Framework Service Contract for the Procurement of Studies and other Supporting Services on Commission Impact Assessments and Evaluations

Interim, final and ex-post evaluations of policies, programmes and other activities

Evaluation of the Impact of European Space Policy on European Space Manufacturing and the Services Industry

Final Report

Appendices A- I

August 23rd 2012

Centre for Strategy & Evaluation Services

P O Box 159
Sevenoaks
Kent TN14 5WT
United Kingdom
www.cses.co.uk

Contents - appendices

Interviews A

A. Interviews

A list of interviews carried out is provided below. The names have been anonymised in accordance with evaluation good practice and the rules of CSES' Framework Contract with DG ENTR:

No.	Organisation	Role	Type of stakeholder
1	European Commission	Space policy and coordination unit H2	EC
2	European Commission	EU Satellite Navigation Programmes – infrastructure	EC
3	European Commission	EU Satellite Navigation Programmes – infrastructure	EC
4	European Commission	GMES Bureau	EC
5	European Commission	DG INFSO	EC
6	European Commission	DG MARE	EC
7	European Commission	DG Regio	EC
8	DLR – Germany	Director - Space Programmes	National space agency
9	DLR – Germany	Official, Space Strategy and Programmes, SMEs	National space agency
10	DLR – Germany	Adviser on space policy issues	National space agency
11	BMWi, Federal Ministry of Economics and Technology	Policy official, Division VII B3, Space Technologies	National authority
12	BMWi, Federal Ministry of Economics and Technology	Legal specialist, Division VII B3, Space Technologies	National authority
13	Astrium DE (Infoterra)	Director, Institutional Markets	Industry / large firm
14	SpaceTech GmbH	CEO	Industry / SME
15	DKE Aerospace	CEO	Industry / SME
16	Enterprise Estonia	Head of Estonian Space Office in Enterprise Estonia	FP7 beneficiaries / National Agency
17	SAFRAN	Director European Affairs (Corporate Senior Vice-President Space)	Industry / large firm
18	Ministère de la recherche (France)	Chef du département Organismes spécialisés	National authority
19	Ministère de la recherche (France)	Chargé de mission INRIA, ONERA, ANFr et spatial UE	National authority
20	Astrium (Astrium Services)	VP - GMES and European Institutional Business Geo-Information Services	Industry / large firm
21	ESA	Policies Department - Directorate of ESA	ESA

Interviews

A

		Policies, Planning and Control	
22	Sistema	Space Business Manager	Industry / SME
23	OHB	Strategic Director	Industry / large firm
24	ESA	Director for Procurement, Financial Operations and Legal Affairs (D/PFL)	ESA
25	ESA	Cabinet of Director General	ESA
26	Arianespace	Technical Director	Industry / large firm
27	Arianespace	European and International Affairs officer	Industry / large firm
28	UK Space Agency	Assistant Director	National space agency
29	ASI - Italian Space Agency	National and International Relations Department	National space agency
30	ASI - Italian Space Agency	National and International Relations Department Responsible for SME's office	National space agency
31	ASI - Italian Space Agency	National and International Relations Department Responsible for National and International Agreements Office	National space agency
32	ASI - Italian Space Agency	National and International Relations Department	National space agency
33	AIPAS	General secretary	SME Association
34	Vitrociset	Vice President, Space and Transport	
35	Sitael	Director	Industry / SME
36	Thales Alenia Space S.p.A.	Head of Initiative on Security, Institutional Customer and Business Development	Industry / large firm
37	EURAC	Director	Research institute (Space)
38	Centrum Badan Kosmicznych	Director	Institute
39	Kosmonauta.net	Director	Industry/SME
40	Ministère de la Défense	Commandement Interarmées de l'Espace	National Authority
41	Ministère de la Défense	Commandement Interarmées de l'Espace	National Authority
42	University of Thrace	Department of Electrical and Computer Engineering, Democritus	Research institution
43	France Development Conseil	Director	Other

Interviews

A

44	Fondation pour la Recherche Strategique	Member	Other
45	University of Surrey	Researcher	Research institution
46	EARSC	Secretary general	Industry Association
47	NEREUS	Secretary general	Regional association
48	DG ECHO	EC - MIC	European Commission
49	Eurospace	Head, Brussels Office	Industry Association
50	ASTOS	Director, SSBV (SME) and of ASTOS (SME Association)	SME Association
51	SELEX Galileo	Electro-Optical Payloads Marketing & Sales Manager Space Division	Industry / large firm
52	SSTL	Head of EU policy	Industry / large firm
53	International Space Innovation Centre (ISIC), UK	Collaborative R&D and Partnership Development	Innovation and technology agency
54	EGeos	Director, data commercialisation	Industry / large firm
55	EGeos	Head of Earth Observation	Industry / large firm
56	Astrium FR	Sales & Business Development Manager, GEO-Information Services	Industry / large firm
57	Astrium FR / Spot Image	Defence & export control	Industry / large firm
58	UK Space Agency	Head of Earth Observation	National space agency
59	National Oceanic and Atmospheric Administration (NOAA)	Commercial remote sensing industry expert	International agency
60	Independent expert	Expert on remote sensing legislation	Other / space law expert (France)

An Evaluation Steering Group ('ESG') provided steering during the study assignment. This was comprised of officials from the commissioning body, Unit HI Space Policy and Coordination, and from wider Commission services, namely the evaluation function in Unit A4 Planning and Management, and officials from Unit H2 Space Research and Unit H4, the GMES Bureau, GP1: EU satellite navigation programmes : Programme Coordination and Infrastructure, GP2: EU satellite navigation programmes : Legal, Financial and Institutional Aspects, GP3: EU satellite navigation programmes: Applications, International Matters and Security.

Bibliography B

B. Bibliography

In this appendix, a complete reference list of bibliographical sources consulted is provided:

Council Decisions

- Council of the European Union, "Council Decision on the signing of the Framework Agreement between the European Community and the European Space Agency", Brussels, 7 October 2003, http://ec.europa.eu/enterprise/policies/space/files/policy/european_communityandeuropeanagencyframeworkagreement_en.pdf

Green papers/ white papers

- Commission of the European Communities, Green Paper on "European Space Policy", COM(2003) 17 final, Brussels, 21.1.2003, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2003:0017:FIN:en:PDF
- Commission of the European Communities, White Paper on "Space: a new European frontier for an expanding Union - An action plan for implementing the European Space policy", COM(2003) 673 final, Brussels, 11.11.2003, available at http://eur-lex.europa.eu/LexUriServ/site/en/com/2003/com2003_0673en01.pdf

Space Council conclusions

- 1st Space Council – "Orientations from the first Space Council on the preparation of the European Space Programme", Council of the European Union, 25 November 2004, http://register.consilium.europa.eu/pdf/en/04/st15/st15000.en04.pdf
- 2nd Space Council – "Orientations from the second Space Council", Council of the European Union, 7 June 2005, http://register.consilium.europa.eu/pdf/en/05/st09/st09440.en05.pdf
- 3rd Space Council – "Orientations from the third Space Council on Global Monitoring for Environment and Security (GMES)", Council of the European Union, 28 November 2005, http://register.consilium.europa.eu/pdf/en/05/st14/st14499-re01.en05.pdf
- 4th Space Council – "Resolution on the European Space Policy" - Brussels, 22 May 2007, http://register.consilium.europa.eu/pdf/en/07/st10/st10037.en07.pdf
- 5th Space Council – "Council Resolution - Taking forward the European Space Policy", 26 September 2008, http://register.consilium.europa.eu/pdf/en/08/st13/st13569.en08.pdf
- 6th Space Council - Council Resolution on "The Contribution of space to innovation and competitiveness in the context of the European Economic Recovery Plan, and further steps ", Brussels, 15 June 2009, http://ec.europa.eu/enterprise/policies/space/files/policy/6th_space_council_en.pdf
- 7th Space Council - Council Resolution "Global challenges: taking full benefit of European space systems ", Brussels, 25 November 2010, http://register.consilium.europa.eu/pdf/en/10/st16/st16864.en10.pdf

Bibliography

B

- 8th Space Council – under the Polish Presidency of the Council of the EU took place in Brussels on the 5th of December. The value and benefits of space for the security of European citizens', including the role space plays in dealing with crisis situations.

Commission Communications on the European Space Policy

European Space Policy Progress Report and Elements for a European Strategy for International Relations in Space, September 12 2008

- Communication from the Commission to the Council and the European Parliament COM(2007)212 "European Space Policy"
- European Space Policy - Summary of the Impact assessment and Impact assessment (full text)
- Communication from the Commission to the Council and the European Parliament, COM(2005)208, 23 May 2005
- European Space Programme - Preliminary Elements, Sec(2007)504, 26 April 2007
- European Community (EC) and European Space Agency (ESA) Framework Agreement
- Opinion of the European Economic and Social Committee, on the Communication from the Commission to the Council and the European Parliament: European Space Policy COM(2007) 212 final, 13 February 2008
- Title 189 of the Lisbon treaty

Competitiveness Council conclusions from 2011 and 2012.

Commission Communications on industrial policy, innovation and research and development

- Commission Communication "Small Business, Big World" (COM(2011) 702 final) - concerning the internationalisation of SMEs
- http://ec.europa.eu/enterprise/policies/sme/market-access/files/com_2011_0702_f_en.pdf
- Report Internationalisation of European SMEs, December 2009; http://ec.europa.eu/enterprise/policies/sme/market-access/internationalisation/index_en.htm

Studies on the space sector and industrial competitiveness:

- Future of EU Space Policy, OECD International Futures Programme "Space 2030: Tackling Society's Challenges", 2005
- Monitoring of the OECD space project - recommendations, OECD, Summer 2007
- Facts and Figures 2010, ASD-EUROSPACE, the Association of the European Space Industry
- The Space Economy in the UK: An economic analysis of the sector and the role of policy, (BIS ECONOMICS PAPER NO. 3), February 2010
- Euroconsult, *Study on the economic situation of the European space industry and framework conditions affecting the sector*, Final Report, 28 June 2010, contract SI2.508146
- Ecorys, Competitiveness of the European Space Sector, Final Background Study, Rotterdam, March 2011
- Ecorys, Competitiveness of the European Aerospace Sector
- Ecorys, Competitiveness of the GMES Sector

Bibliography

B

- Booz and co. Cost-Benefit Analysis for GMES. European Commission: Directorate-General for Enterprise & Industry, London, 19th September 2011
- OECD (2004), Space 2030: The Future of Space Applications, OECD Publishing.
- OECD (2011b), The Space Economy at A Glance 2011, OECD Publishing,
- OECD (2012), OECD Handbook on Measuring the Space Economy, OECD Publishing.
- P Collins, February 2000, "The Space Tourism Industry in 2030", Proceedings of Space 2000, ASCE, pp 594-603. Presented at Space 2000, Albuquerque, March 2000.
- IFRI, 2012, a turning point for Europe in space Christophe Venet February 2012. l'Institut Français des Relations Internationales (Ifri)
- Government Space Markets, World Prospects to 2020 (Euroconsult, 2012)
- Competing for Space Satellite Export Policy and U.S. National Security, January 2012 (considers impact of ITAR Regulations)
- The Aerospace and Defense Industry in the U.S a financial and economic impact study Deloitte, March 2012
- Various publications – the European Space Policy Institute (ESPI)

<u>Summary of general space legislation and legislation on remote sensing – at European and international levels</u>

International space legislation

- The 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies
- The Convention on the Transfer and Use of Data of Remote Sensing of the Earth from Outer Space of 1978 (currently, only nine States are members), and the non-legally binding Principles relating to remote sensing of the Earth from Space, adopted by UN General Assembly Resolution of 3 December 1986.
- The Principles Relating to Remote Sensing of the Earth from Outer Space (1986), United Nations Office for Outer Space Affairs.
- Report of the Committee on the Peaceful Uses of Outer Space (COPUOUS) Fifty-fourth session (1-10 June 2011), General Assembly Official Records Sixty-sixth Session (Supplement No. 20)
- 1992 US Land Remote Sensing Policy Act
- US Presidential Decision Directive 23, U.S. Policy on Foreign Access to Remote Sensing Space Capabilities, 9th March 1994
- US Commercial Space Act of 1998 creating Public Law 105-303
- Commercial Remote Sensing Space Policy (CRSSP), April 25, 2003
- Commercial Remote Sensing Space Policy (CRSSP) Imagery-Derived Requirements (CIDR) Tool User Guide, April 2012
- The Evolution of the U.S. Commercial Remote Sensing Space Policy by Jennifer Sloka, 2009
- Canadian Space Agency RADARSAT Data Policy (1994) Document Number: RSCA-PR0004,

Bibliography

B

Sec. 10.1 b.

