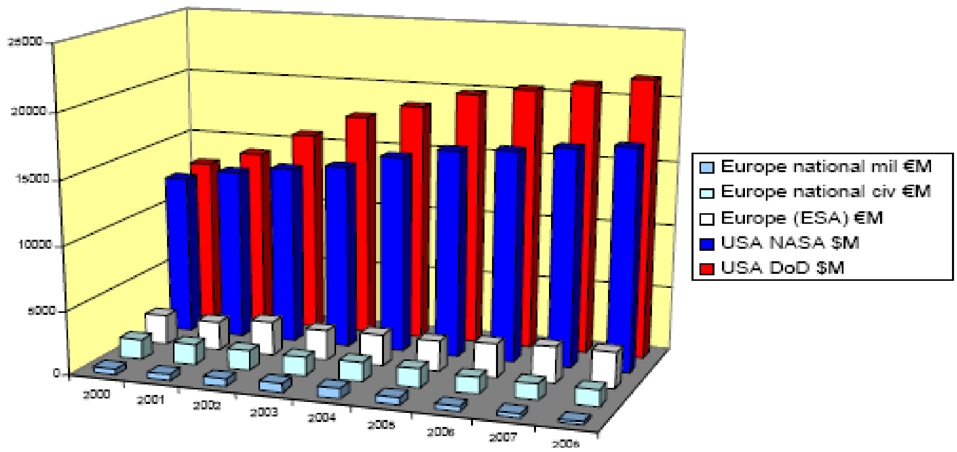


Figure 2: European and US space expenditure (ESTP*(J)*)

The influence of other space nations is increasing: Russia carried out more than 40% of the world's launches in 2004; China masters key space sensor, tracking and other technologies; India is extremely competitive for small to medium sized satellites.

The Russian Federal Space Program for 2006-2016 aims at maintaining space leadership; continuing satellites development in telecoms, earth observation, science and meteorology; replacing Soyuz for human spaceflight; and developing the Angara launch vehicle. The upgrade of the GLONASS satellite navigation system continues. Moreover, the Russian space manufacturing industry will be merged into one company to be more competitive. Cooperation agreements have been signed between Russia and Europe, among which for the operation of Soyuz from the Kourou Space Centre.

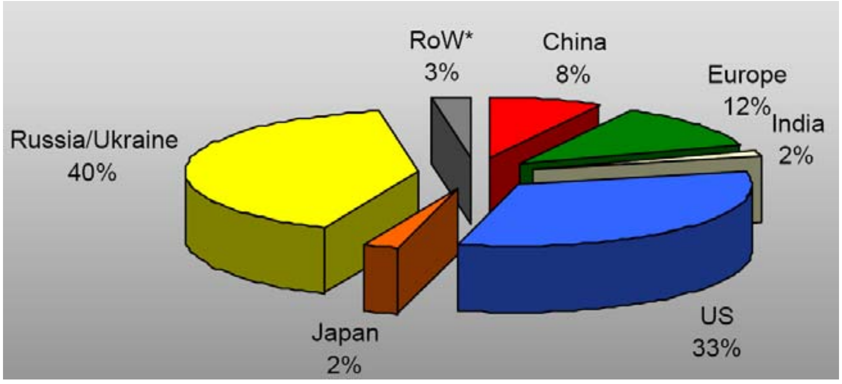


Figure 3: Worldwide institutional and commercial launches by Launch system origin 2000-2005 ***(M)***

In 2004, Russia led space launches (Figure 3) with 21 out of a total of 53 successful launches worldwide. Despite only having a 1% share in public space expenditure (as opposed to 17% for Europe and 75% of the US), Russia carried out more than 40% of the world's launches into orbit in 2004. Similarly, in 2004 China exceeded Europe in the number of launches, though not the number of spacecraft *(M)*.

For Russia, India and China, it would be misleading to measure commitment to space based only on absolute financial indicators without taking into account local purchasing power. Figure 1 presents a modest estimation for the Chinese investments in space. Yet estimates exceed 250 000 people working in space in China, close to ten times the European space industry manpower. Chinese investments in space are considerable in all sectors, with a focus on the development of earth observation and navigation systems, and large covert military programs. Its satellite telecommunications technological level is barely 5 years behind Europe. China fired a missile to destroy an orbiting weather satellite in January 2007, making it the third country after the United States and the former Soviet Union to do this. This means that China has mastered key space sensor, tracking and other technologies important for advanced military space operations. China can now also use "space control" as a policy weapon to help project its growing power regionally and globally. Its investments in Earth observation satellites are considerable with 17 satellites planned between 2000 and 2010 *(L)*.

India is investing substantially in civil space as a catalyst for economic development, accounting for 52.5% of national science and technology investment. India is today the champion in distance learning and telemedicine, and excellent in earth observation. Military investments are very discreet, in a tense regional context. From a commercial point of view, India is selling this expertise in telemedicine abroad and is extremely competitive on small to medium sized satellites, through ISRO, the national space agency.

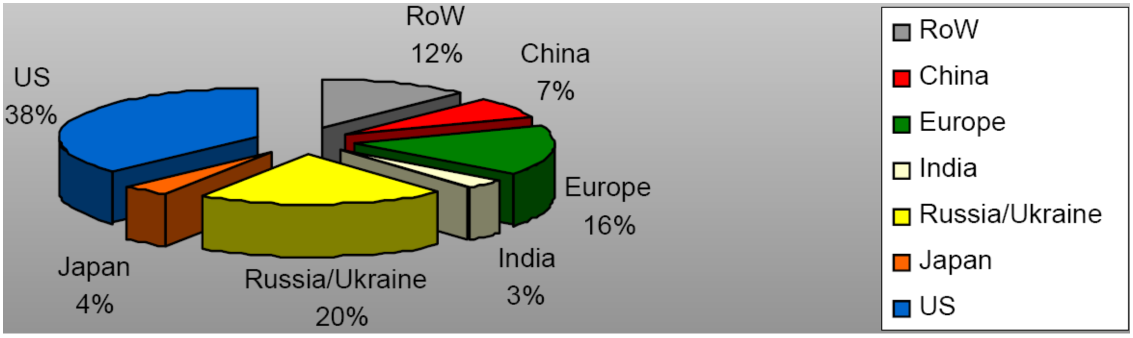


Figure 4: Institutional and commercial payloads launched by payload origin 2000-2005 ***(M)***

2.3. The market-centred European approach

Compared to the US, the European space sector is the result of a substantially different political approach and level of institutional investment. European governments allocate to civilian activities almost 90% of the €6.3bn space budget and strongly promote commercial space activities. Two-thirds of the European space segment turnover comes from institutional customers, while in the US it is around 85%, where industry is not only less dependent on the commercial market but budgets for space are five times larger. For European satellite and launcher manufacturers, therefore, the global commercial market is essential to reach a critical mass and to be able to maintain a minimum of employment and specialised know-how.

The creation of ESA has enabled the aggregation of space budgets and the progressive build-up of a considerable know-how in space science and technologies. The ESA accounts for about two-thirds of an estimated €5.5bn overall European civil space expenditure (Figure 5). Member States contribute to its mandatory activities (space science programmes and the general budget) in accordance with their country's gross domestic product (GDP). Three-quarters of its budget comes from optional programmes. Each Member State decides in which optional programmes they wish to participate and the amount they wish to contribute. The agency operates on the basis of geographical return, i.e. it invests in each Member State, through industrial contracts in proportion to each country's contribution. Geographical return has been a powerful investment incentive for nations. Yet, it has to some extent limited specialisation. Increased flexibility is being brought to the geographical return rules by recent ESA Council decisions.

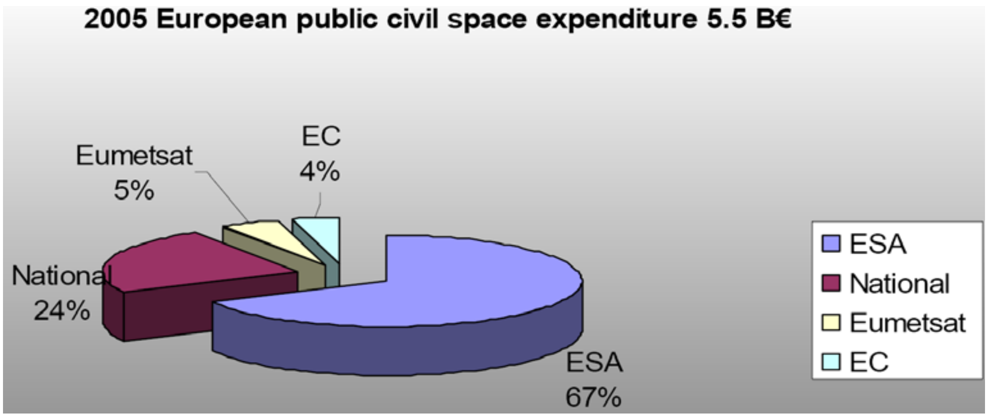


Figure 5: European public civil space expenditure 2005 ***(M)***

Based on contributions by its Member States of about €2.6bn, income from the EU of about €173m, and other income and third party programmes, ESA's overall expenditure amounted to €3.75bn in 2005. Of that total, €2.8bn was spent on optional programmes, with mandatory activities accounting for some €696m. *(M)*

The GDP-linked scale makes Germany, the UK and France the biggest contributors to mandatory activities. However, contributions to optional programmes mean that Italy replaces the UK in the three overall large contributors. Countries such as Spain have recently increased their commitments, with Belgium, Switzerland and Sweden making substantial contributions in relation to their GDP. *(M)*

European nations have emphasised the strategic nature of space. This has been done not only through investing in technology development. In 2003, ESA Member States concluded that an independent, cost-effective European launcher was in the strategic interests of Europe and could not be threatened by the fluctuations of the commercial market. It introduced the European Guaranteed Access to Space Ariane programme, to come into force for the period 2005-2009 and intended to cover selected fixed cost activities (associated with the production of a batch of Ariane 5 to be ordered in 2003). This was done with the intention of placing European industry and Arianespace on a level playing field with international competitors. The financial envelope for this programme for the period 2004-2009 was set at €960m.

The European philosophy is therefore only sustainable if demand from commercial and public customers is significant. If this is not the case, in either the short-term or the long-term, governments would risk being faced with a choice of being entirely dependent on foreign suppliers for strategic systems or to pay whatever it costs to maintain a capability in Europe.

2.4. A highly cyclical commercial market

While commercial markets are substantial and policies pursued by institutional investors have a direct impact on the ability of companies to compete for these, those markets are also highly cyclical. For the first time the commercial market overtook the institutional market at the last peak of the economic cycle (2000-2001), coinciding with the internet bubble (Figure 6). But just two years later in 2003, demand had fallen by 50 per cent. As noted earlier, the European space industry is far more dependent on the commercial market than its counterparts.