- Canadian Legislative Act Governing the Operation of Remote Sensing Space Systems, S.C. 2005, c. 45, received Royal Assent on 25 November 2005 (amended 2007).
- Memorandum of Understanding between the National Space and Development Agency of Japan and the National Aeronautics and Space Administration of the United States of America for Cooperation in the Advanced Earth Observing Satellite (ADEOS) Program (1994)

European space legislation

- Act to give Protection against the Security Risk to the Federal Republic of Germany by the Dissemination of High-Grade Earth Remote Sensing Data (Satellite Data Security Act — SatDSiG) of November 23, 2007.
- Statutory Ordinance on the *Satellitendatensicherheitsgesetz* – SatDSiG of March 26th 2008 (Bundesgesetzblatt 2008 Part I No 12, published in Bonn, 4th April 2008).
- General space law "*Loi relative aux opérations spatiales*".
- Document COSMO-SkyMed National Data Policy and Resources Sharing (DPRS) on 7 March 2007 (ASI and the Ministry of Defence).

Sectoral studies, academic articles, papers and presentations on the EO sector (satellite-based remote sensing).

The documents below have been used to inform both the mapping of national legal frameworks on remote sensing and to map out the market size and structure.

- Satellite-Based Earth Observation, Market Prospects to 2020, Euroconsult, Adam Keith, 2011
- Very High Resolution Imaging Using Small Satellites Andrew Cawthorne, David Purll, Stuart Eves, Surrey Satellite Technology Limited, 6th Responsive Space Conference April 28–May 1, 2008, Los Angeles, CA
- Journal of Space Law, University of Mississippi School of Law, Volume 34, Spring 2008, no. 1, Report on Proceedings of the 2nd International Conference on the State of Remote Sensing Law.
- National Regulation of Space Activities. Series: Space Regulations Library, Vol. 5.Jakhu, Ram S. (Ed.) 1st Edition., 2010,
- Improvement to the Legal Regime for the Effective use of Satellite Remote Sensing Data for Disaster Management and the Protection of the Environment (Space Law journal).
- Economic and Policy Aspects of Space Regulations in Europe, European Space Policy Institute (ESPI), June 2011 (Parts 1 and 2).
- L'Italia e le attività spaziali: considerazioni sull'opportunità di una legge spaziale italiana di Valentina Mariani
- US Commercial Remote Sensing Satellite Industry – an analysis of risks, RAND, US Department of Commerce, Kevin M. O'Connell et al.
- The Evolution of the U.S. Commercial Remote Sensing Space Policy, Lori Ward, Director, Commercial Sales GeoEye, originally published in Acronym magazine, Issue 11

Bibliography

B

EU space research and GMES programme documentation, Galileo

- Annual work programme 2011, adopted by the European Commission in accordance with the article 15 of the Regulation on the European Earth monitoring programme (GMES) and its initial operations (2011 – 2013)
- Regulation (EU) No 911/2010 of the European Parliament and of the Council of 22 September 2010 on the European Earth monitoring programme (GMES) and its initial operations (2011 to 2013)
- Regulation (EU) No 912/2010 of the European Parliament and of the Council of 22 September 2010 setting up the European GNSS Agency, repealing Council Regulation (EC) No 1321/2004 on the establishment of structures for the management of the European satellite radio navigation programmes and amending Regulation (EC) No 683/2008 of the European Parliament and of the Council
- 2008 Regulation (EC) n° 683/2008 of the European Parliament and of the Council of 9 July 2008 on the further implementation of the European satellite navigation programmes (EGNOS and Galileo)

Programme evaluations

- Ex-ante evaluation and Impact assessment on the European Earth Observation programme (GMES) and its initial operations, 05/2009, available at: http://ec.europa.eu/enterprise/dg/files/evaluation/090520_ia_and_ex-ante_gio_en.pdf
- Interim evaluation of FP7 Space Research Activities, 04/2011, available at: http://ec.europa.eu/enterprise/dg/files/evaluation/fp7_space_research_2011_en.pdf
- 2011 Report from the Commission to the European Parliament and the Council on the Mid-term review of the European satellite radio navigation programmes

Statistics

- Eighth DG RTD Progress Report on SME Participation in FP7 (autumn 2011).
- State of the Innovation Union report (COM(2011) 849 final)
- Common Strategic Framework for Research and Innovation from 2014 and associated documentation

Indicators

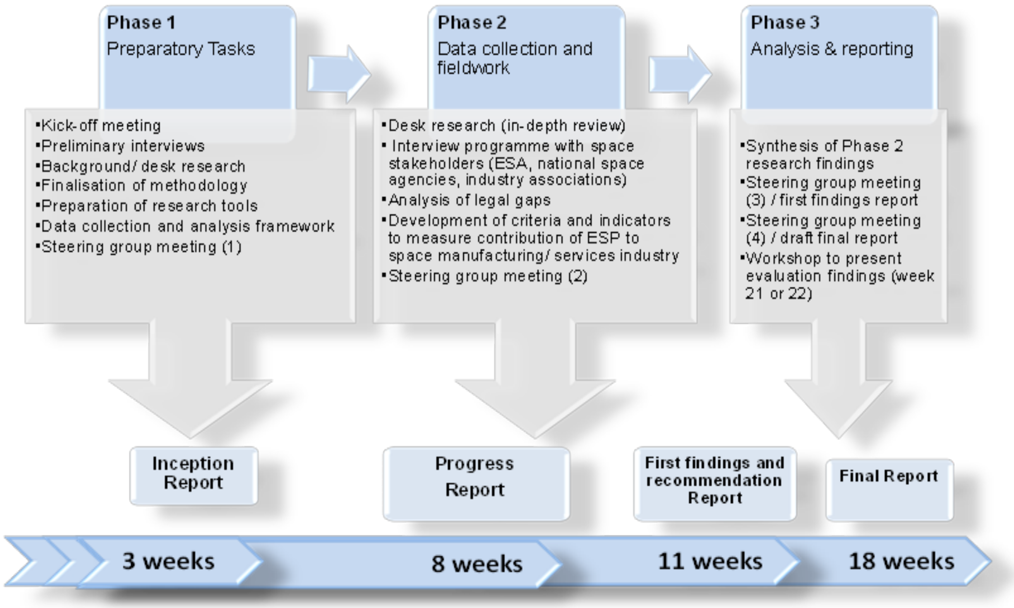
- DG Enterprise Annual Management Plan
- C-SPACE Project - Conditions for Space Policy and Related Action Plan Consolidation in Europe

Methodological approach C

C. Methodological approach

The following diagram summarises the methodology and work plan that was adopted:

Figure D.1 - Methodological approach



The study was carried out over three phases: an inception phase, a data collection and fieldwork phase and an analysis and a reporting phase. A number of tasks were carried out as part of the assignment. These were:

- Extensive desk research (e.g. policy communications, documents about the legal situation in the EU and internationally on satellite-based remote sensing, and sectoral competitiveness studies;
- An interview programme with industry and wider space stakeholders;
- The development of a SWOT analysis and an analysis of key issues relating to space industrial competitiveness;
- A review of the potential scope for the development of space applications and services (and a review of their growth and job creation potential);
- A mapping assessment of national legal frameworks on space (both of general space laws and legislation on private satellite data policy). An analysis of legal gaps that need to be considered in the development of a European Space Industrial Policy; and
- Submission of this report and the holding of a Steering Group meeting.

In total, 60 interviews were carried out as part of the research. The interviews were carried out in a selected number of Member States with the aim of speaking to a representative sample of space stakeholders: Belgium, France (2 visits), Germany, Italy (2 visits) and the UK. The majority of

Methodological approach C

interviews were carried out face to face, but a number of discussions also took place by phone. In addition, discussions were undertaken by phone in Estonia and Poland.

Interviews were carried out across the different categories of stakeholder identified in the tender specifications e.g.: (i) European Commission officials across DGs that are potential users of space services and data; (ii) ESA and a representative sample of National Space Agencies; (iii) National authorities responsible for space policy; (iv) Industry – large firms and SMEs, representing upstream and downstream, across manufacturing, data and services; and SME and industry associations in the space sector.

The evaluation results were presented at a meeting of the European Space Expert Group on 24th July 2012. The focus was on satellite data policy i.e. the regulatory part of the assignment.

Space legislation – supporting analysis D

D. Space legislation – supporting analysis

This section provides a summary of the regulatory situation on general space legislation and then a detailed assessment of legislation on satellite data policy in respect of the distribution of VHR and high-resolution commercial remote sensing data within the EU.

D.1 General space legislation within the EU

Although the study has focused on the current regulatory situation on commercial satellite data policy, it is also important that the state of play in respect of general space legislation across EU27 is taken into account. In some cases, such as France and Germany, general space legislation makes explicit reference to private satellite data policy. A factual description of the legal situation is provided in Appendix D.

In summary, from the review of **general space legislation**, it can be concluded that:

- There is considerable divergence in national regulatory approaches across the EU. Only 9 out of 27 EU Member States (**Austria, Belgium, France, Germany, Italy, Netherlands, Spain, Sweden,** and the **United Kingdom)** have adopted legislation in the space field. In addition, among EFTA countries, **Norway** has also adopted general space legislation.
- The purpose of adopting general space legislation is linked to meeting international obligations under the UN Outer Space Treaty, 1967.
- A general enabling framework has been put in place to ensure that space-based activities are subject to appropriate regulatory control and that operators are appropriately scrutinised and monitored.
- Examples of issues addressed through space legislation are: authorisation, certification and licencing schemes to conduct activities in outer space, registration and liability issues.
- France and Germany are the only two EU Member States that have adopted primary legislation on high-grade satellite data.
- The number of Member States with general space legislation is likely to increase in the next few years. Since many market operators operate on a pan-EU basis, they are subject to national legislation in more than one EU country, which is manageable for large firms, but a significant challenge for SMEs.
- Many space firms are focused on European rather than national markets. Primary data distributors and second tier distributors are therefore subject to legislation in more than one Member State and different regulatory requirements.

A distinction can be made between space-faring nations among EU Member States that have a longstanding legal framework in place, countries that have only recently adopted space legislation and those that do not have a legal framework at all, in the absence of a strong space industry.

Norway has the longest standing national space act, dating back to 1969. The Act on Launching Objects from Norwegian Territory[1] into Outer Space stipulates that the Ministry of Trade and Industry is responsible for regulating permission to launch activities in outer space.

[1] 13 June. No. 38. 1969

Space legislation – supporting analysis D

Sweden has had an Act on Space Activities since 1982 (Act 1982:963). The Act applies to activities in outer space (space activities). In addition to activities carried on entirely in outer space, its scope extends to the launching of objects into outer space and all measures to manoeuvre or in any other way affect objects launched into outer space. It does not however cover receiving signals or information. As in the Netherlands, there is a licensing system in place with a government Ministry responsible for the distribution of licenses. Sounding rockets are not subject to regulation and this was of relevance in lowering regulatory barriers to the development of suborbital space tourism[2].

In the **UK**, there has been a Space Law since 1986. A recent legislative initiative to limit third party liability for satellite operators was cited as a good example of how the intelligent use of regulation can promote growth. The setting of a new upper limit on third-party liability for UK satellite operators – as is already the case in other EU countries such as France or Belgium for instance - should bring about a reduction in insurance costs for satellite operators.

The aim is to enable UK satellite operators to become more internationally competitive by reducing their insurance premiums for compulsory third-party liability insurance (for launch and in-orbit operation). This will help to create greater business certainty for new space-based enterprises, thereby promoting competitiveness.

In **Spain**, there has been a national space law since 1995 ROYAL DECREE NO. 278/1995 OF 24th February 1995 by the Prime Minister's chancellery. The law covers the launch of outer space objects under the requirements of the UN Convention in relation to Space Exploration and the establishment in Spain of the Registry of Objects Launched into Outer Space as provided for in the adopted by the United Nations General Assembly on 12 November 1974.

The **Netherlands** Space Activities Act of 2007was designed to meet the need to regulate activities in outer space under the Outer Space Treaty (OST). The legislation, which came into force in 2008 stresses the importance of clarifying the liability regime, setting out registration obligations and meeting responsibilities under Art VI of the OST. Under Chapter 2 of the legislation, there is a Licence for Space Activities. All entities wishing to conduct activities in space need to obtain an appropriate license from the Ministry of Economic Affairs.

In **Belgium**, a Space Law was passed in 2005 (a further bylaw was adopted in 2008). Under the dispositions of the law, the activities covered include the launch and space operations under Belgian jurisdictions (for the national territory or for instance a Belgian craft in international waters). The law also reinforces the need for space objects to be registered and the role of the state in recovering the financial losses in case of damage to a space objects (under certain conditions). The law does not however include a chapter on data policies.

In **France**, a general space law, the *"Loi relative aux opérations spatiales[3]"* was voted in June 2008. It was noted that the general French space law is one of the most complete laws since it includes procedures for space launches and space manoeuvres. Within the declaratory regime, the French authority has the right to intervene when the national security of France is concerned or when there is a risk of non-conformity with France's international obligations. Data policy falls within the scope of this general law and is examined in further detail in Section 2.3.

[2] Swedish authorities planning to host flights of the Virgin Galactic suborbital space plane want to have it classed as a sounding rocket.

[3] Loi n° 2008-518 du 3 juin 2008, http://legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000018931380

Space legislation – supporting analysis D

Germany produced a draft German Space Law prepared by the German Federal Government as part of a new Space Strategy[4] adopted in November 2010. The Federal Government is continuing to work on the preparation of the German Space Act so as to provide a clear, single, integrated legal framework in which science and industry will be able to operate in Germany. An enabling space law was seen as critical in providing a stable and dependable legal framework to allow for long-term planning by the German space industry. The purpose of the new general space law is to encourage private investment in the space sector and the development of private enterprise business models. Germany has also introduced more specific legislation to regulate the use of private satellite data policy. A case study focusing specifically on this legislation is provided in Section 2.3.

One of the most recent national space laws is that of **Austria**, the "Federal Law concerning the authorization of space activities and the institution of a National Space Registry (Austrian Outer Space Act)." The law deals with a number of aspects stemming from the Outer Space Treaty, namely licensing, liability, registration, and environmental articles. In March 2012, the first two Austrian satellites will be launched into Outer Space. Austria has ratified all 5 United Nations Space Law treaties. National legislation resulted from the need to meet Austria's international obligations.

The 2007 Impact Assessment of the European Space Policy (ESP) noted that in order to be competitive, the European space industry needs a regulatory framework based on clear and stable rules, predictable and adapted procedures. It also highlighted the potential role of the European Commission (in cooperation with the Member States) in improving regulatory coherence to facilitate the growth and development of new and emerging areas within the European space industry, such as space services.

This section focuses on the potential role of an EU regulatory approach to fostering the development of the commercial remote sensing industry and in promoting the distribution of Very High Resolution (VHR) and High-Resolution data, while maintaining high levels of security. In this sub-section, an examination is provided of:

- The **evolution of the commercial remote sensing industry** and of growth in demand for VHR and high-resolution satellite imagery.
- The current state of play in respect of **regulation on data control** in the distribution of commercial VHR and high-resolution satellite data in the EU and internationally
- Feedback from national authorities and industry as to whether a **common EU regulatory framework** would be useful and effective in this field.
- A **problem analysis** as part of an evidence-based review as to whether problems can be identified due to the prevalence of different national regulatory approaches on satellite data control (e.g. transparency issues, access to information, and the impact on the internal market and competition).
- Consideration of **policy options** in respect of the possible development of an EU regulatory framework on commercial satellite data (advantages, drawbacks).

The study scope does not allow for an assessment of wider space-related legal issues[5].

[4] Making Germany's space sector fit for the future - the space strategy of the German Federal Government, German Federal Ministry of Economics and Technology (Bundesministerium für Wirtschaft und Technologie; BMWi), 2010

[5] These include, among others, authorisation/certification to operate in space, the supervision of space activities, the registration of space objects, liability and insurance.

Space legislation – supporting analysis D

D.2 National legislation on remote sensing in the EU

As noted earlier, the global remote sensing industry is an emerging industry. Presently, only a few Member States such as **France, Germany** and **Italy** have satellite-based high-grade[6] remote earth sensing capabilities. In most EU countries, there is currently no legal framework to regulate the use of high-resolution satellite data.

The introduction of regulation has first and foremost been concerned with **ensuring high levels of security in the use of high-resolution satellite data**. The quality and the availability of EO geographical information data has increased significantly. Satellite imagery of less than 1m spatial resolution that 5 years ago was only available to the military, security and intelligence agencies is now available commercially. Putting in place procedures to protect national security is in turn a pre-requisite for promoting the commercialisation of EO data, and access to international data markets.

Legislation in those few EU countries that have already introduced it has focused on regulating primary data distributors (and sometimes satellite operators, who are often, but not always one and the same).

D.2.1 Review of National legislation on remote earth sensing data

To date, only three Member States – namely **France, Germany** (primary legislation) and **Italy** (secondary legislation) have adopted a regulatory framework on satellite data policy. However, a small increase in the number of EU Member States operating VHR and high-resolution EO satellite systems is expected in future. For instance, a private company in Spain will launch the DEIMOS-2 programme, a very high resolution satellite (1 m), for which the tentative launch date is foreseen for last quarter of 2013. The **UK** will launch a high-resolution remote sensing satellite constellation by the end of 2014. It is also possible that there will be additional market entrants, for instance, in France in future.

A description is now provided of the regulatory framework in those few Member States that have already put in place such a framework. The information has been obtained through a combination of desk and field research. The situation in the **UK** is also described, since the UK is expected to develop high-resolution satellite imagery capabilities in the short-term. At the end of the description of the approach in each country, a short assessment is provided as to how effective the regulatory approach has been, in terms of its advantages and drawbacks.

D.2.2 France

In **France**, until June 2008, there was no dedicated remote sensing law in France. Up until the late 1990s, the collection and distribution of remote sensing data was subject to international space law and the general framework provided by the 1967 Outer Space Treaty[7].

[6] This relates to data with a spatial resolution of 0.6 – 4m. However, spatial resolution is not the only variable that matters, and the total information content of the data also needs to be considered (e.g. spectral resolution, spectral bands). According to the interview feedback, there is much less of a security issue for mid-resolution EO data, thereby regulation focuses on high-grade data.

[7] The 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies

Space legislation – supporting analysis D

This is a key part of the legal framework for international space law with more than 100 signatories. All satellite operators wishing to launch a new satellite must apply to the national competent authority (in this case, CNES) in order to obtain a license to ensure access to radio spectrum.

Work then began on the development of a regulatory framework on satellite data policy by CNES in the early 2000s following the privatisation of the main space companies in the late 1990s. CNES used to own SPOT-images, the French market leader, but this is now owned by a private company. CNES exited the market due to its regulatory responsibilities in overseeing the declaratory regime for the distribution of high-resolution data. The transition from government-owned to commercially-owned and operated satellites strengthened the rationale for setting up a data control framework to regulate commercial operators.

Initially, the data control regime applied in France since approximately the early 2000s operated in the absence of a formal regulatory framework. Rather, screening procedures were applied as part of data control for security purposes but were not published or transparent for market operators. The general and specific criteria applied were classified. Indeed, the existence of data control procedures could not even be formally acknowledged by primary data distributors.

Literature on French space law stresses that even in the absence of a dedicated regulatory framework on high-resolution remote sensing data, commercial providers have been subject to data control regimes as a result of legally-binding contractual agreements for data licensing. 'Even in the absence of a legal text, governmental control was imposed on the commercial policy of SPOT-image to ensure the protection of national interests and respect for France's international obligations'[8]. This was initially carried out by the Ministry of Defence, but subsequently was undertaken by GIRSPOT. It is likewise the case for other commercial data distributors, such as e-GEOS in Italy, which has obligations due to the fact that the satellite system is dual-use and particular attention therefore needs to be paid to data distribution policy.

Moreover, in addition to licensing restrictions on data distribution, informal data control mechanisms have operated in France, although the precise procedures were classified. Of particular note was the setting up of an inter-ministerial working group 'GIRSPOT' by the SGDSN (*Secrétariat général de la défense et de la sécurité nationale)* comprised of the Ministry of Foreign Affairs, Ministry of Defence, Ministry of Research and CNES. The working group's role was to identify specific situations that might necessitate restrictions to be imposed on the commercial activities of SPOT image. Most reports produced by GIRSPOT have dealt with the installation of direct receiving ground stations in foreign countries. GIRSPOT does not however have the power to impose any restrictions directly. Rather, the Prime Minister has the sole responsibility to impose limitations on the distribution of satellite imagery by Spot Images on the recommendation of GIRSPOT. Any restrictions imposed on data distribution are then implemented by CNES.

[8] Journal of Space Law, University of Mississippi School of Law, Volume 34, Spring 2008, no. 1, Report on Proceedings of the 2nd International Conference on the State of Remote Sensing Law. Chapter on French Space Law, P Achilleas, C.f. pg 7

Space legislation – supporting analysis D

Screening procedures were tailored depending on the data product concerned and key technical parameters such as spatial and spectral resolution. The thresholds to define which data products should be subject to data control have evolved over time to reflect the progressive strengthening of the spatial resolution of satellite-based VHR and high-resolution imagery. For instance, whereas data from Spot 5's Digital Elevation Model (DEM) was controlled in the past, the spatial resolution is no longer considered such a security risk now since technology has rapidly evolved and the quality of satellite imagery. The consequence is that this particular data is no longer subject to stringent control. Formerly, however, SPOT was subject to transactional monitoring in respect of all imagery requests over specific target areas prior to data acquisition in respect of DEM requests.

Among the drawbacks of the informal data control approach outlined above from a commercial provider's point of view were that obtaining a response from the inter-ministerial process for data control could take up to 60 days (e.g. in the above example relating to Spot 5). This sometimes led to delays in data delivery for customers, and uncertainties with regard to the timing of the approval of data requests. It was of course possible for data requests to be made by commercial users for prior authorisation well in advance of the data being needed over a specific target area. Nevertheless, the lack of transparency in satellite data policy created uncertainties with regard to data acquisition for users and for distributors, delays in establishing whether they could satisfy customers' data needs.

Although overall, the role of GIRSPOT in implementing data control policy was regarded as having worked 'quite well', a clear drawback was that its activities and the criteria it applied for assessing data requests were classified. Since data control was applied on a non-transparent basis, according to research published in the Journal of Space Law, this brought into question the legality of its recommendations since any commercial data users affected were not made aware of the criteria by which decisions on data distribution were made, or able to query the reasons for the refusal of specific data requests.

Consequently, the French Ministry of Defence identified a need to ensure that the mechanism for regulating data control was based on the rule of law and in so far as possible, on transparency principles. The Working Committee on the General Space Law then received a specific request from the Ministry to incorporate a specific chapter on remote sensing as part of the General Space Law 2008, which was then being drafted.

There were concerns about restricting the availability of information without clear and transparent rules to determine data control policy. A potential risk was identified by the Ministry of Defence that commercial satellite operators and primary data distributor may sue for damages for restrictions in satellite imagery where these could not be adequately justified on security grounds, with a commercially-damaging loss of service continuity. A further concern expressed both by a stakeholder in France and by the NOAA was that there was a need to strike a balance between the right to access information (in this case, high-resolution satellite imagery) which is a human right[9]and security considerations pertaining to its usage.

[9] An interview with the NOAA in the US has confirmed that there are issues around access to information in respect of satellite imagery. This may pose freedom of speech issues under the first Amendment.

Space legislation – supporting analysis D

The General Space Law "*Loi relative aux opérations spatiales*"[10] was adopted in 2008. Title VII of the law (Articles 23 -25) sets out in general terms the law's declaratory regime, under which any person or entity programming, operating or exploiting a satellite from the French territory; any other satellite data received on the French territory and any French national exploiting or operating satellite data must declare their operations to the *Secrétariat général de la défense et de la sécurité nationale* - SGDSN (under the authority of the prime minister) if they fall in certain categories. Neither the CNES nor the Ministry of Defence satellites are subject to the law.

Article 23 within Chapter VII of the French Space Operations Act stipulates that any primary *"exploitant"* of space data with certain characteristics must declare its activities. It states that *'tout exploitant primaire de données d'origine spatiale exerçant en France une activité présentant certaines caractéristiques techniques définies par décret en Conseil d'Etat doit préalablement en faire la déclaration à l'autorité administrative compétente. Ces caractéristiques techniques sont notamment fonction de la résolution, de la précision de localisation, de la bande de fréquence d'observation et de la qualité des données d'observation de la Terre faisant l'objet de la programmation d'un système satellitaire ou reçues'.*

The specific rules regarding the distribution of space data are under the responsibility of the *Secrétariat général de la défense et de la sécurité nationale* - SGDSN (under the authority of the French Prime Minister). The law is implemented through a declaratory regime based on a risk-based approach, where no specific authorisation is necessary but the primary data distributor *(exploitant primaire de données)* must declare transactional activities to the SGDSN. The new rules were developed in coordination with the satellite operators behind SPOT images. The need for such legislation was reinforced by the development of a new generation high-resolution panchromatic and multispectral Earth Observation (EO) satellite, "PLEIADES-HR SATELLITE"[11].