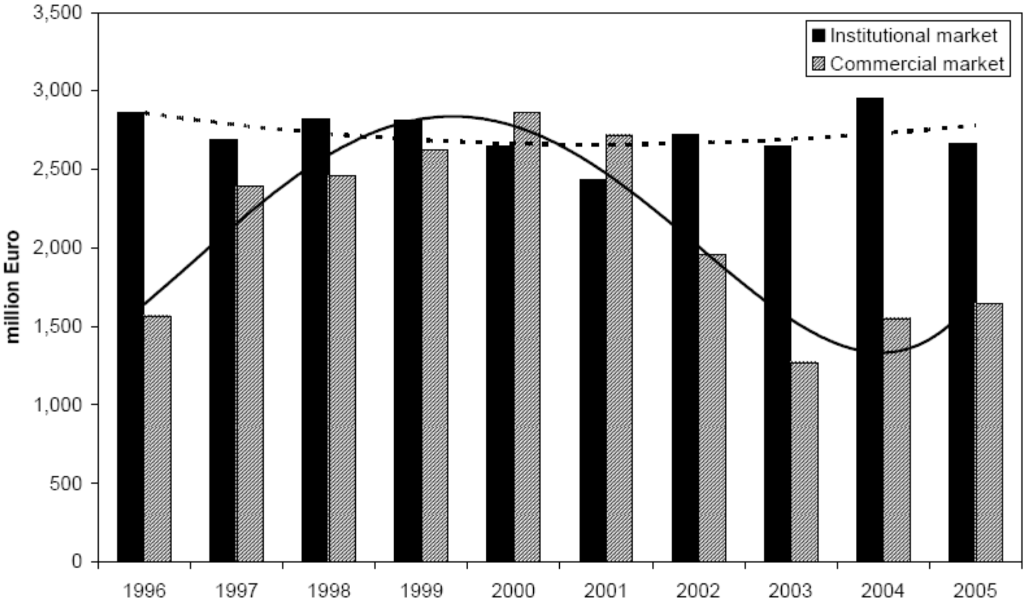
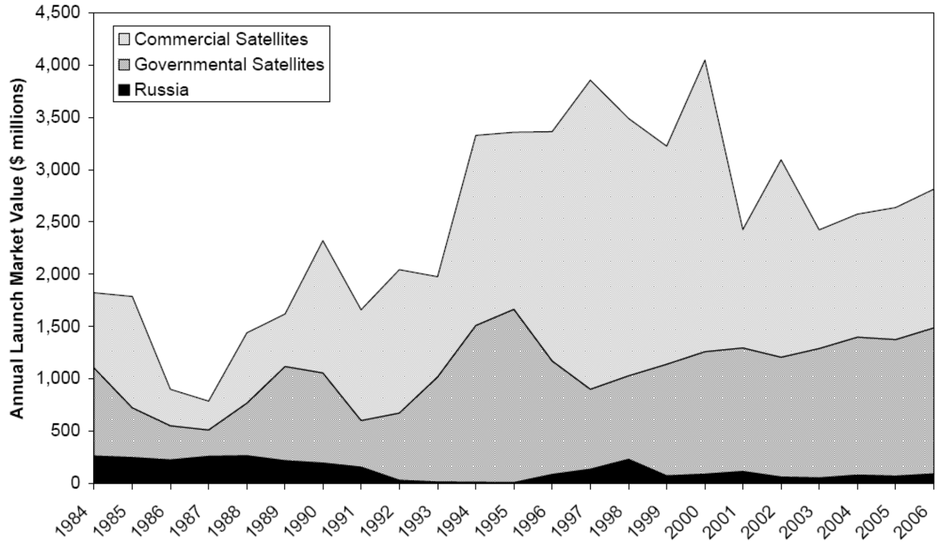


Figure 6: Turnover by Customer for the European Space Industry *(N)*

The institutional market is therefore vital to the space manufacturing industry because it can provide a large, stable source of revenue. In many countries, it is also a captive market to the domestic industry, i.e. strong competition from foreign suppliers may be prevented.

This economic cycle is amplified in the launcher market. While that market (Figure 7) was quite buoyant in the 1990s, the demand for launching services has declined since 2000 as a result of cyclical factors and unfulfilled expectations. In 2000-2003, the world satellite industry stabilised at an average of 63 satellites launched per year; the average annual value of this market was $2.6bn, down from a record of $4bn in 2000. Yet, the launch market will remain highly cyclical in the coming years both in the institutional and the commercial market.



2004 & 2006 are estimates

Figure 7: Annual launch market (Euroconsult *(L)*)

The space value chain can be split into three categories: the space segment suppliers, the ground segment suppliers and the service sector. Global revenue for the industry as whole was valued at $97.2bn in 2004, with the bulk of it generated by satellite services. A detailed analysis of these market segments is at Annex 1. *(K)*

The cyclical commercial market covers three key areas:

– telecommunications and broadcasting, representing the bulk of the market;

– Earth observation and geographic information; and

– location and navigation.

The commercial market presents major uncertainties for the future. Developments in satellite communication technology and services will have to keep pace with the evolution of applications to enable satellite communications to maintain its competitive position. *(I)*

The competition from satellite manufacturing newcomers such as China and India will grow. The technological advantage of European satellite manufacturers will still last a few years, but not more than 10. The prices offered by those new manufacturers from low production cost economies (Russia, China and India) can be up to 50 % cheaper.

Some estimate that the level of activity generated by the commercial market in European industry could then correspond to a workload below 50% of the capabilities of industrial production currently available. This constitutes a challenge to all who are responsible for maintaining a balanced European industrial capability, making the public space sector of increasing importance *(U)*.

2.5. Fragmentation in European demand and supply

By their nature, space systems can meet the needs of users across a wide geographical region, or even globally. For each individual user, a dedicated satellite would be unattractive but when their demand is aggregated, the cost per user can be significantly outweighed by the benefits received in terms of lower costs, higher quality or a combination of both. For telecommunications and broadcasting, market mechanisms have been able to take over from the public sector organisation of early services and individual households constitute a large body of demand. Where public authorities are almost exclusively the potential users, their inability or unwillingness to specify their requirements inhibits the growth of new services and space systems are utilised to only a limited extent by European public authorities for the development and implementation of public policies, in comparison to other space powers. This may be a consequence of the operation of the principle of subsidiarity: potential users may be at national, regional or even local level and do not easily aggregate their requirements. Attempts to aggregate requirements have to take account of this legal position. GALILEO and the GMES initiative are designed to overcome these market imperfections.

Some of the policy responses which have been taken have been introduced at national level, particularly where security and defence requirements are concerned. Member States are now recognising that one consequence of this is a lack of interoperability between systems. Contracts are being placed to remedy this retrospectively, at significant cost.

On the supply side, system integrators have undergone a process of consolidation in Europe, as elsewhere. For the equipment and subsystem supplier industry which feed into the system integrators, ESA characterises the sector as rather fragmented *(U)*. Different interests are represented by companies in each sector and these tend to be reinforced by the 'fair return' rules of ESA and policies of national administrations. Further details in this are in Annex 3. *(J)*

2.6. An uncertain regulatory outlook lacking harmonised national laws

Manufacturing and service industries need a regulatory framework based on stable and clear rules, predictable and adapted procedures, but also on reactivity and optimisation. Interoperability and standardisation are intertwined issues, closely related to regulation. Standardisation is a key contributor to the competitiveness of industry and enables a more efficient development of technologies and capabilities. For industry, standards give clarity regarding future markets and are an incentive for further investments. Consumer demand can be the driver for standards. However, many new space services are derived from public-led programmes.

Interoperability of space and ground-based systems is urgent and has a strategic dimension, particularly for European activities, but its introduction needs clear political support from Member States. National space infrastructures in Europe are generally not interoperable. This limits the possibility to take maximum advantage of Europe's different space assets in civil or security programmes. The result is a cost disadvantage and on occasion serious operating inefficiencies. Interoperability needs to be built in at the design stage, but is currently added as a costly afterthought.

Export controls are an intrinsic part of how industry operates and conducts business. Since space technologies are sensitive by nature, many countries have adopted stringent export or import controls regulations, which may impede the free flow of technologies in a globalised economy. This has two types of consequence: intra-European and extra-European. Within Europe, the manufacturing process for space systems requires the free cross-border movement of not only components but also partially or fully integrated satellites. Test facilities to simulate in-orbit conditions are highly expensive and their duplication is consequently minimised. This results in the need to transport products to and from those facilities. Their export may be controlled by two or more Member States, each of which may adopt different definitions: a satellite may leave the country under one type of legislation and return under a completely different type. The costs to industry may result from both administrative complexity and schedule delays. For commercial satellites, this impacts on international competitiveness.

Securing access to spectrum and orbital resources provides the necessary encouragement to satellite operators to take long-term investment decisions. Market forces create an imbalance between terrestrial assets and space infrastructures insofar as the satellite programme cycle takes much longer than terrestrial infrastructure developments. Moreover, the introduction of charges and auctions may result in satellite operators being required to pay in each Member State for the same spectrum allocation or, worse, being denied its use in one or Member States within the satellite's natural operating area or "footprint". The establishment of a suitable legal framework should better balance spectrum allocations between space-based and terrestrial infrastructures as well as facilitate and encourage the use of space services in all fields. In addition, in order to pursue the challenges of scientific knowledge and discoveries, the availability of scientific bands needs to be strengthened.

Similarly, the regulation of the launch and operation of space objects is governed by national law, for which there is no harmonisation for even the most basic concepts, such as jurisdiction. These laws result from international obligations entered into by the majority of European countries subscribing to UN treaties and conventions. The number of states with legislation is set to more than double over the next few years, increasing the risk that a company could find itself subject to more than one set of legislation and having to meet potentially conflicting requirements. The expected multiplication of space legislation will therefore need to be assessed in the context of determining whether Europe ought to play a role in the harmonization of space law regulations, especially since the majority of space investments in Europe are cross-border cooperation programmes.

3. OBJECTIVES OF A POLICY INITIATIVE FOR THE SPACE SECTOR

To overcome the effects of the factors described in the preceding chapter, a policy for the European space sector will need to pursue the following objectives:

i. to foster innovation, industrial competitiveness and economic growth and be the market leader in commercial space;

ii. to meet Europe's space security and defence needs, including all aspects of security such as environmental, health and energy security;

iii. to enhance the contribution of space research to the knowledge-based society, play a significant role in the international exploration endeavour and be the leading scientific research community in space; and

iv. to secure independent access to new technologies, systems and capabilities.

To achieve this will involve:

i setting clear priorities with maximum European impact in strategic, economic and social terms;

ii. optimising public resources, making full use of existing competences and coordinating programmes;

iii. establishing an optimum regulatory environment;

iv. implementing a tailored industrial policy aimed at achieving global competitiveness while maintaining the motivation of Member States to invest in space;

v. providing funding for the development of critical systems and technologies;

vi. raising awareness about the unique capabilities and benefits of space as an enabling technology;

vii. developing balanced international cooperation with selected strategic partners.

Any policy should also take into account the value-added of space for a range of EU policy areas.

3.1. The Lisbon agenda for competitiveness

The space sector is a driver for the Lisbon Action Programme for Growth and Employment[4]. The major technological and scientific breakthroughs achieved in the space industry make a significant contribution to the European economy's competitiveness as a whole, support the creation of a highly-skilled workforce and generate many highly innovative small and medium size businesses, particularly in the space services sector.

4 "Working Together for Growth and Jobs: a New Start for the Lisbon Strategy" COM(2005) 24, 2.2.2005.

The unique technological requirements of the space environment push technology in electronics, materials, propulsion, energy generation etc. to limits never reached before. The uniqueness of this environment also represents an unparalleled test field for experiments in all scientific disciplines, from physics to biology not to mention the advances in engineering, software and virtual reality required by development, testing, calibration activities and the modelling of extreme environments and situations. But space technologies have also translated into numerous non-space applications as shown in Annex 3, from Anti-Corrosion Coatings to Blood Pumps, and will continue to do so.

3.2. Promoting the knowledge-based economy

Space contributes to the foundations of a knowledge-based society. *(H)* Space science has revolutionised our understanding of the Earth and the Universe, raising questions concerning the origin of the Universe, the development of life, its existence elsewhere and the long-term habitability of our planet. Space can contribute to European cohesion and identity, reaching citizens across all countries in Europe; it is a powerful stimulus for the youth to enter scientific and technical careers.

Space-based systems enable European citizens to rely on improved weather forecasts, satellite TV, smarter personal communications and advanced navigation/transport, and they open up new opportunities in environmental monitoring, tele-education and tele-medicine.

3.3. Sustainable development

Space helps us understand the fragility of our planetary systems and their complex interrelation. Space-based observations make it possible to see the Earth as a dynamic, integrated and interactive system of land, water, atmosphere and biological processes *(P)*. Space remote sensing can be used, in co-ordination with ground-based systems, to monitor:

- the sources of fossil fuels ;
- the sources of actual emissions of methane (its effect on climate may be some 20 times greater than that of carbon dioxide);
- land use changes such as deforestation and reforestation, and thus improve the measurement of carbon sinks;
- rainfall and water resources;
- loss of Arctic ice and sea surface temperature, impacting fish populations and coral reefs;
- agricultural and industrial pollution.

On 10 January 2007 the European Commission set out proposals and options for keeping climate change to manageable levels in its Communication "Limiting Global Climate Change to 2° Celsius: The way ahead for 2020 and beyond." The Communication, part of a comprehensive package of measures to establish a new Energy Policy for Europe, is a major contribution to the ongoing discussions at international level on a future global agreement to combat climate change after 2012, when the Kyoto Protocol's emissions targets expire. The Communication proposes a set of actions by developed and developing countries that would enable the world to limit global warming to no more than 2°C above pre-industrial temperatures. If collected on a long-run systematic basis, space data will be a major tool to analyse Climate Change and monitor the measures to be taken.

3.4. Security and defence

The European Union is a global actor which faces new threats to its security. Assuming global responsibility increasingly relies on access to space-based information and communication systems. Such systems are required for the monitoring and enforcement of international agreements and treaties such as the Kyoto Protocol.

The SPASEC Panel of experts acknowledged the valuable role that space assets play in the security domain for both the civil and military communities at local, national, regional and global levels. Satellites have a role to play in complimenting terrestrial communication facilities in the management of emergencies. The particular areas where satellites have a role to play are:

– Supplementing the terrestrial communication coverage so that there is continuous coverage over any area where a disaster might occur;

– Rapidly supplementing the capacity of terrestrial networks in the event of an emergency since, even if the terrestrial networks are not damaged, there is likely to be a greatly increased demand on the terrestrial networks;

– Backup to terrestrial networks in the event they are damaged by a disaster;

– Interconnection of national networks for emergency services so that there is seamless coverage over the whole disaster area;

– As part of the individual national civil protection authorities communication infrastructure;

– Rapid broadcasting of information to the public.

The SPASEC Panel also confirmed the relevance of using earth observation systems and data relay satellites in support of EU borders surveillance, in particular maritime borders, in order to fight against illegal activities (e.g. human trafficking, drug smuggling) and to monitor transport activities in and around Europe. *(F)*

4. POLICY OPTIONS TO ACHIEVE THE OBJECTIVES

4.1. No European Space Policy

It is quite difficult accurately and fairly to characterise the "no change" option. As noted earlier, producing a policy statement has been a long-running process, via the Green and White Papers, and before that Council Resolutions on the European Space Strategy. In view of the clear political mandate given to the Commission and the DG ESA, a failure to have a coordinated European Space Policy would arguably imply abandoning the aim of bringing together the political commitment and actions of the EU, the EC, the ESA, the Member States and other intergovernmental bodies such as EUMETSAT. One interpretation of this option would therefore be a reversal of the previous trend, signalling a reduced interest in the EU to invest in and exploit space systems.

There is a less pessimistic interpretation, which would assume that the current arrangements would stabilise and not be enhanced in the foreseeable future. With the encouragement of their respective Member States, the Commission and the ESA would continue to work closely together on programmes of mutual interest, particularly GALILEO and GMES. The Member States would conduct their own space programmes without any explicit coordination or exchange of information with European institutions and bodies, there would continue to be a fragmented institutional market facing European industry, and separate national positions would be taken vis-à-vis third countries, except possibly in the areas of the exploration initiative and the Group on Earth Observation. There would be no specific impetus to consider reform of industrial policy within ESA nor to assess improvements in the framework of relations between the EU and the ESA.

Both these possibilities are assessed in the chapter on potential impacts (chapter 5).

4.2. Increased coordination and growing use of space applications to deliver other European policies

In this option, all key actors at national and European level could agree to the systematic exchange of information concerning their plans for space-related programmes. The aim would be to achieve a coherent, unified European institutional space market policy, allowing industry to manage variations in demand, invest in technology and ensure the development and maintenance of critical capabilities. As the institutional market consists not only of capability-building programmes but also the utilisation of space applications, the aggregation of European public policy needs for the benefits of citizens would form an important part of this under the umbrella of a European Space Programme. The policy should be designed to ensure space policy and user policies are mutually reinforcing.

Sustained funding commitments by Intergovernmental and European Community funding lines would each be required under this option, as they would also for national and multilateral programmes. Each individual actor would remain responsible for ensuring the implementation of the programmes it initiates, using networked European technical capacities. In particular, proposals would be brought forward for the sustainable funding and coherent management of operations GMES services.

This option would demonstrate a willingness to ensure that Europe’s space activities must be cost-effective, well coordinated and closely aligned to the needs of the operators and users. It would therefore recognise that such improvements are essential to attract and lever further public and private investment.

The development and use of space-based applications to provide operational services is increasingly to be conceived in system-of-systems configurations: integrating different space applications (telecommunications, navigation and Earth observation); combining European and non-European systems; and integrating data from different sources: space-based, ground-based and airborne. The Commission and ESA would coordinate current (eg FP7) and future programmes in this area.

The protection of the space infrastructures is necessary for both the military and the economy and must be addressed commonly. C3 - command control and communication - is nowadays the backbone of military capabilities and relies extensively on spatial infrastructure. Any shutdown of part of the spatial infrastructure would have major consequences and freeze a significant part of economic activity and impair considerably the organisation of emergency services. Technology programmes would address this.

4.3. Changing the political framework for space in Europe

The proposals contained in the previous option would increase coordination while retaining a non-EU intergovernmental framework for the majority of space activities in Europe, maximise the output from existing investments and so create the conditions for organic growth in public space expenditure. An option involving more significant change would be to bring those intergovernmental activities into the European Union framework.

Such a framework would be designed to continue to permit Member States to participate optionally in programmes under intergovernmental funding arrangements. In parallel it would draw on the research and, as appropriate, operational budgets managed along Community lines. Suitable administrative arrangements would be necessary for non-EU Member States which are currently members of ESA. It might also be structured so as to allow inter-pillar activities, in order to strengthen civil/military coordination.

4.4. Radical change – Community framework, substantial budget increase

An even more radical change option would bring space activities into the European Community framework within a clearly defined period as an integral part of a political decision to boost space investment significantly. This would involve both the transfer of existing national civil space budgets into the Community budget and a commitment of new Community funds to space research or to operational space systems.

The White Paper on space policy hypothesised three different scenarios for an increase in overall expenditure on space across Europe (EC, ESA and national programmes, civil and defence). As concerns Pillar I activities, the range of increase considered was 23-35 per cent. In money terms, this would be of the order of €1.25-2bn.

Such an investment would be likely to be spread across a range of areas from underpinning technologies and science, through increased expenditure on planned operational systems such as GMES, to new centrally funded operational systems to the benefit of policies such as regional development.

5. POTENTIAL IMPACT OF THE OPTIONS

5.1. Political constraints and evaluation of the options

Current political considerations constrain the options which could be pursued in the immediate future. First, the political mandate has already been determined for the immediate future through the communication 'Preliminary Elements' *(E)* and the orientations given by the 'Space Council' following its discussion on this. In order to consider a sufficiently wide range of options, other timescales have to be invoked. The "do nothing" scenario would therefore have significant negative consequences, as described in section 5.2 below.

Second, the orientations of second meeting of the 'Space Council' invited the Joint Secretariat of the Commission and ESA Executive "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." *(O)* During the extensive consultations in the preparation of the ESP, Member States have made it clear that they would not want the ESP or the way in which it is considered for endorsement to pre-empt in any way the outcome of this further analysis, which should include the scope for enhancing cooperation within the existing EC-ESA Framework Agreement and the outcome of studies being on the impact of the options on ESA. For these reasons, the options discussed in sections 5.3 and 5.4 would not be politically feasible at this point in time. The level of discussion has consequently been limited here and they will need to be assessed further when that work has been completed.

5.2. No European Space Policy

As noted in the previous chapter, this can be interpreted either as a reversal of the previous trend towards coordination or stopping the process at the current stage of development.

A number consequences could follow, to a lesser extent in the second case:

– a failure to see GMES through to operational status and precious time-loss in the fight against climate change;

– an incapacity to provide the European space industrial base with the necessary visibility on the institutional market representing the backbone of its business, possibly resulting in further restructuring and lay-offs;

– a continuing lack of coordination throughout civil space in Europe, restricting specialisation and therefore the development of new technological competitive advantages and increased economic competitiveness for the space segment industry;

– an under-exploitation of the potential synergies between civil and military space in Europe, leading to limitations in capabilities and in interoperability in crisis situations;

– a slower pace and fragmentation of efforts in space developments in comparison with the other space powers – US, Russia, Japan, India and China;

– continued dependence on foreign suppliers for critical space technologies, as well as for other basic components and subassemblies that might be subject to export restrictions;

– no perspectives for the creation of a supplier base for advanced but currently immature technologies (e.g. Compound Semiconductors);

– under-utilisation of space systems by European public policies, resulting in lost opportunities for increased efficiency and effectiveness of all those policies.

In the impact assessment supporting study (see section 5.5.1 RPA), the option of no change is taken as the base case against which other options are measured. It suggests that, on the basis of the criteria used to make the assessment[5], all other options would score more highly. This option could only be valuable if it was associated with a revision of the EC-ESA Framework Agreement.

5.3. Changing the political framework for space in Europe

A fully EU framework for European space activities could permit more effective coordination arrangements, including dual use, as well as providing all Member States with an effective means to take part in space activities. It would create a clearer programmatic framework for the government bodies involved and, therefore, for the sector's investors and users. It would be established in a way which allowed expenditure under EC rules to be assured, without the need for negotiations between the Commission and the ESA on a case-by-case basis and without the need to establish new legal bodies programme by programme (cf GALILEO Joint Undertaking).