The law was purposely drafted to be relatively general since it will be complemented by a *décret d'application* (implementing decree) which provides the general framework for the law (published in 2009) and a *décret simple* which is not subject to a vote and sets out the practical implementation aspects of the law and will formally designate a national competent authority (in likelihood, the SGDSN). In French law, a *décret simple* is simply promulgated by the Prime Minister and requires neither another vote by the National Assembly nor confirmation by the Conseil d'Etat. This allows for the technical parameters of the law to be updated if necessary.

According to the law, responsibility for carrying out data control for security purposes lies with commercial satellite operators. The aims of such checks are to: (i) Prevent the misuse of commercial data (especially the protection of troops on the ground) (ii) Prevent terrorist attacks (and the protection of strategic and critical infrastructure) and (iii) Take into account the interest of allies (e.g. the protection of allied troops and critical infrastructure).

The law seeks to achieve the above objectives without harming the interests of the scientific community or harming competition, by instituting a simple declaratory regime that does not impose a heavy administrative burden on companies and increases the transparency of decision-making relating to data requests. However, interviews with French industry suggest that even after the *décret simple* is adopted and the law comes into effect, the main benefit will be the fact that primary data distributors and national authorities will be protected from potential liability claims that could have arisen in the absence of a regulatory framework.

[10] Décret n° 2009-643 du 9 juin 2009 relatif aux autorisations délivrées en application de la loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales
http://smsc.cnes.fr/PLEIADES/

Space legislation – supporting analysis D

It should be noted however that to date only the general criteria on satellite data policy have been published in the French Space Law. The technical characteristics for satellite data control that must be declared as part of the new regulatory regime have been incorporated into a draft specific decree of the Conseil d'Etat, but the decree has not yet come into effect. Due to the French Presidential elections in April 2012, there was a further delay in the decree being made public. It is waiting to be signed by the French Prime Minister. Since the *décret simple* has not yet been published, Chapter VII of the 2008 General Space Law in France pertaining to regulating satellite data is not yet in effect.

Interviewees from the commercial remote sensing industry in France stated that there remains uncertainty as to which specific satellites will be subject to the new rules until the technical parameters outlining the spatial and spectral resolution under which the legislation will apply. Initial indications are that the decree is expected to set a minimum technical threshold in the region of 2m on-board spatial resolution. This means that new VHR resolution systems, notably the Pleiades satellite (a VHR panchromatic and multispectral EO satellite) launched in December 2011, are expected to be subject to the legislation. However, other satellites such as Spot 6 and 7, new high-resolution, optical imaging satellites are scheduled to be launched in 2012 and 2013 respectively may fall outside the scope of the decree, since the on-board resolution will be 2.2m. The minimum threshold under which satellite data will fall under the new Regulations has not yet been published.

Once the *décret simple* has been adopted, many of the detailed restrictions that will apply will remain classified, however, which may undermine the objective of strengthened transparency. The overall approach is expected to be similar to that applied presently through informal data control mechanisms. There will be a distinction between:

- Areas deemed as being of security interest – sales can take place to authorised users only
- Areas of security interest on French territories - data control will be applied through imagery resampling of areas to a different resolution (e.g. to ensure critical infrastructure protection).
- Areas outside security interest – the free distribution of data to all users in principle, but with some data control depending on the customer requesting the data.

For data resellers and end-users requesting data, there will be a number of possible outcomes: a sale with no restrictions, a sale with a time delay and a refusal to grant the data sale.

With regard to processes for carrying out the data check on behalf of the data distributor, as in Germany, in France, the data control process for checking the sensitivity of data is meant to be automated. A key difference with Germany is that no blacklist is published by the French Ministry of Foreign Affairs, only guidelines on data security. The German authorities did however stress that although a list of countries is published that are considered to be sensitive, this does not preclude the distribution of data, depending on the target area, and subject to appropriate security checks.

In practice, satellite operators who are also primary data distributors based in France are already working under the existing regulatory framework. Feedback from industry representatives in France has indicated that putting in place a formal data policy as part of the general space law is viewed positively as being helpful in providing greater legal certainty both in terms of protecting primary data distributors from possible legal action for loss of service continuity by their customers and in terms of operating through a clearer framework.

Space legislation – supporting analysis D

However, while the process for checking the sensitivity of data requests and for screening customers was not viewed as problematic, until the *décret simple* is published, there remain industry concerns as to how many areas will be deemed sensitive, and subject to classified restrictions. The greater the number of restrictions and requirements to resample images, the more potentially commercially damaging the impact of the regulation might be.

Table D.1: The evaluator's view - remote sensing legislation in France

The declaratory regime in France represents a 'light-touch' regulatory approach compared with the approach in Germany, with its combination of a licensing approach and transactional monitoring. An advantage of the French approach however is that it is centred on a risk-based approach depending on the target area for taking the satellite imagery and the client requesting the data. There is no formal list published of blacklisted countries by the French Ministry of Foreign Affairs.

Once the technical details are developed and the *décret simple* is adopted, the new legal framework should provide greater legal certainty for primary data distributors. The liability-related issues that the legislation is designed to overcome appear to be mainly concerned with protecting primary data distributors and government Ministries involved in data screening by making data customers aware at the application stage that security procedures will be applied. However, as in Italy, many of the criteria for determining whether particular data requests are granted will **remain classified**.

From the point of view of customers globally (e.g. data resellers, downstream users), it is questionable how far the new approach will ensure stronger transparency since the criteria being applied will not be known, resulting in uncertainty as to whether data requests will be granted. It will however represent an improvement compared with the informal approach adopted hitherto since the existence of data control procedures will be explicitly acknowledged in the data request form.

A further weakness of the approach in France is that it has taken 4 years for the specific regulations regulating satellite data to be drawn up and published, including technical parameters defining the scope of the decree, which will determine which specific satellite systems fall within the legislation's scope and will be subject to data control. This creates uncertainty for market operators.

Under the informal data control mechanisms that precede the new legal framework, there were uncertainties with regard to the timing of the approval of data requests. Unlike the German regulatory system, there is no fixed timeframe by which time the responsible competent authority (likely to be the SGDSN) must carry out sensitive data requests. It remains to be seen whether there will be possible delays in data acquisition by users. This was however a concern for industry.

D.2.3 Germany

Germany was the first EU country to develop a regulatory framework in the field of satellite data (2007). A more detailed assessment is therefore provided, structured as follows:

- **Introduction and rationale** for the adoption of legislation on high-grade remote earth sensing data;
- The **legislative development process** (including industry consultations);
- The **regulatory approach** - licensing combined with transactional monitoring
- A review of the **administrative practices and procedures** for controlling data access and use, the criteria used for carrying out a sensitivity check;
- Analysis of the legislation's implementation to date, effectiveness and impacts.

Space legislation – supporting analysis D

Introduction and rationale

The Act on Satellite Data Security *(Satellitendatensicherheitsgesetz - SatDSiG[12])* in **Germany** entered into force on 1st December 2007. The Act was developed by the German Federal Ministry of Economics and Technology (BMWi - *Bundesministerium für Wirtschaft und Technologie*). Supplementary details on technical implementation were published through Statutory Ordinance on the *Satellitendatensicherheitsgesetz* – SatDSiG of March 26th 2008[13].

The purpose of the Act is, first, to safeguard the security and foreign-policy interests of the Federal Republic of Germany in connection with the dissemination and commercial marketing of satellite-generated Earth remote sensing data especially in international markets. Secondly, the Act was intended to create legal certainty for companies (satellite operators, primary data distributors, second-tier data distributors and downstream customers) to allow them to better assess the risk-reward and commercial potential of this relatively new market segment within space services.

There was a need for a clearly defined and transparent procedure for the dissemination of Earth remote sensing data. BMWI has noted that *'the Act closes the gap in the legislative framework because, unlike the export of the corresponding satellites or related technologies, there are no rules governing the distribution or transfer of satellite data or images and export control regulations make no provision for such data products'.*

The need for legislation was driven by technological progress in the development of high-grade satellites. Germany is one of the European leaders in the development and manufacturing of high-resolution Earth remote sensing satellites. For instance, the **Terra SAR-X satellite** has a spatial resolution of 1m[14]. A potential follow-up - TerraSAR-X II - is presently under discussion between the German authorities and commercial satellite operators. If funded, this would provide a spatial resolution of up to 50cm by 2015. Other satellites developed in Germany, such as the RapidEye satellite constellation[15] launched in 2009 also has high-grade EO capabilities.

The objectives of putting in place a regulatory framework on satellite data policy in Germany are summarised in detail in the following table. These arguments are also relevant at the European level:

Table D.2: Rationale for the Introduction of a Regulatory Framework on Private Satellite Data Policy.

- **Respond to the need for regulation in light of technological progress in the development of next generation satellites,** such as TerraSAR X, which produce high-grade Earth remote sensing data with a high spatial resolution and high-quality information content.
- **Ensure that Germany's national security and foreign policy interests were protected in relation to the distribution and marketing of satellite data.** The legal framework helps to ensure that security considerations are taken into account in the use of high-grade **satellite** data. The aim was to make sure that access to high-resolution and / or high information content data is not misused by malevolent actors.
- **Ensure that operators and data distributors can exploit the full commercial potential of space-based data and gain access to international commercial markets.** Ensuring that security concerns have been

[12] http://www.gesetze-im-internet.de/bundesrecht/satdsig/gesamt.pdf
[13] Idem.
[14] Terra Sar X is a radar satellite with all-weather and day/night observation capabilities
[15] www.rapideye.net/about/constellation.htm

Space legislation – supporting analysis D

taken into account is a crucial pre-requisite in opening up new markets, notably at international level.

- **Provide legal certainty to operators and data distributors in the production and distribution of satellite-based data on licensing and wider regulatory requirements** –the law sets out licensing requirements required by satellite operators, primary data producers and developers of downstream services and applications (secondary users). The existence of a legal framework means that data can be provided to clients while respecting security concerns.
- **Facilitate obtaining export licenses for German satellite hardware**
- **Maximising the exploitation of satellite data** –putting in place a robust regulatory framework was regarded as a pre-condition for developing international markets for high-resolution data. The existence of a robust legal framework sends a strong message and provides reassurances that security issues are addressed seriously by German satellite operators and by primary data distributors.

Source: CSES analysis based on interview with BMWi and with industry representatives

There are a number of satellite operators licensed in Germany, with one major satellite developed through a PPP approach between the German government and industry and a second entrirely commercially owned. There are then a small number of 3-5 primary data distributors operating in Germany, such as Astrium's Infoterra and European Space Imaging, which is a supplier of VHR high-resolution satellite imagery and distributes data from US commercial satellites.

Since the development of high-resolution VHR satellites has required substantial investment by both industry and the German government, it was deemed necessary to put in place a regulatory framework to exploit the full economic potential of the commercial distribution and marketing of high-grade data (especially in accessing growing international data markets), while maintaining high levels of data security.

The legislative development process and regulatory approach adopted

The BMWi has lead responsibility within the Federal German government for coordinating the development of the *SatDSiG* Act. A number of other Ministries, notably the Ministry of Defence, Ministry of Foreign Affairs and Ministry of the Interior were also closely consulted. To ensure that the legislation was appropriate to the German context, a benchmarking exercise was carried out to compare different international experiences of regulating satellite data policy in countries that already have high-grade remote Earth sensing capabilities, drawing on experiences in the US, Canada and Japan in particular.

In addition, the UN principles on remote sensing were taken into account[16]. While various existing regulatory frameworks on satellite data were taken into account in drafting the legislation, it was viewed as essential that legislation on satellite data in Germany should be tailored to the national context to reflect national-specific security and foreign policy considerations.

Extensive consultation with industry took place prior to the legislation's adoption over a 3 year period, reflecting the topic's complexity and the need to achieve a broad consensus with industry during the legislative formulation process and the legislation's administrative implementation. Industry was initially sceptical about the need for a regulatory framework on satellite data policy, reflecting concerns about administrative burdens and the cost of complying with new regulations.