Analysis in the impact assessment supporting study suggests that, on the basis of the criteria used to make the assessment (see section 5.5.1 RPA), the option of an EU agency under Pillar 2 would score highly under any of the demand scenarios studied.

This option has, however, a number of uncertainties which have still to be reduced. The legal base for an agency which could be both inter-pillar and allow variable geometry participation within each programme requires further study, under the existing Treaty and under the draft Constitutional Treaty. Similarly, further analysis is required of the extent of the changes which might be necessary to the financial and industrial policy rules of the ESA if its activities were to become intergovernmental within the Treaty.

5.4. Radical change – Community framework, substantial budget increase

The radical change option would have two main aspects:

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5 The criteria for determining the relative performance of different models (options) have been reviewed by the Study Team and revisions have been made to those set out in the Specification/Proposal. The revised and extended set of criteria/objectives is as follows:
- to contribute to European cohesion;
- to contribute to the position of Europe on the world scene;
- to strengthen Europe's space and technological capabilities;
- to maximise Europe's market access to the rest of the world;
- to improve the competitiveness of the European space industry;
- to enable the implementation of demand-driven space programmes;
- to improve the efficient use of resources for space in Europe;
- to encompass or accommodate the production of dual use (e.g. civil and defence) applications; and
- to maximise, to the extent possible, the institutional coherence.

The precise meaning of each criterion/objective is open to a degree of debate and the subsequent scoring of options against these will depend, to some extent, on the interpretation used

– a transfer of activities from national and intergovernmental frameworks to a Community framework; and

– an increase of European civil space expenditure of between one quarter and one third.

From the Community's standpoint, this could be expected to provide a framework in which the Commission could develop a farsighted strategy for the development and use of space systems for the benefits of Community policies and have available the resources to implement it. Investment in operational space systems and in the technologies to underpin them would be combined within a single decision-making set of bodies (the relevant Councils of the EU). Industry would have a more secure framework for investment, with decisions taken over a 7 year period, rather than three years or the life of an individual programme. This does, however, presuppose certain features of such a Community programme, for example that the percentage support for R&D projects would continue at the current level and that procurement policies would enable industry both to achieve a degree of profit and exploit technologies and in some cases systems in the commercial market.

Analysis in the impact assessment supporting study suggests that, <u>on the basis of the criteria used to make the assessment</u> (see section 5.5.1 RPA), the option of a Community programme managed by a Community Agency would score highly under any of the demand scenarios studied.

The radical option of itself would represent a substantial commitment of all Member States to a strengthened space investment, which would increase investor confidence in the industry. However, it would involve a significant transfer of in excess of €6bn per annum from intergovernmental and national expenditures to the Community budget, along with a pooling of decision making on priorities. Such a change would be particularly marked for what are presently national programmes. There is no indication that Member States have any wish to pursue this approach at this point in time. On the contrary, the Constitutional Treaty approved but not ratified by all EU-25 specifically notes that "the exercise of [Community] competence shall not result in Member States being prevented from exercising theirs".

5.5. Increased coordination and growing use of space applications to deliver other European policies

This option would aim at delivering to Europe the objectives defined in chapter 3 of this Impact Assessment, and at answering to the problems analysed in chapter 2. We analyse hereafter more specifically its impact on the economy, the environment, society and its security.

5.5.1. Economic impact

The increased coordination option would provide visibility on European space institutional programmes and pave the way for their better coordination. Public policy has been the basis of building competitive industrial capacity, particularly in the space segment industry. The European institutional market is built on civil and military national programmes and on ESA programmes based on the principle of “fair return”, by which industrial contracts are distributed geographically in proportion to funding. This has enabled the leveraging of funds and allowed national priorities to converge. It has, however, limited rationalisation of facilities within prime contractors and specialisation among suppliers of sub-systems. The process of increasing flexibility into the ESA rules, after an assessment of the most recent reform, should improve further the efficiency, specialisation and competitiveness of European industry.

The coherent, unified European space policy will allow industry to manage variations in demand in commercial markets, invest in technology and ensure the development and maintenance of critical capabilities.

The maintenance and development of know-how across the European space industry is essential if systems are to be developed based on European policy requirements. Member States through EC, ESA, national agencies and industry have provided Europe with a high-quality technological base enabling the development of successful institutional and commercial applications. However in some critical technologies, Europe has fallen as much as 10 years behind major space powers, as a result of insufficient funding and lack of coordination. Europe has thus become dependent for strategic technologies on suppliers who may be subject to export restrictions, including to the European market; this also restricts industry's ability to address certain export markets. The European Space Policy calls for Europe to develop in due time, under a coherent policy, the next generation of advanced space technologies to allow industry to compete successfully on the basis of the knowledge content of its products and services.

The increased coordination option also calls for Europe to identify critical technologies and guarantee their funding, as well as focus and improve coordination of cross-sectoral research in those domains. It also calls for technology transfers to be closely monitored both for security and commercial reasons: Europe has to provide security to its citizen, and to enable its companies to maintain their competitive advantages on the international market. Centres of excellence should be developed in those domains, in order to provide a critical mass of innovative capacity. The Concept of Centres of Excellence has proved its efficiency in numerous other high-tech areas.

Synergies will be maximised between space and non-space technologies (e.g. materials and nanotechnologies, electronics and embedded systems, robotics, batteries and fuel-cells), with appropriate support for validation and space qualification of new technologies. The ESA-led process of harmonising technology development programs is providing transparency on space R&D across Europe and paves the way for improved coordination. Its momentum would be increased and extended.

The GALILEO project is the first Flagship of the European Space Policy. GALILEO has been a clear example of the benefits of working towards the introduction of the European Space Policy, as it is a collaborative project, depending on the development of dedicated technologies, the construction of a space infrastructure by the European space industrial base, and long-term funding and running commitment from a federated European user-community.

The GALILEO project was the object of an extensive study by PricewaterhouseCoopers (PwC) *(R)*. The aviation and maritime industries are those that will provide the most reliably quantifiable benefits. Benefits arising from route guidance seem far more hypothetical since the majority of journeys will be undertaken on known routes that do not offer potential for such time saving. The following table states the Value of Key Benefits as estimated by PwC (Euro m 2000 prices), the first NPV column taking into account route guidance benefits, the second without:

Table 3: Benefits of GALILEO				
Description of Benefit (Blended average discount rate 5,67% used at time study conducted)	**Annual values** **2010**	 **2020**	NPV 2008-2020 Based on NEI forecasts using PwC discount Rate	NPV 2008-2020 Based on sceptical assessment of benefits
Improvements in air traffic control				
Cost savings for airlines	323	2959	6,835	6,835
Time savings for passengers	162	1478	5,017	5,017
Marine navigation	214	1166	2,962	2,962
Route guidance:				
Cars	177	359	1,320	-
Trucks and buses	790	1789	7,060	-
Light commercial vehicles	530	1077	3,960	-
Total Benefits	2196	8828	**27,154**	**14,814**
Deployment & Development (2001-2008)			(2864)	(2864)
Operational Costs	(200)	(200)	(1032)	(1032)
Net Benefits			**23,258**	**10,918**

Source (annual values only): NEI Review of the Galileo Cost Benefit Analysis, June 2001

5.5.2. Environment impact

Space technology directly contributes to

– a better understanding of climate change and ecological processes;

– a global monitoring of environment and climate evolution or degradation;

– a control of greenhouse gas emissions, forestry, energy and water resources.

The environmental impact of the increased coordination option will be greatest in the area of the introduction of systematic monitoring of the environment, through GMES. GMES is the second flagship of the European Space Policy. GMES is a clear example of the benefits of implementing the European Space Policy, as it is a collaborative project, depending on the development of dedicated technologies, the construction of a space infrastructure by the European space industrial base, and long-term funding and running commitment from a federated European user-community. GMES aims at environment monitoring, but also at security monitoring.

The full system architecture for GMES is currently being established. Until this has been done, including decisions being taken on where it will be necessary to develop dedicated European infrastructure and where it will be possible to take advantage of investments made for other objectives, the full economic costs of each GMES service will not be known. It is for this reason that, as noted earlier, a separate impact assessment will be required.

Moreover, the benefits of GMES services will primarily be indirect. Just as accurate information on the money supply in the economy is of no value unless informed decisions and actions are based on the basis of it, the same will be the case for GMES. To secure these benefits will require investment both in GMES services and infrastructure and in delivery mechanisms within each of the policy areas identified. GMES will not therefore guarantee such benefits, only enable them.

However, the benefits of GMES have been evaluated in a major study *(G)* conducted by PricewaterhouseCoopers under a contract to the ESA. The assessment covers 25 years, with a 4 % discount rate applied to bring future benefits to today's values. The study's results find that benefits which GMES could enable can be quantified in today's net present value (note that "net" here means "discounted" and is not benefits net of costs). Tables 4 and 5 elaborate these.

GMES policy domain	Application of GMES services	Potential GMES Impact	Indicator to characterise GMES impact
Global environment	Climate change – reduction in uncertainty	Reduced Global damage costs imposed by climate change, through enhanced mitigation & reduced deforestation	Damage costs per tonne of Co2^{e} Climate value of forests per Ha
	Desertification	Reduced loss of productive land	Economic value per Ha of productive land
Development and aid	Humanitarian aid & food security	Improved health and welfare in Africa	Value of a Disability Adjusted Life Year in Africa
Security	Crises response in Africa	Improved health & welfare of refugees in Africa	Value of a Disability Adjusted Life Year in Africa
Natural resources	Agriculture	Efficiencies in monitoring CAP	CAP monitoring costs
	Biodiversity & ecosystem services	Reduced loss of forests	Existence value of biodiversity per Ha of forest
	Fisheries	Reduced illegal fishing	Value of illegal fish landings (per tonne)
European environmental protection	Air quality	Human health benefits	Statistical value of life in Europe
	Water Quality	Efficiencies in delivering the WFD	WFD monitoring costs Nitrate removal costs
	Land use	Reduced soil quality degradation Urban planning efficiencies, energy savings	Soil Thematic Strategy monitoring costs N/A
	Marine and Coastal environment	Reduced oil discharges	Economic cost of oil spill clean up
Risk & civil protection	Floods	Reduced flood impact in Europe	Health, welfare & property damage costs of flooding
	Forest fires	Reduced forest fire impact in Europe	Health, welfare & property damage costs of forest fires
	urban subsidence & landslides	Reduced geohazard impact in Europe	Health, welfare & property damage costs
	Industrial risk	Reduced industrial accident impact in Europe	Health, welfare & property damage costs
Sustainable growth	Competitiveness Efficiency savings	Improved cost efficiency for primary users of GMES information	Cost savings of primary users

Table 4 Indicators used in economic modelling of the value of GMES benefits (G)

PWC found that reducing scientific uncertainties in climate change could eventually produce benefits of more than €5bn per year. These could accrue, for example, in reducing the increase in the incidence of natural disasters or, more readily, in adapting for their effects (more accurate knowledge of the requirements to be met by flood defences etc). In addition, GMES could constitute a critical aspect of end to end infrastructure for reporting on rates of deforestation, permitting both the negotiation of international treaties and the further development of the market for off-setting forestry investments for enterprises aiming at carbon neutrality. The assessment is of a potential €1.0-4.4bn per year from consequential reduced deforestation; and around €240 million per year from reduced desertification.

In each case, the costs of current and foreseen activities are so huge that even a relatively small percentage benefit resulting from the introduction of GMES would produce substantial gains for society. For comparison, a NOAA study on the impacts in the US of droughts, floods and coastal storms calculated nearly $US 20bn and the impact assessment for INSPIRE was €1.2-1.8bn per annum. The PWC report is not out of line with these.

In development/aid, through improved functioning in both headquarters and field operations, as well as improved donor feedback and awareness, some €80 million of benefits could be enabled annually, while nearly €200 million per year could be achieved through a modest reduction in conflict-related injuries and deaths.

The benefits identified can be summarized as follows:

1. Efficiency savings delivered by GMES: These are the most straightforward to realise and are expected to begin immediately. These are projected to grow to around €310 million per annum by the year 2030. In aggregate the represent over 25 years, €2.8bn in present value terms.

2. Benefits accruing due to the development of new policies at European level: They are expected to begin around 2013. This includes applications in humanitarian aid, conflict resolution, air quality, flooding, and other applications in the Risk and Civil Security policy domain. These are projected to amount to €2.9bn per annum by the year 2030 (projected benefits rise incrementally over the appraisal period), €15bn in aggregate in present value terms (2013-2030).

3. Development of new global agreements and cooperation: Due to the difficulties inherent in realising these benefits, they are not expected to begin until 2025. This comprises GMES applications in the fields of desertification, deforestation and climate change. These are projected to total €7bn per annum by the year 2030 (these benefits are expected to accrue only in the longer term), or a total of €17bn in present value terms. However, because the long lasting nature of the benefits, the inclusion of terminal values increases the net present value to €120bn.

The study estimates that the potential GMES benefits accumulated over the 25 year period 2006-2030 would be comparable to 0.2% of current annual EU GDP.

Table 5: Summary of projected economic benefits: GMES 'Full Service' Scenario (€m, 2005 prices)

Benefit category	Projected benefit Areas	Out-turn 2012(a)	Out-turn 2020(a)	Out-turn 2025(a)	Out-turn 2030(a)	PV Benefit(ii)	PV Benefit including Terminal Value
One	Efficiency savings(i)	162	232	272	312	2,786	N/A
Sub-total		**162**	**232**	**272**	**312**	**2,786**	**2,786**
Two	Humanitarian aid	80	80	80	80	892	N/A
	Conflict Resolution	197	197	197	197	2,202	N/A
	Forest ecosystems (EU)	6	6	6	6	63	N/A
	Air Quality	-	-	1,675	1,675	4,167	N/A
	Marine	351	319	304	291	3,622	N/A
	Flooding	135	227	314	435	2,584	N/A
	Forest Fires	9	21	39	73	278	N/A
	Seismic applications	22	44	68	103	520	N/A
	'Other' Civil Security (landslides, infrastructure stability, industrial risk)	6	18	37	75	254	N/A
Sub-total		**807**	**913**	**2,719**	**2,935**	**14,582**	**14,582**
Three	Desertification			145	247	615	1,472
	Deforestation – climate			631	1,074	2,488	6,146
	Deforestation -ecosystem			65	75	185	258
	Climate change - adaptation			3,309	5,631	14,010	111,779
Sub-total				**4,085**	**6,952**	**17,298**	**119,655**
TOTAL		**969**	**1,145**	**7,076**	**10,199**	**34,666**	**137,024**

5.5.3. Security impact

GMES will also contribute to security monitoring. The contribution of Space to the European Security and Defence Policy has been the object of an extensive analysis in the document on "ESDP and Space" *(S)*, which provides for identified and agreed upon ESDP requirements to be reflected in the global EU Space Policy and its corresponding European Space Programme (ESDP Presidency report, endorsed by the European Council on 17 December 2004). Its analysis of the impact or contribution of space to security is as follows:

> "Space-based sensors have the advantage of unrestricted access over potential or actual areas of operation and areas that are otherwise difficult to gain access to for political or military reasons. They can provide evidence of illicit activities, therefore

contributing to the fight against those who would wish to undertake terrorist actions from foreign territory.

The EU therefore needs to achieve an adequate level of operational capabilities and readiness, to ensure its own security as well as for contributing to the world security, in accordance with the objectives set in the European Security Strategy, in particular in the conduct of Crisis Management Operations (CMOs). Space assets can contribute to many capabilities needed for any civilian and military operation, such as communications, intelligence, positioning and weather forecast. Intelligence gathering at the tactical level can often be met by military means other than space assets, such as drones or reconnaissance aircraft, where that is politically and operationally feasible."

None of the new security threats is purely military; nor can any be tackled by purely military means and peace keeping operations call for a comprehensive and holistic approach, which integrates military operations as well as the ensuing humanitarian aid activities and policing operations. The increased coordination option therefore envisages working towards better interoperability between civilian and military Crisis Management Operations (CMOs) teams, covering space-based applications for communications, earth observation, signal intelligence, early warning, positioning, navigation and timing. An increasing number of satellites are operated in a dual-use framework, and single-use systems become a thing of the past.

European states are moving ahead on the development of national security space capabilities, and are beginning to coordinate their initiatives. The increased coordination option would encourage sharing and pooling resources of the European civilian and military space programmes, drawing on multiple use technology and common standards, would allow significant cost-effective collective achievements.

The policy will provide the conditions for the maintenance and strengthening of the European industrial base, including the development of new and critical technologies. This will provide defence authorities access to guaranteed suppliers, not hampered by export controls. The policy also promotes the development of a mechanism to increase coordination between Member States' national defence space programmes, as well as increased synergy and interoperability between operational defence and civil systems.

The two following examples illustrate this not yet quantified risk:

- In 1998, the Galaxy IV satellite malfunctioned, shutting down 80 percent of US pagers, as well as video feeds for cable and broadcast transmission, credit card authorization networks and corporate communications systems. To restore satellite service, satellites had to be moved and thousands of ground antennas had to be manually repositioned, which took weeks in some cases. (source: Rumsfeld report)

- If the GPS system were to experience widespread failure or disruption, the impact could be serious. Loss of GPS timing could disable police, fire and ambulance communications around the world; disrupt the global banking and financial system, which depends on GPS timing to keep worldwide financial centers connected; and interrupt the operation of electric power distribution systems.(source: Rumsfeld report)

The European Space Policy calls for measures to be taken for the protection of critical space infrastructures, both civil and military.

5.5.4. Societal impact: the shift towards the knowledge-based economy

OECD economies are increasingly based on the production, distribution and use of information and knowledge. This is reflected in the growth of high technology investment and high technology industries, and in the growing role of highly skilled labour in the production of goods and services. *(P)* Space-based systems, transmitting data, voice and video, play a critical part in collecting and distributing information. Communication systems, payment systems and positioning systems are indispensable to the economic activity in the EU. GPS-based timing synchronisation is being used both for transportation-related digital communication links and other applications such as telecommunications and banking. Meteorological and environment monitoring networks are also critical. Their significance can be assessed by looking at the potential impact of any shutdown of part of our spatial infrastructure would have major consequences and freeze a significant part of the economic activity as well as impair considerably the organisation of emergency services.

Increased understanding of natural phenomena and of the impact of anthropogenic activity should provide the basis for sounder environmental policies. As well, the application of Earth observation to agriculture gives farmers new knowledge that they can use to adopt more effective agricultural practices. Even when the research effort does not directly serve economic and social objectives, it can have a major impact on society. For instance, space-based navigation systems, which were originally developed for military purposes, are finding an increasingly broad range of civil applications. *(P)*

The increased coordination option will accelerate the process of connecting EU policies to the potential benefits offered by space systems. Satellite communications might help to bridge the digital divide in the developing world and between developing and developed countries. Space-based solutions provide the means to create in short order a fully fledged communication network covering vast territories in countries where terrestrial facilities are underdeveloped or inexistent. *(P)* Experience in India tends to show that well-managed programmes can be useful in promoting education via satellite in large populations. Satellite links may be the only way to bring education to certain regions of the world that are remote and/or lack ground infrastructure. Though distance learning is not a perfect substitute for traditional education, it is a way to help disseminate knowledge and skills to a larger audience. If they are to work effectively, programmes must be well thought out, taking into consideration a country's linguistic diversity (*e.g.* different dialects). For education, this can be achieved through active networking by schools, colleges and universities. The main difficulty in developing such applications is the cost of developing the programmes and cost-efficient use of communications satellites links. *(P)* Bringing aid programmes and space technologies together can help to overcome this.

Satellite applications can also be used for expanding medical support in developing countries. In the 1990s, the Indian government already launched a subcontinent-wide telehealth programme to provide medical support to villages via a satellite network, as part of its strategy to develop space applications for sustainable development and Europe can build on this example in other regions, particularly Africa. At a telemedicine workshop held in Brussels in January 2006 (eHealth for Sub-Saharan Africa, Opportunities for Enhancing the Contribution of ICT to Improve Health Services: TELEMED Task Force), the importance of satellite telecommunication technology as a key asset for supporting health systems in Sub-Saharan Africa (SSA) was clearly demonstrated. With its 47 countries and 750 million inhabitants (2005 figures), it has the highest burden of communicable diseases such as HIV/AIDS, tuberculosis, and malaria and an average life expectancy at birth of 46 in 2004.

Health service coverage is low, as for example figures for immunisation coverage and the numbers of births attended by skilled personnel show. The region faces a serious health workforce crisis, due to the migration of doctors and nurses to more developed countries, and also due to the death of skilled personnel from disease.

At European level, it has been argued that satellite communications might facilitate the integration of member states and make it possible to improve the quality of services to citizens, companies and public authorities more rapidly by reinforcing the communications infrastructure linking the new members with the rest of the Union, and by facilitating cultural exchange, in particular, by television broadcasting via satellite *(U)*.

5.6. Comparison of options

No European Space Policy could result in a failure to see GMES through to operational status; continued lack of coordination in civil space in Europe; an under-exploitation of civil and military synergies and continuing lack of interoperability; and under-utilisation of space systems by European public policies, resulting in lost opportunities for increased efficiency and effectiveness. The option of no change is the base case against which other options are measured. In the impact assessment supporting study, this option is taken as the base case against which other options are measured. On the basis of the criteria used to make the assessment, all other options would score more highly.

Changing the political framework for space in Europe to a fully EU framework could permit more effective coordination arrangements, including dual use, providing all Member States with an effective means to take part in space activities. It would create a clearer programmatic framework all stakeholders. It would be established in a way to avoid the need for negotiations with the Commission on each programme. However, it has a number of uncertainties which have still to be reduced. Space activities would need to encompass also Pillar 1. The legal base for an inter-pillar agency allowing variable participation in each programme requires further study. Further analysis is required of whether changes might be necessary to the financial and industrial policy rules of ESA, if its activities were to become intergovernmental under the Treaty.

Radical change – Community framework, substantial budget increase would have two main features: a transfer of activities from national and intergovernmental frameworks to a Community framework; and an increase of European civil space expenditure of between one quarter and one third. This could provide a framework for the Commission to develop a farsighted strategy for the development and use of space systems for the benefits of EC policies and the resources to implement it. There would be a single set of decision-making bodies. Industry would have a more secure framework for investment. This does, however, presuppose the percentage of support for R&D projects would continue at the current level, in many cases 100 per cent.