[16] Convention on the Transfer and Use of Data of the Remote Sensing of the Earth from Outer Space (entered into force August 21,1979). Currently, only nine States are members, and the non-legally binding Principles relating to remote sensing of the Earth from Space, adopted by UN General Assembly Resolution of 3 December 1986.

Space legislation – supporting analysis D

However, according to the BMWi, there was growing recognition among the German space industry about the importance of putting in place a regulatory framework on data policy since there would otherwise be limitations in terms of maximising the commercial potential of satellite data without an enabling framework. Subsequently, the German space Industry recognised the need to reassure international governments, regulators and commercial customers that security issues would be taken into close account in data distribution from high-grade satellites.

The German regulatory system

The regulatory approach in Germany is characterised by the combination of a **licensing system** and a **transactional approach**.

There are two different types of remote sensing licenses in Germany, the first for operating a high-resolution satellite and secondly, a license for data distribution which must be obtained by primary data distributors. The reason for the adoption of a dual-licensing system was specific to Germany, since there is a high-resolution radar satellite system where the operator is distinct from the company responsible for commercial data distribution (the same is true of the Cosmo-Skymed Satellite in Italy).

The approach to regulating satellite data in Germany through a dual-licensing system can be contrasted with the US and Canada, which have implemented a single licensing regime for commercial satellite operators. It also differs from France, which has a 'declaratory regime' (i.e. there is no formal licensing requirement, but satellite operators are required to identify and declare their customer base to the relevant authorities and to carry out security screening using a risk-based approach. According to interviewees from the VHR EO industry, the fact that there different regulatory approaches, and different mechanisms for data control, such as licensing and a declaratory regime does not create significant difficulties, either in terms of maintaining adequate security or in the commercialisation of data. Rather, the procedures have evolved based on the requirements of national-specific systems and security considerations.

Although the regulatory framework includes a dual-licensing system for operators and primary data distributors, the main focus has been at the **transactional level**[17]. According to the BMWi, a transactional approach was appropriate because it maximises security and is effective in facilitating speedy data flows to commercial customers. Under the risk-based approach, the aim of transactional monitoring is to identify the very small percentage of data requests that represent a genuine security risk.

A licensing approach has been adopted in the US and Canada, but without transactional monitoring. This can be explained by the fact that in the US, approximately 70% of sectoral turnover is from a single governmental customer (the NGA). Although the two US market leaders, GeoEye and Digital Globe, do have an international customer base, the terms of the licensing agreement require them to inform the responsible licensing regulatory authority about any new significant foreign clients two months prior to data acquisition. Since the main clients are governmental institutions and security agencies, there is a relatively small customer base compared with some European-based primary and second-tier data distributors.

[17] An individual transaction is defined as the ordering of a data product. Monitoring activities relate to data requests from downstream customers.

Space legislation – supporting analysis D

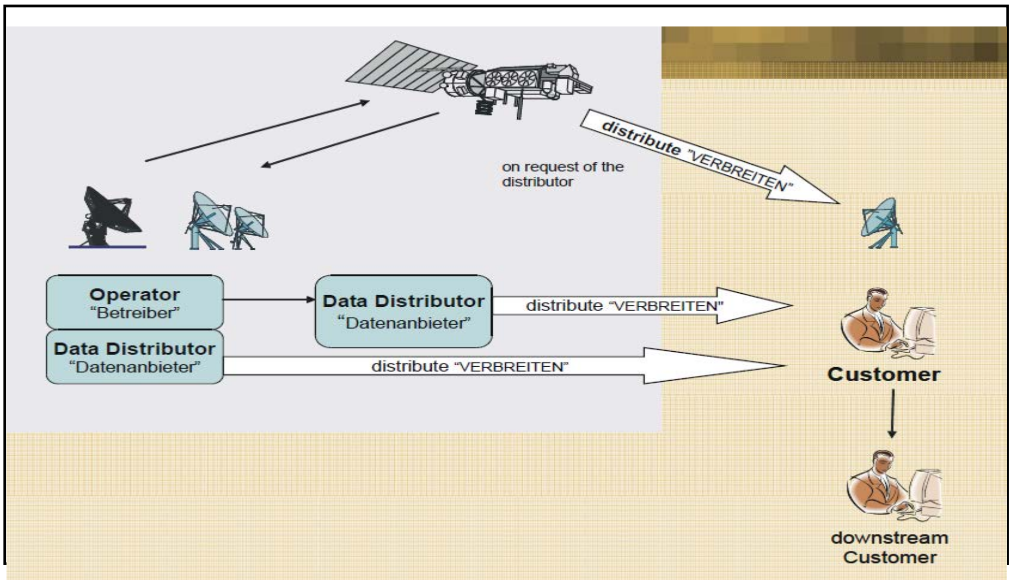
In Germany, transactional monitoring was felt to be an appropriate regulatory approach since the business model for primary data distributors is more dependent on the development of commercial data markets with many smaller-scale commercial clients both in the EU and third countries. The research found that this is more the case for optical than for radar satellites, whose client base is smaller and often includes governmental and defence customers.

The German authorities perceived that without transactional monitoring, there would be a risk that commercial data markets would be restricted because data control filtering mechanisms would have to be adopt more generalised restrictions on data flows. For instance, although Germany does have a 'blacklist' of countries to which the distribution of VHR data must be security screened, this does not impose a blanket ban on the free distribution of data. Other factors are taken into account by the regulator when screening potentially sensitive data requests, such as the specific target data acquisition area, the nature of the client and the sector. For instance, there may be general concerns about the export of data to say Iran, but there may be perfectly legitimate data needs among users, such as monitoring an agricultural area

Transactional monitoring is therefore seen as a mechanism to avoid imposing a 'catch-all' ban on data sales to particular countries. The decision as to whether to grant data access (or not) in respect of data requests identified as being sensitive and therefore subject to closer scrutiny by the deemed sensitive is judged on a case by case basis. This helps to maximise the full exploitation of high-resolution commercial data. There may be legitimate reasons for the use of high-resolution data by downstream users in particular countries even if there are concerns about completely free data distribution in the country concerned.

The regulatory approach in Germany is summarised in the following diagram.

Figure D.1: - Act on Satellite Data Security, Germany, 2007: core processes and procedures:



Space legislation – supporting analysis D

The Satellite Data Act requires a one or two-stage procedure depending whether the data request is identified as being 'sensitive', or 'non- sensitive'. All individual data requests are subject to a :: sensitivity check which is undertaken by the primary data distributor using a largely automated process and in the case of the small number of cases where data requests are identified as being sensitive, further review by the national competent authority, leading to a decision as to whether to grant a data permit for the specific request.

The process for checking all individual data requests can be summarised as follows:

Phase 1 - The sensitivity check by primary data distributors

- Compulsory requirement for primary data distributors[18] to perform a sensitivity check on all individual data requests under the terms of the data distribution license;
- The sensitivity check is carried out using predefined procedures and criteria without any power of discretion;
- The risk assessment must be carried out prior to data distribution. There is no shutter control time delay.
- All transactions must be documented for possible official audit/ monitoring inspection by the national competent authority (BAFA);
- If the transaction is identified as being "non-sensitive", then the distributor may deliver the data. If the transaction is "sensitive", then a permit is required.

The process is now explained in more detail.

The **criteria for carrying out the sensitivity check** and detailed technical parameters are set out in the 2008 Statutory Ordinance of March 26th 2008. This supports the implementation of the 2007 Act, which sets out the general principles for regulatory high-resolution and high-information content satellite data. The technical parameters used in the sensitivity check to assess the security risks posed by high-grade commercial satellite data are: (i) Spatial resolution (ii) Spectral resolution and the number of resolution channels and (iii) Spectral bands - panchromatic, multispectral, full-colour and whether multispectral images allow for analysis of near infrared, shortwave infrared and thermal infrared (iv) the radiometric resolution and (v) the temporal resolution.

Minimum threshold criteria have been set for determining whether the **quality of information content** falls within the scope of the Satellite Data Act and is subject to the Act's requirements. These are set out in Section 1 of the Statutory Ordinance in a chapter entitled *'Data with particularly high information content':* The thresholds are:

- A sensor belonging to an earth remote sensing system is, either alone or in combination with one or more sensors, technically capable of generating data with a particularly high information content, if a **geometric resolution of 2.5 metres** or less can be generated in at least one spatial direction.

[S]Second-tier data distributors and downstream users indirectly fall under the legislation's scope, however, only primary data distributors are responsible for carrying out the sensitivity check.

Space legislation – supporting analysis D

- A particularly **high Information content** is also given, if (1) in the 8 to 12 micrometre **spectral range** (thermal infrared) a **geometric resolution** of 5 metres or less can be generated in at least one spatial direction (2) in the 1 millimetre to 1 metre spectral range (microwave), a geometric resolution of 3 metres or less can be generated in at least one spatial direction or (3) the number of **spectral channels** exceeds 49 (super and hyper-spectral sensors) and a geometric resolution of 10 metres or less can be generated.

The BMWi stated that it is vital that the **quality of information content is examined, not only the spatial resolution**. Low-medium resolution satellite data could still be used for adverse purposes, such as the identification of materials allowing for the identification of camouflaged people or vehicles. The type of satellite in question also needs consideration. For example, radar satellites have specific features that are different from satellites using optical sensors. This influences the quality of information content.

The technical parameters are well understood by engineers involved in primary data distribution and are supported by flowcharts in the Statutory Ordinance. In addition to technical parameters, a number of other criteria are taken into account as part of the sensitivity check, namely the: **target area** (does the satellite data requested include sensitive areas, such as critical infrastructure) the **temporal resolution** (frequency of imagery requested), the **time delay** between the data being requested and the actual requested delivery time, the **type of satellite** (radar, optical); the **country from which the date request was made**; and the **customer** requesting the information; (e.g. governmental, other institutional, commercial).

Since the sensitivity check is carried out using a computerised **algorithm, for meta-data processing**, 80%-90% of the sensitivity check can be automated, reducing the burden on the handful of primary data distributors directly subject to the legislation. The detailed criteria used in the algorithm for the initial sensitivity check are classified, but follow key remote sensing principles and the technical parameters in the Statutory Ordinance. The sensitivity check by the data provider in respect of specific data requests is carried out in accordance with procedure and clearly defined criteria in the Act (c.f. Section 17). There is no room for discretionary assessment. Primary data distributors can carry out the sensitivity check and assess whether an individual transaction is sensitive without contacting the competent authority. Primary data distributors' customer services departments can normally determine whether a data request is sensitive or non-sensitive almost immediately, without any need to contact the competent authority.

Non-sensitive data requests can be distributed almost immediately to clients following the sensitivity check but the distributor must alert BAFA immediately to all data requests deemed to be sensitive. It is then is responsible for scrutinising these and determining whether a data permit in relation to the specific request should be granted. The underlying data and images are never examined during the sensitivity check. This reflects practical considerations in that data requests are often made by downstream users well in advance of the data being needed and relates to a data acquisition over a particular target at a specific future point in time. The sensitivity check therefore has to be performed without the data necessarily being available, therefore the analysis is based on an assessment of the meta-data.

BAFA has responsibility for monitoring high-grade data distribution in Germany, and routinely undertakes monitoring visits to primary data distributors holding a distribution license to check that they are performing the sensitivity check correctly. Companies can be subjected to a monitoring visit at any time and must therefore ensure that their processes and procedures are compliant with the flow chart and requirements on document retention set out in the 2008 Statutory Ordinance.

Space legislation – supporting analysis D

Under Section 18, there is a compulsory requirement to retain data in relation to all individual transactions. The data provider is obliged to record all requests for the dissemination of data of a high-grade earth remote sensing system. This covers: 1. The actual request including the persons who prospectively come into contact with the data as provided for in the request and their usual places of residence, 2. Checking the identity of the requesting party, 3. the procedure and the results of the check of the sensitivity of the request under Section 17 (1) in conjunction with the provisions of a legal ordinance under Section 17 (3), 4. The data-generation order placed with the Operator of the high-grade earth remote sensing system, 5. The receiving logs of ground segments, 6. The details of encryption processes, codes used and code management, 7. The reports of the processing sequences of the ground segment, 8. The meta data of the data, in particular, target area, time of generation of the data, sensor operating mode and data-processing parameters.

Phase 2 - Assessment of sensitive transactions by BAFA and the granting of permits

About 10-20% of data requests are identified as being potentially sensitive and are then referred to BAFA. Although the specific criteria applied by BAFA for screening sensitive data requests are classified, the general criteria are clear, since they are published in statutory ordinance to support the 2007 Satellite Data Act.

Under Section 17 of the Act, a data request is deemed to be sensitive if: 1. The information content of the data obtained as a result of the sensor-operating mode used and form of processing used, 2. The target area represented by the data, 3. The time of generation of the data and the period of time between generation of the data and compliance with the request and 4. The ground segments *to which the data are to be transmitted when viewed as a whole, reveal the possibility of harm being caused to the vital security interests of the Federal Republic of Germany, to the peaceful co-existence of nations or to the foreign relations of the Federal Republic of Germany.*

There are two possibilities if a particular data request is identified as being sensitive during the sensitivity check. The primary data distributor may decide straight away to refuse to distribute the data to the prospective client. Alternatively, they may refer the request to BAFA and then apply for individual permission to grant a permit to distribute a specific dataset. The decision as to whether to grant the permit is made on a on a discretionary case by case basis, taking into account the general criteria mentioned earlier and classified information drawing on information provided by relevant government agencies, including the security and intelligence services, and through cooperation with international government agencies where appropriate. Permission is then either granted to distribute the sensitive data or refused by BAFA.

It is vital for the development of commercial data markets that decisions on data requests should be taken promptly by the competent authority so that the data can either be distributed in real-time, or as close to real-time as possible so as to maximise the information's potential value to commercial clients.

Space legislation – supporting analysis D

Effectiveness and impact of the legislation's implementation

Since the Value of Information is centred on the real-time nature of data transmission, it was imperative that BAFA was able to provide a rapid response to data requests, while at the same time maintaining high security levels. Despite the initial concerns of industry about the speed with which sensitive data requests would be processed by the competent authority, sensitive data requests have been handled very promptly.

The BMWi has noted that since individual data producers determine how they implement administrative procedures and processes in order to meet their obligations under the Act, data distributors themselves can determine the speed of the initial sensitivity check and many elements of the process can also be automated.

While carrying out a sensitivity check may appear to be administratively burdensome the BMWi stated that *'an estimated 90%+ of data transactions are non-sensitive'.* This was confirmed by industry. A primary data distributor found that data requests identified as being sensitive have been processed efficiently and promptly by BAFA. The firm estimated that most sensitive data requests were still granted. Only approximately 1% of data requests have been rejected overall.

The market leader in Germany operates as both a primary and secondary data distributor. It has approximately 10000 customers registered in its database, which includes d ata re-sellers but mainly downstream data users. The company also carries out automated screening on behalf of other primary data distributors, because it has the IT systems and security procedures in place to carry out sensitivity checks within minimal administrative burden . The company viewed it as being helpful that there was a regulatory framework in place because this was useful in reassuring clients that security considerations were taken very seriously in the distribution of data. This was especially the case in winning US governmental clients.

As noted earlier, a significant part of the sensitivity check process can be automated and the main administrative burden occurs through one-off set-up and familiarisation costs. Once the necessary internal systems and processes have been set up to carry out the sensitivity check by primary data distributors, there are few ongoing costs or burdens.

An advantage of the Act on Satellite Data Security is that since it provides general legal framework for regulating Satellite Data, but is sufficiently flexible to allow for future developments in new or emerging areas of the satellite data industry through Statutory Ordinance. The law provides an overarching legal framework with bye-laws then introduced to provide detailed administrative implementing rules for applying data policy in respect of specific types of satellites. For instance, in the Statutory Ordinance of March 26th 2008, detailed rules are set out concerning the regulation of radar satellite data. In future, the German authorities envisage introducing further bye-laws as technologies emerge allowing for the development of new types of satellites e.g. optical, high-spectral, and infrared satellites, satellites with specific sensors.

Space legislation – supporting analysis D

The legislation has **successfully addressed security concerns** that high-resolution and high-information content data is not misused to harm German national security or foreign policy interests. This was seen as especially important in relation to developing new commercial markets in third countries. The BMWi stated that the introduction of a regulatory framework on satellite data has **facilitated high-grade data distribution rather than inhibited it**. "The law was a critical precondition for fostering the development of commercial markets in high-grade satellite data". This was confirmed in discussions with industry stakeholders, who acknowledged that it was necessary to reassure international clients that security issues are given strong attention in data policy. A large multinational provider of geo-information products and geospatial services commented that: *'the legal framework is an enabler. If legislation on satellite data policy had not been in place, there would have been much greater difficulties in developing new markets for high-grade satellite data'*.

A 2011 study on the *Economic and Policy Aspects of Space Regulations in Europe*[19] analysed the impact of the introduction of licensing regimes for data producers and data distributors. It was noted that legislation such as the 2007 Act on Satellite Data Security in Germany affects a very small number of satellite operators and primary data distributors. *'It might be assumed that licensing and data controls would affect the entry of new operators into national markets or the creation of new business in the distribution of space data. However, commercial operators of EO satellites are often the commercial branch of national space agencies operating satellites developed by the agencies and publicly funded. They are licensed to act as sole distributors of the data generated'.*

Table D.3: The evaluator's view – remote sensing legislation in Germany

The 2007 Satellite Data Security Act has been effective because it has managed to balance industry's concerns regarding the potential administrative burdens of introducing new regulation with the need to send a strong signal to potential customers and to national authorities both in the EU and in third countries that security issues relating to the distribution of VHR and high-information content data are treated very seriously.

The regulatory mechanisms put in place in Germany are the most robust and transparent among the regulatory frameworks examined. This has been achieved through a combination of licensing, transactional monitoring, and the designation of a national competent authority with regulatory responsibilities for screening sensitive data requests and for monitoring the implementation by primary data distributors of their obligations under the Act. Since the sensitivity check process has largely been automated, the level of administrative burden has been much less than feared.

The regulatory framework provides transparency for market operators, and the procedures appear to be accepted by German industry. Industry elsewhere were concerned about implementing the German system of monitoring all individual transactions at the point the data request is made for optical satellites, where there is a wider customer base than for radar VHR imagery.

A further advantage of the approach in Germany is that the regulatory system is designed to facilitate data flows, by considering individual data requests on a case by case basis, rather than imposing a rigid blacklisting approach. Another benefit is that the 2007 Act is sufficiently generic that it affords flexibility for the adoption of further Statutory Ordinance in future as different types of VHR satellites are developed and launched in future (e.g. optical, high-spectral, and infrared satellites).

[19] Economic and Policy Aspects of Space Regulations in Europe, European Space Policy Institute (ESPI), June 2011 (Parts 2). *C.f. 'Reflections on Data Licensing. Enabler or Spoiler in the Development of Space-Based Commercial Services',*

Space legislation – supporting analysis D

D.2.4 Italy

In **Italy,** the use of high-grade remote earth sensing data is presently regulated through secondary legislation. This in turn is based on an earlier 2001 Intergovernmental Agreement between France and Italy concerning the use of data which also sets out data sharing arrangements from the development of a dual satellite system between the two countries, consisting of:

- The **Pléiades system** in France – providing the optical component
- The **COSMO-SkyMed system**[20] in Italy - providing the radar component

The terms and conditions for the bi-lateral Intergovernmental Agreement ("the Agreement") were set out in a cooperation agreement in the Earth Observation field signed in Turin on 29 January 2001. The Agreement was aimed at providing a framework for the future development of a dual radar and optical satellite system through joint cooperation between France and Italy for civil (institutional and commercial) and military purposes. It was also intended as a framework to provide data sharing between the two countries' respective satellite systems.

The Agreement sets out key principles regarding the management and use of data generated through the dual system (i.e. Pléiades and COSMO-SkyMed). Guiding principles on data policy in relation to commercialisation aspects were not however stipulated in any detail, other than through references to the ownership rights of the two countries in relation to each respective satellite system. The Agreement gave priority to the Italian and French Ministries of Defence in the use of the satellites daily programme (Art. V); the option for each of the two Governments, through their respective security bodies, to exercise the right of "veto" regarding the request for data acquisition or data distribution (Art. V); and the two Ministries of Defence had ownership rights over any data requested for military and defence purposes. For all other data, the French Government retains the ownership of optical component data and the Italian Government keeps the ownership of radar component data (Art. VIII).

Since the Intergovernmental Agreement was mainly concerned with information sharing, data ownership and dual-use arrangements, there was subsequently a need to develop a more detailed framework on some aspects of data policy (notably the commercialisation and use of data by civil and commercial users) through the adoption of secondary legislation through a Ministerial Decree (or bye-law) in 2006 and further documents in 2007 and 2009.

The Italian authorities felt it necessary to develop a regulatory framework in specific response to the fact that COSMO-SkyMed is a dual-use system and has required substantial civil and military investment. Given that it has high-resolution capabilities, there was a need to regulate data usage in order to **strike a balance between security considerations and promoting the commercialisation of data** to help recoup operating costs.

[20] COSMO-SkyMed is a radar satellite constellation system and has been jointly financed between the Italian Space Agency (ASI) and, the Ministry of Defence and the Ministry of Education, Universities and Scientific Research.

Space legislation – supporting analysis D

e-GEOS[21] has been given specific responsibility for the commercial distribution of COSMO-SkyMed civil component products. The three different civil standard products generated by the COSMO-SkyMed System (that are addressed in the national data guidelines document (see below) are: (i) Spotlight 2, with a resolution up to 1-metre; (ii) STRIP MAP, with a resolution up to 3-metre and (iii) SCANSAR, with a resolution of up to 30-metre. Clearly, of the three, data policy is most relevant in respect of Spotlight 2 and STRIP MAP, which both produce high-grade data.

Subsequent to the Intergovernmental Agreement, Italy has enacted a series of regulations relevant to the COSMO-SkyMed system data policy that set out general principles on the commercialisation and use of data by civil and commercial users. Inter-Ministerial Decree no. 32 of 1 December 2006 was adopted through secondary legislation in accordance with the provisions set out in Art. VIII of the Intergovernmental Agreement. The Decree provides that:

- The Italian Space Agency (ASI) shall provide the interface between the civil (institutional and commercial), national and international users of the COSMO-SkyMed system data and is granted the right to programme, process, promote, use and disseminate the data for civil and commercial users;
- ASI and the Ministry of Defence retain the intellectual property rights concerning the COSMO-SkyMed system products obtained within the framework of their respective civil and military satellites programmes.

A national data policy document was also set out in 2007. ASI and the Ministry of Defence approved the document COSMO-SkyMed National Data Policy and Resources Sharing (DPRS) on 7 March 2007. This outlined general principles in respect of national policy on the distribution of COSMO-SkyMed civil component data. It also defines three main groups of COSMO-SkyMed System user categories based on their user rights and limitations:

- **The owners of the system:** ASI and the Italian Ministry of Defence; (ii) institutional, national and international users, scientific users; (iii) generic (or commercial) users, including all other users;
- **The data acquisition and dissemination** of COSMO-SkyMed subject to the control of national security authorities through a classified procedure with the "right of veto";
- The **Committee for the Guidance and Coordination with the Institutions (OICI - *Organo di Indirizzo e Coordinamento con le Istituzioni*)** which is responsible for defining data policy guidelines for civil and commercial usage.

Data users may utilise the data and/or products in compliance with the terms and conditions set out in the COSMO-SkyMed licence of use.

The OICI is an important body and shares some similarities with the role of BAFA in Germany i.e. it is responsible for scrutinising sensitive data requests. The OICI is composed of representatives from ASI, the Ministry of Defence and National Security Authorities. Its main tasks are to:

- Define guidelines for the use of data produced through the civil component; and

[21] E-GEOS is a joint venture company established between the Italian Space Agency (20%) and Telespazio SpA (80%), a Finmeccanica/Thales company, upon the authorisation of the Ministry of Education, University and Research.

Space legislation – supporting analysis D

- Coordinate with other state administrations to ensure that the distribution of COSMO-SkyMed data products respects security, national defence and foreign policy considerations, while at the same time seeking to maximise potential benefits from the exploitation of the data for civil needs, both institutional (e.g. civil protection, research and development) and commercial.

A 'control table' is used for assessing individual data requests. The sort of generic criteria that have been taken into account in this process are:

- Technical parameters e.g. spatial resolution;
- The country from which the data request emanates (there is a controlled list of countries); and
- The specific geographic area on which information has been requested (e.g. if high-grade data were requested covering sensitive areas).
- Ensuring that the specific user requesting the data does not pose a threat – i.e. may use data for malevolently for instance, in a way that supports terrorism.

The **control table** serves as a "filtering" mechanism for data product requests. The **control table** consists of five Annexes to the Guidelines Document approved in 2009 mentioned earlier. EU Regulations on combatting terrorism, and a list of countries that pose security concerns are among the items to be checked as part of the control process.