The radical option would represent a substantial commitment of all Member States to a strengthened space investment, increasing investor confidence. It would involve the transfer of more than €6bn per annum from intergovernmental and national expenditures to the Community budget, along with a pooling of decision making on priorities. There is every indication that Member States have no wish to pursue this approach at this point in time.

The overall results of the impact assessment supporting study were that, <u>in the longer term</u>, further consideration should be given to a Community Agency or an EU Agency.

Increased coordination and growing use of space applications to deliver other European policies would provide visibility on European institutional programmes and pave the way for immediate steps towards their better coordination. The process of increasing flexibility into the ESA rules could improve further the efficiency, specialisation and competitiveness of European industry.

- The **societal impact** of space-based systems is substantial. The increased coordination option will accelerate the process of connecting EU policies to the potential benefits of space systems.

- **The environmental impact** of the increased coordination option will be in the introduction of systematic monitoring, through GMES. The benefits of GMES have been evaluated in a major study[6] conducted by PricewaterhouseCoopers. Work is in hand to estimate the costs of a sustainable system.

- **Satellites contribute to security and defence policy.** The increased coordination option would encourage sharing and pooling resources of the European civilian and military space programmes; drawing on multiple use technology and common standards.

6. MONITORING AND EVALUATION

DG-ENTR will conduct an updated review of the sector at 2-3 year intervals.

Pending any decisions relating to the longer-term, the Joint-Secretariat will conduct an evaluation of the operation to date of the EC-ESA Framework Agreement as a basis for a decision on the prolongation of the agreement when the first four year period of its life expires in May 2009.

Building on the preliminary analysis in the RPA and the parallel impact assessment being undertaken by ESA consultants, the Joint Secretariat will conduct an appraisal of the main possible cost-efficient scenarios for optimising the organisation of space activities in Europe in the future. This evaluation will be presented to the 'Space Council'.

[6] PricewaterhouseCoopers July 2006: Socio-Economic Benefits Analysis of GMES, prepared for ESA

ANNEX 1: THE EUROPEAN SPACE INDUSTRY

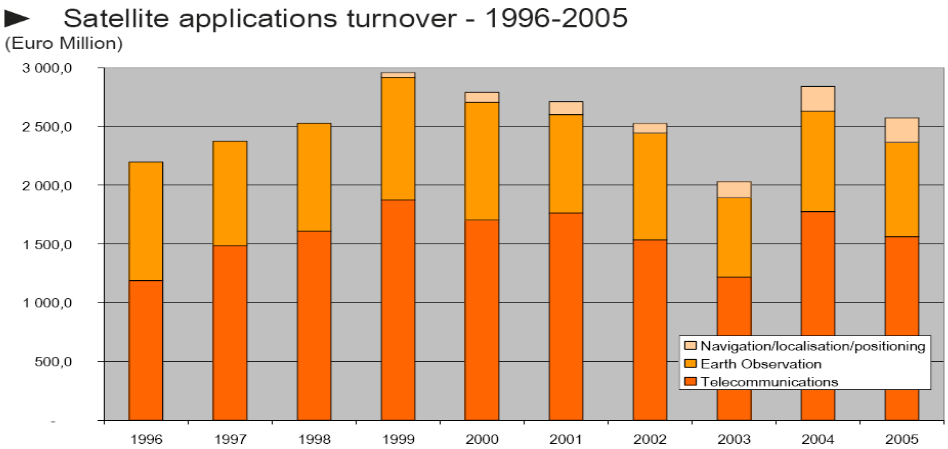
The European Space Industry can be differentiated with three main areas of activity:

First The most important domain, in terms of business, are satellite applications. Revenues here come from sales of operational systems. They also include revenues from R&T activities, prototypes and research on future systems. Satellite applications are:

– Telecommunications: this includes a large share of commercial and operational systems for video, data and voice applications. Customers for operational telecommunications systems are mostly commercial satellite operators.

– Earth Observation (including meteorology): this area of application includes a variety of systems and technologies, with operational systems (such as the Meteosat or Spot systems) and research for future systems and sensors. Customers for EO systems are mostly found in the public domain, including the military.

– Navigation/localisation: this is a relatively new area of development for the space industry in Europe. Fuelled by Galileo development programmes, this area should grow significantly when the Galileo system rollout begins. *(N)*



(N)

Figure 8

Second, in terms of volume, is launchers.

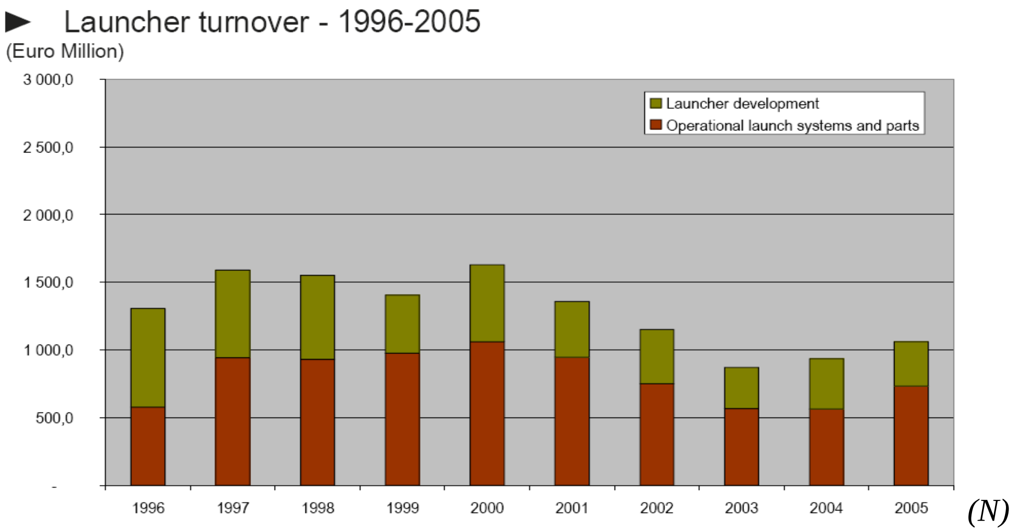


Figure 9

Third are customers for science satellites and research, which are exclusively public institutions. Activities included here are:

– Space infrastructure and manned programmes, with the European participation in the ISS programme representing the larger share in the past decade (ATV activities are included also).

– Science, including Earth and space science, a rather stable activity domain, due to the fact that science programmes are funded in majority through ESA mandatory programmes.

– Microgravity activities.

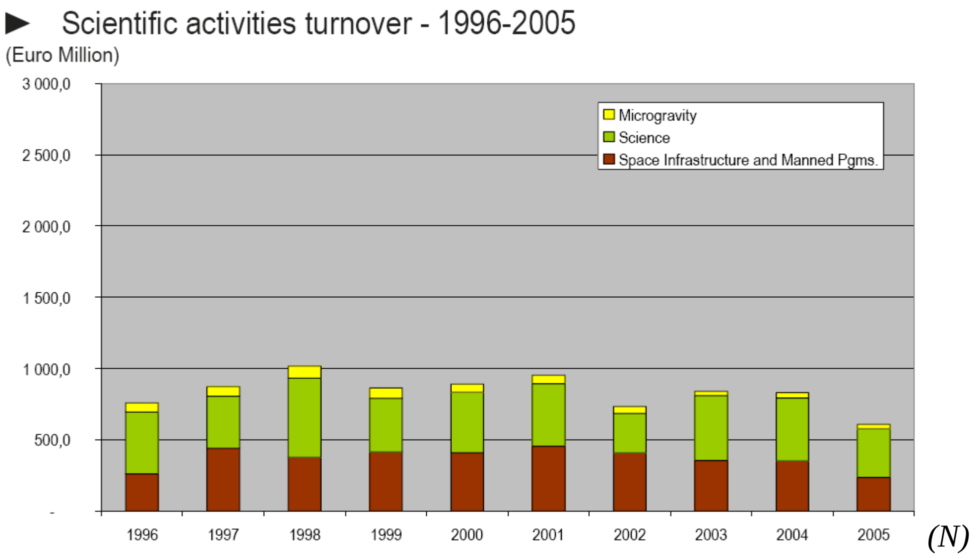
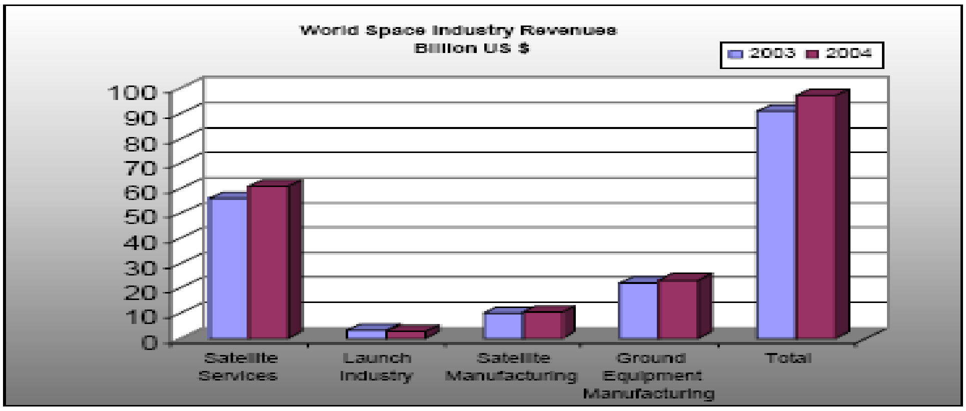


Figure 10

ANNEX 2: A COMPLEX INDUSTRIAL AND COMMERCIAL SPACE VALUE CHAIN

The global launcher and satellite manufacturing industry



(SIA- Futron Co. - State of the World Satellite Industry – June 2005)

Figure 11: World space industry revenue 2005

The world satellite manufacturing industry currently includes a total of 20 companies, of which six (the main players) compete internationally for the prime contractorship of commercial geostationary (GEO) satellites. Euroconsult (2004) suggest that, since the year 2000, the market balance has been shifting away from the dominance of the US companies. As of mid-2004, the two main European manufacturers, EADS Astrium and Alcatel Alenia Space, were controlling about 40% of the industry's backlog value, up from 20-25% in the 1990s (Euroconsult, 2004). In 2005, the US share of manufacturing revenues fell to 41% (Futron, 2006).But CAST and ISRO are entering actively the international market.

However, the European space manufacturing sector has experienced low margins, declining revenues and a reduction in employment since the year 2000 *(N)*. Furthermore, Futron (2006) report that whilst, globally, the sector declined by 24%, US satellite manufacturing only declined by 18%, suggesting a greater decline in the European industry. This decline, globally, was due to a number of reasons, including:

– lower government contract revenues, with the average price of government payloads launched in 2005 being 69% lower than those launched in 2004 (Futron, 2006); and

– significant progress in terms of the durability and capacity of spacecraft, which has reduced the need for additional satellites.