- Annex 1 contains 3 EC provisions with a list of blacklisted natural persons and entities to whom it is forbidden to deliver any kind of data products to such natural or legal persons. See EU Regulations no. 2580/2001, no. 423/2007 and the Common Position document no.140/2007/PESC, adopted in the framework of the international antiterrorism policy.
- In Annexes 2 and 4, classified lists of Countries are reported. It is only possible to deliver Spotlight 2 images to users coming from such countries only if such images concern their national territory (also in compliance with the Principles of the United Nations); no limitations are foreseen for the other types of products (STRIP MAP and SCANSAR);
- In Annexes 3 and 5, particular classified combinations of "applicant Countries – requested areas" are reported, whereby "a case by case" OICI assessment is required to deliver Spotlight 2 products. However, no restrictions are foreseen for the other COSMO-SkyMed Products.

As noted earlier, e-Geos is the sole primary data distributor in Italy licensed to distribute COSMO-SkyMed data working directly under the regulation. However, it was not possible to obtain information on the detailed procedures that E-Geos uses to screen data requests. However, the above general criteria relating to the control table approach provide a good indication of the sort of factors that are considered. Data requests identified as being sensitive are then subject to scrutiny by the OICI, which has the power to refuse data requests. It was not however possible to obtain information on what percentage of data requests are deemed as being sensitive or are refused.

Table D.4:The evaluator's view - remote sensing legislation in Italy

Even though a regulatory framework has been put in place supported by procedures for (i) screening data users and (ii) checking the sensitivity of the data acquisition target area, these are only known to those directly applying the procedures (e.g. primary data distributors and the OICI Committee), and not to all market participants.

Overall, there is less transparency compared to the German system, which may affect second-tier distributors and downstream users should their request for data be refused. Moreover, as in France, the majority of the

Space legislation – supporting analysis D

criteria applied in carrying out the security screening checks are classified, leading to concerns about the lack of transparency for data users.

However, since less than 1% of total data requests are not granted (a level common with Germany), there does not appear to be a material difference in terms of what this means for data users in terms of service continuity.

The fact that COSMO-SkyMed is a dual-use radar satellite system has meant that there were system-specific complexities in developing an appropriate framework to facilitate data commercialisation. This raises the question as to whether it may also be necessary to develop primary legislation in future to allow for additional new market entrants and to strengthen transparency in decision-making procedures relating to the screening of data requests for data users.

D.2.5 The UK

The UK does not presently have a regulatory framework and defined formal policy on satellite data distribution. The Export Control Organisation within the Department for Business Innovation and Skills (BIS) is the authority that grants export licenses. BIS is the regulator responsible for overseeing a general export control regime. The BIS website states that *'Export licenses and permissions will be needed to sell some satellites, data and services to destination countries that are considered sensitive by the international community'*[22]. The current export licensing rules allow for restrictions to be imposed on the dissemination of satellite data to certain countries, should particular security concerns be identified.

By the end of 2014, the UK will shortly join the small number of EU Member States that have commercial operators of civil high-resolution EO satellites. As in other EU countries, there has been a steady evolution in spatial and spectral resolution capabilities over successive generations of satellite development. Whereas the DMC2 (part of the Disaster Monitoring Constellation (DMC)) provides a spatial resolution of 22m (mid-resolution) the UK-DMC3 satellite constellation, its successor, has a resolution of 1m (monochrome) to 4m (colour / multispectral).

In the absence of a general data policy framework in the UK, an agreement specific to the DMC3 is under negotiation between the company responsible for the satellite's development and UK government. The way in which data policy will work in practice, and the criteria for determining access to and the use of high-grade data is still under discussion. No further information is available because of the ongoing and sensitive nature of the agreement.

According to an interviewee from the UK commercial remote sensing sector, this may illustrate the need for a more generic defined policy in the future to allow for future developments. However, the UK government position is that a formal regulatory framework is not necessary and could harm the development of the market if it imposed overly onerous burdens. The view of the UK Space Agency was that there is a need to strike a balance between security considerations and commercialisation needs, but that bilateral agreements between companies and governments should be sufficient to control data policy, without recourse to formal legislation.

The strong commercial potential of the distribution of high-resolution data can be demonstrated by the fact that a Chinese customer has agreed to pay for the system's construction, launch and insurance costs up-front in return for seven years' exclusive use of the imagery through a contract worth $170.2m. By exporting data rather than satellite hardware, the transaction overcame technology-transfer concerns that could have arisen under the US' ITAR regulations. Leasing satellite

[22] http://www.bis.gov.uk/assets/ukspaceagency/docs/industry/export-licensing-clarification-document-v3.pdf

Space legislation – supporting analysis D

imagery capacity provided a practical alternative solution. However, this required discussions between public and regulatory authorities and industry in China, the UK and the US to secure the contract.

With regard to the wider implications of such examples of commercial contracts being won to export satellite data capacity rather than to export hardware, then this raises a question as to whether a common regulatory framework on would facilitate such transactions from European companies to international customers.

Table D.5: The evaluator's view – data control policy in the UK
The **UK's** position in respect of satellite data policy is under consideration. As yet, there is not a fully defined policy, reflecting the fact that the UK remote sensing industry is not yet as advanced as in **France, Germany** and **Italy**. Nevertheless, there has been marked progress towards developing high-resolution EO capabilities. There is a question mark over the medium term as to whether export control regulations are suitable for controlling satellite data distribution. The large contract win by a UK company in China highlights the importance of giving consideration to a defined framework in future.

Space legislation – supporting analysis D

D.3 International Legislation on Space and Space-based Remote Sensing

The Outer Space Treaty of 1967 sets out the basic principles of international space law and provided an anticipative framework to encourage the development of national legislation for the commercialisation of space and the increased involvement of private entities in space activities. In recent years, there has been a proliferation of national space laws both internationally and in some EU countries. A number of studies have been carried out to map out space laws, such as work by the Committee on the Peaceful Uses of Outer Space (COPUOS).

This identifies some of the core components of an effective law-space, the minimum standards that all national space laws should meet, sets out the objectives of space laws and provides key definitions, the governing permissions and licenses for private space activities and identification of the competent body to release them, the definition of liability and discipline of the registration of space objects. Many countries have adopted general space legislation governing space-based activities in accordance with the UN Convention on activities in outer space.

Furthermore, a number of international conventions on remote sensing data use can be noted. The '*Convention on the Transfer and Use of Remote Sensing Data of the Earth from Outer Space'* was adopted in 1978[23]. In 1986, a further Convention was adopted on '*The Principles Relating to Remote Sensing of the Earth from Outer Space'*[24]. This sets out 15 principles on remote sensing and provides a definition of the terms "remote sensing" [25], "primary data" and "processed data" and "Group on Earth Observation". The implication for countries that have signed up to the Convention is that they should develop national legislation in order to control data policy.

A number of countries internationally have developed regulatory frameworks for the processing and distribution of high-grade EO satellite data so as to allow for its commercial exploitation such as the **US**[26] (1992, 1998, 2003 and 2006), **Canada**[27] (1994, 2005 and Amendment Act in 2007), **India**, **Russia** and **Japan**[28] (1994 and 2007). The regulatory position in Canada, the US and in Japan has been ascertained in some detail through this study. It has not been possible to obtain detailed information with regard to satellite data policy in all the other countries mentioned.

The 1992 US **Land Remote Sensing Policy Act** regulates the collection and utilisation of space-based land remote sensing data. The Act introduced a licensing requirement for remote sensing operators, but was exclusively concerned with protecting national security interests. Indeed, there was an explicit reference to the prohibition of the commercialisation of weather satellites.

[23] The *Convention on the Transfer and Use of Data of Remote Sensing of the Earth from Outer Space* of 1978 (currently, only nine States are members), and the non-legally binding *Principles relating to remote sensing of the Earth from Space*, adopted by UN General Assembly Resolution of 3 December 1986.

[24] The Principles Relating to Remote Sensing of the Earth from Outer Space (1986), United Nations Office for Outer Space Affairs.

[25] The sensing of the Earth's surface from space by making use of the properties of electromagnetic waves emitted, reflected or diffracted by the sensed objects, for the purposes of improving natural resource management, land use and the protection of the environment.

[26] Presidential Decision Directive 23, U.S. Policy on Foreign Access to Remote Sensing Space Capabilities, 9th March 1994.

[27] Canadian Space Agency RADARSAT Data Policy (1994) Document Number: RSCA-PR0004, Sec. 10.1 b..

[28] Memorandum of Understanding between the National Space and Development Agency of Japan and the National Aeronautics and Space Administration of the United States of America for Cooperation in the Advanced Earth Observing Satellite (ADEOS) Program (1994)

Space legislation – supporting analysis D

However, the 1998 **Commercial Space Act**[29] introduced amendments to the 1992 Land Remote Sensing Policy Act, and allowed public sector users the possibility for the first time of data acquisition from commercial providers *'for scientific or educational purposes or to meet the requirements of the National Aeronautics and Space Administration, and other Federal agencies and scientific researchers'.*

On July 31, 2000, the NOAA published an interim final rule on the *'Licensing of Private Land Remote-Sensing Space Systems'* in the Federal Register. This introduced a licensing scheme for US commercial remote sensing operators[30]. The regulations were effective from August 30th, 2000, and set out the agency's requirements for the licensing, monitoring and compliance of operators of private Earth remote sensing space systems under the Act.

The licensing system is overseen by a dedicated regulatory agency, the NOAA Commercial Remote Sensing Regulatory Affairs (CRSRA)[31]. The aim of adopting the licensing system was to maintain security while encouraging the growth and development of commercially-focused operators. It should be noted that US Federal Agencies, especially the NGA account for a significant proportion of total revenue, although US remote sensing firms such as GeoEye also export data internationally, including through European data resellers.

The process of applying for a license to operate a private remote sensing space system is described in the 2006 amended regulations[32]. There are differences in licensing conditions depending on the type of satellite system in question, for instance, specific to synthetic aperture radar (SAR) and hyperspectral systems. The introduction of the licensing system only applies to US operators and the requirement to obtain a license also applies to subsidiaries and affiliates. The presence of a licensing scheme was not viewed as creating any specific barriers to data distribution.

With regard to how data control works in practice, once licenses have been issued, unlike in Germany, transactional monitoring does not take place at the level of every individual transaction. Rather, the NOAA works closely with individual licensees. There are also procedures in place for licensees to inform the NOAA about any significant or substantial agreements entered into with any foreign nation, entity, or consortium, not later than 60 days prior to concluding the agreement. There is then the added security protection of shutter control on commercial high-resolution imagery satellites on the grounds of national security. This approach is commonly used across many different countries.

As technological capabilities have evolved and the NOAA has assumed responsibility for licensing more advanced high-resolution systems, it has put a stronger emphasis on data protection. The NOAA provides each licensee with a Data Protection Plan template and works closely with licensees to develop plans which address the specific security issues of each licensee. Moreover, a condition is currently included in NOAA licensed systems with imaging capabilities of > 0.82m panchromatic ground sample distance (GSD) to withhold the distribution of satellite imagery for 24 hours from the time of collection before releasing to a non-U.S. Government approved user.

[29] US Commercial Space Act of 1998 creating Public Law 105-303

[30] The regulations apply to any person subject to the jurisdiction or control of the United States who operates or proposes to operate a private remote sensing space system, either directly or through an affiliate or subsidiary.

[31] http://www.nesdis.noaa.gov/CRSRA/

[32] 15 CFR Part 960, Licensing of Private Land Remote-Sensing Space Systems; Final Rule NOAA, Department of Commerce, see Federal Register / Vol. 71, No. 79 / Tuesday, April 25, 2006 / Rules and Regulations

Space legislation – supporting analysis D

Since the regulations were adopted, two new commercial remote sensing satellites have been launched and are now operational; the NOAA has issued 10 new licenses for increasingly advanced remote sensing space systems, bringing to 23 the total of licenses issued. However, some licenses are for scientific and educational rather than commercial purposes, with 3 systems operated for instance by universities[33].

Overall, the licensing system was regarded as working well by the NOAA, with flexibility for the US Government to periodically review license conditions so as to determine whether circumstances such as advances in technologies may warrant changes. There is moreover flexibility in the license system. For instance, licenses can be issued for new and advanced technologies that have not previously been licensed by the NOAA to address the unique characteristics and attributes of particular satellite systems.

For example, the NOAA may grant a ''two-tiered'' license that allows the licensee to operate its system at one level, available to all users, while reserving the system's full operational capability for the US government and federal agencies or for US government-approved customers only. This was seen as appropriate since the latest generation of VHR satellites produce military-grade spatial and spectral resolution data. This data can be rebased however and distributed to commercial clients.