Table 6: Satellite manufacturers worldwide ***(K, from Euroconsult 2004)***

	GEO & non-GEO satellites	Non-GEO satellites
Satellite manufacturers competing domestically & internationally	Boeing Satellite Systems (US) Lockheed Martin (US) Space Systems/Loral (US); EADS Astrium (Europe) Alcatel Alenia Space (Europe) Orbital Science Corp (US)	SSTL (UK)
Satellite manufacturers competing domestically (mainly or exclusively)	Northrop Grumman (US) NPO-PM (Russia) RKK Energia (Russia) NPO Yuzhnoe (Ukraine) NEC-Toshiba (Japan) Mitsubishi Electric (Japan) Israel Aircraft Industry (Israel) CAST (China) ISRO (India)	General Dynamics (US) Bell Aerospace (US) McDonald Dettwiler (Canada) OHB System (Germany)

The world launcher market is shared by four key players for its commercial part (figures average from 1994 to 2003):

– **Arianespace** (Ariane 4 (phased out in 2003) and Ariane 5 (first launched in 1999)) (Europe) (46%);

– Lockheed Martin markets and sells non-military launch services on the Atlas and the Russian Proton through **International Launch Services (ILS)**, a joint venture with Khrunichev State Research and Production (27%);

– **Sea Launch** is an international partnership between The Boeing Company, RSC Energia of Russia, Kvaerner ASA of Norway, and SDO-Yuzhmash/PO-Yuzhmash of Ukraine. (Boeing contributes the composite payload fairing and payload mating adapter, while Yuzhmash contributes the first stage and Energia, the upper stage). The Zenit 3SL is launched in the Pacific Ocean, aboard a converted mobile oil rig (13%);

– **Khrunichev** (Proton) (Russia) (7%).

This share looks set to continue; as of May 2004, 35% of the $13.7bn minimum market for commercial launches over 2004-2013 had been firmly contracted, with Arianespace, Boeing and ILS together representing 82% of the orders already placed. Worldwide, two launchers could challenge the three main contenders in the coming years: ISRO (India, GSLV) and China Great Wall Industry Corp. (China, Long March). Japan seems to focus on its national market. The entry of low-cost launchers such as the Space Exploration Technology (SpaceX) Falcon may represent a major competitive threat for established launcher manufacturers, with pricing aimed at 70 percent less than them.

In 2005, Lockheed Martin and The Boeing Company announced the formation of a joint venture, called the United Launch Alliance, which would merge the Delta IV and Atlas V manufacturing, operations, and sales. ULA will combine the production, engineering, test and launch operations associated with **US government launches** of Boeing Delta and Lockheed Martin Atlas rockets.

Despite the decline in business in recent years, the supply side has not cut back; new launching capacity has come on stream, leading to significant over-capacity. Arianespace was in the red for three years over the 2000-02 period, with a cumulative loss of €538 million ($677 million). However, the company's situation improved in 2003 and it has returned to profitability. The EGAS Ariane programme has two main objectives:

– to provide Europe with *guaranteed* access to space by securing the capability to offer reliable launch services for at least six launches a year over a period of five years; and

– to foster the creation of a European institutional market for the Ariane launcher, maximising its use by institutions through competitive market prices, reliable service and launch priority.

The European launcher and satellite manufacturing industry

European space segment suppliers had a turnover of €4.4bn in 2005, with a workforce of 28000, spread over all European states. *(N)*It is a niche strategic sector, embedded in the wider European aerospace and defence industry. As highlighted in 2.2.1, the market shares of European companies are impressive on the international commercial market, proving their present competitiveness.

The space segment suppliers are distributed across Europe, with the main industrial sites located in France, Germany and Italy, and, to a lesser extent, the UK, Spain and Belgium. The concentration ratio of turnover and employment is high within the sector; five large industrial groups (Alcatel, EADS, Finmeccanica, Safran, and Thales) are directly responsible for more than 80% of the total space industry employment. (For more details on the European Space Industry, see Annex 1)

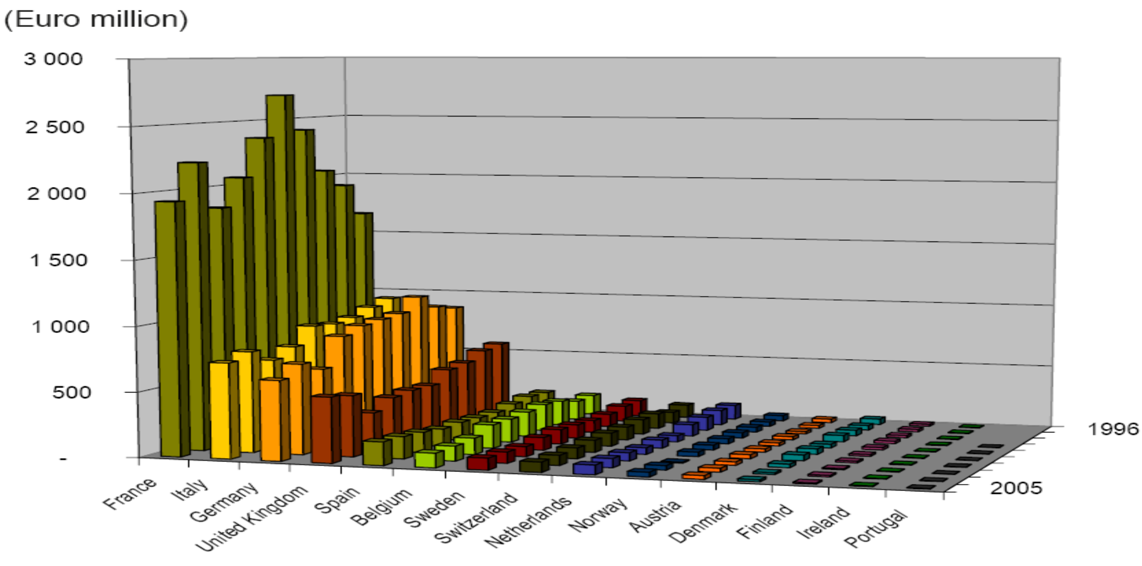


Figure 12: Space industry consolidated turnover by country - 1996-20051 *(N)*

The concentration is linked to the large fixed sunk costs necessary to develop, test and bring to market various technologies. For example, the Ariane 5 launch vehicle took 10 years to develop at a cost of $9bn (Space.com, 2000). Such investments, and associated risks and uncertainties preclude many countries from developing domestic space industries and have pushed them to invest through ESA. Fragmentation is, however, still clearly observed in many parts of the industry, particularly in military space sectors where security concerns are important. This is recognised by the ESA (2003) which characterises the equipment and subsystem supplier industry as rather fragmented with a high degree of duplication of competences amongst the equipment suppliers and between the equipment suppliers and the system integrators. *(K)*

The trend towards consolidation has not, however, occurred in the case of the small, micro and nano satellite markets, where development costs are significantly lower due to less onerous technology requirements and the experimental nature of the spacecraft being developed and SMEs can compete on the basis of lower overhead costs. The same is true of subsystem suppliers, including spin-in technologies from related industries.

The number of SMEs in the space segment is rather small, despite the fact that most industrial activities are carried out by small space units. Small dedicated space units are usually fully integrated in larger companies or controlled by larger companies and groups (as above but also Siemens, Sagem, RWE and Fuchs). SMEs represent less than 5% of the total space industry manufacturing employment, whereas small space units (within larger companies) represent around 20% of the total *(N)*. However, it is of note that non-space specific SMEs may be involved as subcontractors to prime contractors.

Satellite services market

Compared to terrestrial solutions, there are a large number of applications needing communication connectivity which can be delivered by satellite. The only major technical drawback satellite has is the latency due to the path delay from ground to the satellite and back. A significant advantage that satellite has for many applications is the wide geographical coverage. But the competitive position of satellite communications with respect to terrestrial services is not strong: *(I)*

Satellite competitive position	*Total Score*	*Application*
Clear advantage	>+2	Military, audio broadcasting, mobile audio broadcasting, TV broadcast, TV and radio contribution, search and rescue, Air Traffic Management, SCADA
Slight advantage	+1, +2	Messaging, Asset Tracking, infrastructure backup, management of emergencies
Broadly neutral	0	e-health, e-learning, thin route telephony backhaul
Slight disadvantage	-1,-2	Fax, teleworking, e-commerce, e-government, business TV, video applications on the internet, audio applications on the internet, video conference
Clear disadvantage	<-2	Trunking, Internet access, personal content distribution, basic internet applications, fixed voice telephony, mobile voice telephony, VoIP telephony, internet gambling and gaming, , audio conference

Table 7: Summary of the competitive position of satellite delivery with respect to terrestrial delivery (*I*)

To date, the commercial satellite market has evolved through three demand cycles, each corresponding to a new generation of spacecraft technology with improved performances.

Significant **technological advances** that have been achieved and have strongly impacted demand for spacecrafts relate to (Euroconsult, 2004):

– the average bandwidth available on a satellite has almost doubled over the past ten years with currently about 1,600 MHz per satellite provided, mainly in C-band and Ku-band frequencies. The introduction of Ka-band transponders on hybrid satellites significantly increases that average;

– the operational lifetime of communications satellites has also increased, at a rate of about two years per generation, from 6-7 years in the early 1970s to 14-15 years for the satellites currently being launched; and

– the launch mass of commercial communications satellites has grown steadily, from 750kg in the early 1970s to about 2,000 kg in 1991, as a result of operator's needs and the availability of more powerful launchers. The average mass of satellites launched in 2004 was 4,000kg.

Growth in the third demand cycle stopped a few years ago because of the restructuring of the satellite operators due to market pressures. To maintain profitability (in the face of decreasing demand and overcapacity), operators had to cut capital expenditure on acquiring and launching satellites (Euroconsult, 2004). However recovery seems on its way.

Companies active within the satellite communications markets can be divided in to:

– **retailers** ($ 17bn turnover in 2004)– providing services direct to the consumers (e.g. business to customer) – these can be further divided into direct-to-home television broadcasting (*DBS*) and digital audio broadcasting (*DAB*), both concentrated in the US;

– **wholesalers** ($ 7bn turnover in 2004)– providing capacity for professional users (e.g. business to business) – these can be further divided into *fixed satellite services* (FSS) and *mobile satellite services* (MSS), with Europe the largest market for FSS services since the mid-1990s, driven by the growth of SES Astra (part of SES Global) and Eutelsat. Recent consolidations in the sector led to the creation of two giants controlling more than 50% of the FSS commercial market: Intelsat + PanAmSat, and SES + New Skyes. This concentration enables those operators to exercise a considerable price pressure on the satellite manufacturers.

The FSS industry is a capital-intensive sector, generating high depreciation and amortization costs, with relatively low costs of sales and operation. The FSS industry experienced considerable growth over the years 1990-2000 with annual growth rates over 10% in both revenues and transponder demand. However, due to a stagnant transponder demand[7]

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7 Euroconsult (2005b) indicates that global transponder demand increased by around 2.8% in 2004 (up from 1.7% in 2003 and a negative growth of 0.5% in 2002). The number of transponders leased is also estimated to have increased from around 4,100 units in 2000 to around 4,400 units in 2004. North America (1,182 units), Asia Pacific (1,037 units) and Western Europe (730 units) accounted for around 70% of transponder demand in 2004. This represents a 1.5% compound annual growth rate (CAGR) over the period which, when compared to a 10% CAGR in the mid-nineties, highlights the maturing of the business.

They are on average 40 transponders on a satellite. Since 1998, the average revenue derived per year from a 36MHz transponder has been decreasing. This decrease was stopped in 2000 (by one-off events) and between 2000 and 2002, the average revenue per transponder decreased at a CAGR of 3.6% - to a world average of $1.66 million per year. In general, the average revenue per combined with decreasing transponder lease prices, revenues declined in recent years but are now recovering. The FSS industry is a profitable business, with average profit margins in 2004 of 60% for EBITDA, 21% for operating profit (EBIT), and 16% for net profit. The FSS industry has already started purchasing satellites from Indian and Chinese manufacturers.

ANNEX 3: SPACE & TECHNOLOGY

Research and development activities on space technologies are funded mainly through National specific programmes and ESA programmes, roughly on a nearly equal basis. In total, near to €380 million are invested yearly by ESA Member States in space technology R&D programmes, corresponding to 6% of the total European investment in civil space applications. Within ESA alone, technology R&D programmes amount to 6,5% of ESA global budget.

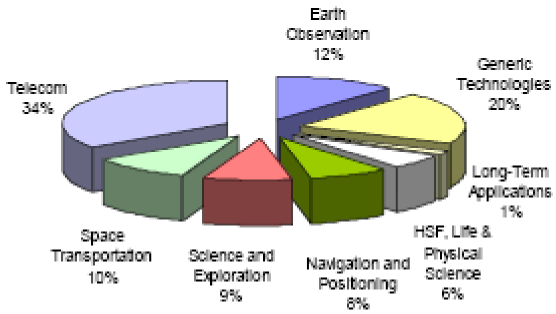

Figure 13: Share of European investment in space technology R&D, by service domains (M)

Telecommunications is the domain where Europe spends the most of its R&D budget (34%), followed by Earth Observation (12%), Space Transportation (10%), Science & Exploration (9%) and Navigation, while 20% of the budget is spent in horizontal R&D activities, applicable across a different number of technology domains.

A complete landscape of on-going and planned space technology developments, mainly conducted through ESA and National programmes, is comprehensively described in the *European Space Technology Master Plan (ESTMP)*. The requirements for new technology developments are mapped in the *European Space Technology Requirements Document*. Furthermore, the ESA *Technology Long Term Plan* (TLTP) presents the technology development objectives and needs for all service domains, to prepare future programmes and support Industry competitiveness, indicating the forecasted ESA funding needed for the coming decade (2006-2015).

Technology developed in association with space activities is used in many industries and non-space applications. Technology is transferred through intentional efforts by governments to identify new applications, as well as through organic adaptation of technologies, via connections among researchers, labs, and companies *(H):*

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transponder varied from region to region - ranging from \$0.89 million to \$2.9 million in 2004 across various world regions. Western Europe generated a higher average revenue per transponder than any other region - the quasi-duopoly for satellite TV broadcasting being a major influence. In 2004, the average revenue per transponder grew by an estimated 3.6% to \$2.9 million. Most of this growth has been generated by the continuous decrease of the US dollar exchange rate (vs. the Euro) in 2004 - apart from which the prices have been relatively stable over the last five years (Euroconsult, 2005b).

Table 8: Space Foundation Space Technology Hall of Fame Inductees	
Active Pixel Sensor	Advanced Communications Technology
Advanced Lubricants	Anti-Corrosion Coatings
Anti-Shock Trousers	Automatic Implantable Cardiovertor Defibrillator
Cochlear Implant	Cordless Tools
Data Matrix Symbology	DeBakey Blood Pump
Digital Image Processing – Medical Applications	Digital Latching Valve
Direct Readout Satellite System	DirecTV
Earth Resources laboratory Applications Software – ELAS	Excimer Laser Angioplasty System
Fabric Roof Structures	Fire-Resistant Aircraft Seats
Global Positioning System (GPS)	Heat Pipe Systems
Humanitarian Demining Device	Improved Firefighter's Breathing System
InnerVue Diagnostic Scope System	iROBOT PackBOT Tactical Mobile Robot
LADARVision 4000	Light Emitting Diodes – Medical Applications
Liquid-Cooled Garments	MedStar Monitoring System
Miniature Accelerometer	Monolithic Microwave Integrated Circuit Technology (MMIC)
Multi-Junction (MJ) Space Solar Cells	NanoCeram Superfilters
NASA Structural Analysis Computer Software – NASTRAN	Novariant RTK AutoFarm AutoSteer
Outlast Smart Fabric Technology	Parawings or Hang Gliders
Physiological Monitoring Instrumentation	PMR-15 Polymide Resin
Portable Hyperspectral Imaging Systems	Power Factor Controller
Precision Global Positioning System (GPS) Software System	Programmable Implantable Medication System
Quantum Well Infrared Photodetectors (QWIP)	Radiant Barrier
Safety Grooving	Satellite Radio Technology
Scratch Resistant Lenses	Sewage Treatment With Water Hyacinths
Stereotactic Breast Biopsy Technology	Tempur Foam
Video Image Stabilization and Registration (VISAR)	Virtual Window
VisiScreen (Ocular Screening System)	

Table 7: Technology Transfer Successes Reported by ESA in 2005	
21 Nov 2005	Imaging industrial products
03 Nov 2005	Space tech onboard transatlantic racer
20 Oct 2005	Space concepts improve life in the desert
13 Oct 2005	Bat inspires space tech for airport security
26 Sep 2005	Gourmet space dinner on Greenland icecap
22 Sep 2005	Motorcyclists keep their cool
10 Aug 2005	Fastnet yacht runs faster with space technology
06 Jul 2005	Sun-powered aircraft to support sustainable development
21 Jun 2005	Ready for dinner on Mars?
24 May 2005	€50.000 for good satellite navigation ideas
28 Apr 2005	Space tech comes down to Earth
21 Apr 2005	Space technology on winners' podium
17 Mar 2005	Test-drive ESA technology
21 Feb 2005	Ariane 5 technology turns the lights on
15 Feb 2005	Space 'eye' for textiles
15 Feb 2005	Space 'eye' gives cloth quality colour control
27 Jan 2005	Telemedicine is healthcare's new frontier
12 Jan 2005	Giant robot helps prevent landslides

APPENDIX I: DIRECTORATES GENERAL REPRESENTED IN THE SPACE TASK FORCE

Directorate General Agriculture and Rural Development

Directorate General Bureau of European Advisers

Directorate General Competition

Directorate General Development

Directorate General Education and Culture

Directorate General Energy and Transport

Directorate General Enterprise and Industry

Directorate General Environment

Directorate General EuropeAid

Directorate General External Relations

Directorate General Fisheries and Maritime Affairs

Directorate General Health and Consumer Protection

Directorate General Information Society and Media

Directorate General Internal Market and Services

Directorate General Joint Research Centre

Directorate General Justice, Freedom and Security

Directorate General Legal Service

Directorate General Regional Policy

Directorate General Research

Directorate General Secretariat General

Directorate General Trade

APPENDIX II: OPINION OF THE IMPACT ASSESSMENT BOARD AND THE AMENDMENTS MADE IN RESPONSE

Opinion of the European Commission Impact Assessment Board

"(A) Context

The Communication on the European Space Policy is a CLWP 2007 strategic initiative. It was preceded by the Framework Agreement (2003) for EU-European Space Agency cooperation, the publication of a Green Paper and White Paper (2003) on European Space Policy and a Communication of the European Commission 'European Space Policy - Preliminary Elements' (2005). The Competitiveness Council of the EU and the Ministerial Council of the ESA, meeting under the auspices of the EC-ESA Framework Agreement in June 2005, confirmed the need for outlining a European Space Policy, and this communication is a joint product of both organisations.

"(B) Positive aspects

(1) Notwithstanding the recommendations hereinafter for a more clear-cut problem definition, the IA is particularly rich. A clear dynamic perspective is given and future problem drivers and tendencies in the field of competitiveness and access to space are analysed in great detail which succeeds in providing an articulate picture for the policy makers.

(2) Input from the stakeholder consultations (both the consultations held during the preparation of the previous Green Paper and the subsequent more focused consultations) is well integrated. Justification is provided in cases when views were not taken into account.

"(C) Main recommendations for improvements

The recommendations below are listed in order of descending importance. Some more technical comments will be transmitted directly to the author DG.

General recommendation: The IA report needs some reworking in order to bring out better how the objectives pursued relate to the underlying problems, the feasible option(s) in relation to the possible scenarios, as well as the challenges for further cost-benefit analysis.

(1) **The IA report should better clarify what the preferred option entails.** The description of the status quo (baseline), the objectives (and how these relate to the problems identified), and the proposed measures need to be clarified - the IA report is supposed to be meaningful as a stand-alone document. Moreover, it needs to be made clear that GMES and Galileo (and their costs and benefits) are fully part of the preferred option and not considered to be part of the status quo.

(2) The feasibility of the various policy options needs to be addressed early on in the assessment. **This could lead to the development of a single option (the proposed strategy) but with the analysis focused on the components of this option (i.e. the suboptions). If it is obvious beforehand that certain policy options are politically unfeasible, for instance**

because they fall outside the mandate that was given to the Commission, this ought to be addressed and taken to its conclusion as part of the problem definition. Alternatively, the options should have a logical and explicit link with the problem definition and should be assessed in detail before being discarded. Such an approach would ensure that options that score better in the overall comparison are explicitly contrasted with the option that is considered feasible, given the political constraints. In this context, a better structured problem definition broken down by the different market segments (space launching, non-commercial, commercial and military satellites) could help sharpen the analysis and evaluating the different options.

(3) The IA report should at least give some qualitative analysis of the costs or cost elements associated with the strategy. **The IA report should avoid giving the impression that the projected benefits will be delivered at zero cost, notably for the GMES. However, it is understood and in line with the principle of proportionate analysis that the cost analysis will be developed later when more specific initiatives and associated funding will be proposed.**

(4) The linkage between policy options and market scenarios needs clarification. **Some of the market scenarios seem to presuppose a particular policy option. More could also be done to explain on which assumptions these market scenarios were developed, and that these are building on well-known or widely accepted sources (such as OECD work).**

(5) The discount rate used needs explanation**. It is not in line with the IA guidelines, but this can be accepted provided that it is explicitly specified that this was not a deliberate choice of the Commission as it has based itself on existing work produced by external resources.**

"(D) Procedure and presentation

The IA report generally follows the format set out in the IA Guidelines, but the "comparison of options" is missing."

Main changes introduced since the Board has given its opinion

The following are the main changes which have been introduced since the Board delivered its opinion (including changes introduced for other reasons).

- A new section (2.6) has been included in the problem definition, concerning regulatory issues.
- The description of the second option (that which was in the event pursued in the Communication) has been substantially re-drafted (section 4.2)
- Section 5.1 now includes an explanation of the political constraints and their impact on option selection.
- Section 5.5 now clarifies the use of discount rates, the nature of the investments required to unlock achievable benefits from GMES and specifies again that GMES funding proposals will be the subject of a dedicated impact assessment.
- Section 5.6 has been introduced to make a succinct comparison of the options.