Ways in which the US government has been able to support the development of the commercial Remote Sensing industry are summarised in Appendix E.

In **Canada,** legislation on remote sensing has been in place since 1994. The Canadian Space Agency's RADARSAT Data Policy set out a framework for the use of satellite data produced by radar satellites. Subsequently, the Remote Sensing Space Systems Act (Canada)[34] was adopted in 2005 (amended in 2007). The impetus for the legislation adopted in 2005 was the development of, a next-generation radar imagery satellite ("Radarsat-2") which was due to be launched by Canada in December, 2007.

As in other countries, legislation setting out data policy was felt to be necessary to protect national security, while at the same time providing an enabling framework to promote the development of the commercial remote sensing industry. This was the first high-resolution satellite to be owned by a Canadian company and not by the Canadian government. It was therefore felt necessary to have a formal licensing system in place.

The absence of such a framework would have meant that the commercial operators would have had to develop commercial markets for data without any clarity as to what is - and is not – acceptable in terms of data security policy. There were also seen as being advantages in aligning Canadian legislation on remote sensing and licensing arrangements more closely with the US arrangements. Since the US already has a more developed remote sensing industry, its regulatory framework was felt to be helpful to achieving the above policy aims. However, the licensing conditions are specific to Canada and the US i.e. broadly similar but not identical.

[33] http://www.nesdis.noaa.gov/CRSRA/licenseHome.html

[34] Act Governing the Operation of Remote Sensing Space Systems, S.C. 2005, c. 45, received Royal Assent on 25 November 2005.

Space legislation – supporting analysis D

The Act introduced a **licensing requirement for the operation of remote sensing space systems** overseen by a dedicated inspectorate. Among the controlled activities within the legislation's scope are: (a) formulating or giving a command to a remote sensing satellite of the system; (b) receiving raw data from a remote sensing satellite of the system; and (c) storing, processing or distributing raw data from the system. System operators must apply for the license and if successful, are then subject to an inspection regime. The license may be revoked by the Canadian government if the continued operation of a licensed system is likely to be (*a*) injurious to national security, the defence of Canada, the safety of Canadian Forces or Canada's conduct of international relations; or (*b*) inconsistent with Canada's international obligations. The legislation allows for improved monitoring by the Canadian government of satellite operations to protect national security, with **'shutter control'** possible**.**

China has supported an active EO programme and has also entered into partnership with other countries such as the China-Brazil Earth Remote Sensing Satellite, CBERS-2, which China launched in 1999. Until 1999, Chinese data users relied solely on data from U.S., European and Japanese satellites for multispectral imagery. Since then, China has made significant progress in catching up with other international spacefaring nations such as **India** and **Japan** in developing its remote sensing capabilities.

Since 2006, the National Remote Sensing Center of China (NRSCC) which operates under the Ministry of Science and Technology has had responsibility for policy making in respect of remote sensing technology. Its overall function is to organize and implement national scientific and technological plans in the field of earth observation and navigation technology. It aims to develop China's innovation capacity and to foster the development of strategic new and emerging industries in remote sensing and for EO data, geographic information system and navigation and positioning. No information was available on satellite data policy in China, although this is clearly an issue since there has been previous sharing of satellite observation capacity for instance with Brazil.

The Beijing-1 satellite, which has been in orbit since 2005, has a 4m ground resolution. China's first high-resolution remote sensing satellite ZY-1-02C of circa 1m was launched in Dec 2011. This is the first customised land resource satellite for Chinese clients. It will provide clients with images for disaster relief services, agriculture development, environmental monitoring and other applications.

Moreover, **China has a rapidly growing market for commercial data**, especially in environmental monitoring and in the aerospace, environmental monitoring and agricultural sectors. This is illustrated for instance by the fact that a Chinese firm[35] will lease high-grade satellite imagery capacity from a European satellite developer (UK) and will need all the capacity from three new satellites for the first 7 years of the satellite's operations.

In **Japan**, the Basic Space Law entered into force on August 27, 2008. The law aims to strengthen space industrial competitiveness by promoting the strategic development and use of space R&D for the benefit of Japanese citizens. The law is based on six fundamental principles; the peaceful use of space; improving the lives of Japanese citizens; the development of the space industry; achieving progress in civil society; contributing to international space activities; and taking care of the environment.

[35] http://www.spacenews.com/contracts/110629chinese-firm-orders-three-optical-imaging-satellites-from-surrey.html

Space legislation – supporting analysis D

One of the policy measures envisaged in the basic space law is the creation of a **standard data policy to facilitate the distribution of satellite data**. The law states that *'it is necessary to examine ways of distributing data to achieve a balance between mechanisms to promote the data's maximum usage and ensuring that international commercial data markets can be fully exploited'*. This will require information about the intended purpose of data use and the image resolution to be taken into account. In addition, '*it is necessary to create and publish guidelines as standard data policies for provision of satellite data including preparation and standardization of metadata and security policies such as the prevention of database falsification, and to prepare an environment for the safe use of data by establishing requirements for the use of data*'.

The basic law also features a series of measures as part of a 5-year development and utilisation plan. This includes support for the **development and launch of a high-resolution satellite system in Japan,** "Daichi-2", which uses L band radar. The Satellite System's development is part of wider attempts to develop satellite infrastructure for earth observation data to facilitate land and ocean observing across Asia and other regions.

The **Basic Act on the Advancement of Utilizing Geospatial Information**[36] ("AUGI"), was adopted on May 30, 2007. Its purpose is to advance policies concerning the use of Geospatial Information in a comprehensive and well-planned manner by establishing basic principles and by clarifying the responsibilities of State and local governments respectively. Among the basic principles of the law are that in relation to the implementation of policies concerning AUGI, consideration should be given to ensuring that national security or people's individual rights and interests are not compromised as a result of expanding the distribution of geospatial information.

In conclusion, the market for commercial high-grade satellite data has undergone a period of growth and development over the past decade, but remains a small specialist market niche. To allow for new market entrants, and to better reflect the increased number of remote sensing satellite operators and data distributors, a growing number of countries internationally have introduced regulation underpinned by a licensing system for satellite operators and primary data distributors. The launch of next-generation high-grade remote earth sensing satellites in the past 5 years has brought into focus the need to ensure that national security and foreign policy.

However, the regulatory framework put in place should help to encourage the growth and development of the commercial remote sensing industry by providing a clear and transparent approach to regulating satellite data, by developing licensing procedures that are conducive to the establishment of a close working relationship between those responsible for licensing, and by putting in place a regulatory framework to ensure greater legal certainty, while allowing flexibility for new technological developments.

[36] www.gsi.go.jp/kokusaikoryu/kokusaikoryu-e30004.html Note: the Act is also referred to as the the NSDI Act of Japan.

Space legislation – supporting analysis D

D.4 European Regulatory Framework on Data Policy

There are already a number of regulatory frameworks at EU level on data policy across different policy areas. There is however nothing specific as yet on data policy for high-grade satellite data. These are summarised below:

Table D.6: - Existing regulatory framework on different types of data policy

- The INSPIRE Directive 2007/2/EC established an infrastructure for spatial information in Europe to support Community environmental policies.
- The Access Directive - 2002/19/EC - on access to, and the interconnection of, electronic communications networks and associated facilities.
- PSI Directive - 2003/98/EC on the re-use of public sector information.
- Database Directive 96/9/EC on the legal protection of databases and copyright.
- Regulation on 911/2010 GMES – Commission is empowered to adopt delegated act(s) defining further a GMES data and information policy.
- Aarhus convention (Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters), 1998 – establishing the right of everyone to receive environmental information held by public authorities

In addition, the GMES Bureau within DG ENTR is undertaking work on GMES data and information security policy. Access to data and information is a fundamental policy issue for all GMES stakeholders. The GMES Bureau held a Workshop on GMES Data and Information Policy in January 2012 to address issues relating to the acquisition, processing and exploitation of Earth Observation data in the context of the GMES programme, which will have 5 satellites. This however relates to publicly funded data rather than to the distribution of commercial EO data.

D.5 Wider space legislation and its impact on competitiveness and the EU export control regime

In this sub-section, a review is provided of wider space legislation and its impact on competitiveness. In particular, the assessment focuses on international export control and intra-EU transfer frameworks.

D.5.1 International Traffic in Arms Regulations (ITAR)

Export control is an important area of international legislation that may have a negative impact on the competitiveness of the European space industry.

The US' **International Traffic in Arms Regulations (ITAR)** provides an export control regime for defence goods. ITAR is a set of US government regulations that control the export and import of defence-related articles and services on the US Munitions List (USML). These regulations implement the provisions of the Arms Export Control Act (AECA), as described in Title 22 (Foreign Relations), Chapter I (the Department of State) and Subchapter M of the Code of Federal Regulations. The Directorate of Defense Trade Controls (DDTC) within the US Department of State is responsible for interpreting and enforcing the ITAR rules. The aim of ITAR is to safeguard US national security and foreign policy objectives. All US manufacturers, exporters, and brokers of defense articles, defense services, or related technical data, as defined on the USML, are required to register with US Department of State.

Space legislation – supporting analysis D

While ITAR regulates the export of defence products, the **Export Administration Regulations (EAR)** relates to export control policy for dual-use commodities, software, and technology. These are enforced by the Bureau of Industry and Security (BIS) within the U.S. Department of Commerce. Since the European space industry is dependent on the US for many critical technologies, especially in electronic space components, but also some systems parts, ITAR regulations may have potential adverse impacts on competitiveness, for instance due to:

- **Delays in procuring key components (especially electronics) -** leading to cost over-runs.
- **Lack of business certainty in procuring key space components and technologies.** Risk of fluctuations in US. policy affecting the ability of European space companies to procure the necessary components. A related issue around missed export opportunities in competing for institutional contracts in third countries.

Many European satellites continue to be ITAR-dependent. The European Space Technology Platform (*ESTP*) has estimated that, on average, 60% of the electronics on board a European satellite are currently imported from the United States, because of the lack of a business case to develop those components at European level.

A small satellite developer interviewed as part of this study noted that all the satellites they manufacture contain US components. One way around this problem has been for the company to lease satellite capacity to countries where ITAR and concerns could prohibit trade i.e. retaining ownership and responsibility for operating the satellite. This has enabled the firm to win contracts among commercial customers in countries such as China.

The omnipresence of export control rules in the export of space technologies has been subject to questioning in recent years. ITAR was aimed preserving unconditional access to strategic technologies, U.S. autonomy in the space sector and U.S. leadership in space technologies. However, the emergence of new space faring countries and new space powers is questioning the capacity of ITAR to meet its purposes.

Nevertheless, it should be recalled that negative economic impacts may not only affect the European space industry, but also its US counterpart. For instance, a January 2012 report by the Aerospace Industries Association (AIA) sought to quantify the effects that strict export control reforms have had on the aerospace industry since the late 1990s. According to the report37, 'the move of satellites and related components to the International Traffic in Arms Regulations (ITAR) export control regime cost the industry up to $21 billion in lost sales and more than 4,000 jobs in satellite manufacturing alone'. While recognising the importance of appropriate measures for arms control, the paper calls for the modernisation of the US export control system.

As was the case for high-grade remote earth sensing data, in the area of export control, there is likewise an issue regarding the need to ensure that sensitive technologies that either safeguard national security or pose a risk to national security if misused are appropriately regulated in a way that does not impose a disproportionate burden so that commercial opportunities can be fully exploited so as to promote economic growth and high-skilled, high-wage employment.

[37] Competing for Space Satellite Export Policy and U.S. National Security, January 2012

Space legislation – supporting analysis D

In common with the US, the **EU has an export control regime** to ensure that exports with dual use potential are appropriately regulated. This is governed by Regulation 428/2009[38] and a list of controlled dual-use items is set out in Annex I to Regulation 428/2009. In the US, the Export Administration Act (EAA) falls within the jurisdiction of the US Department of Commerce and controls the export of dual use items.

D.5.2 The distribution of radio spectrum for space operations

The radio frequency spectrum is vital for the competitiveness of the space industry not only in Europe, but globally. This is particularly the case in the satellite sector (*telecommunications, satnavs, EO*). Since spectrum it is a limited natural resource, it needs to be managed effectively.

Frequency allocation is governed by the "Radio Regulations", an International Treaty adopted by the International Telecommunications Union (ITU), and its application through national regulations on licensing the use of the radio spectrum. The ITU is the organisation responsible at global level for co-ordinating the use and distribution of radio spectrum. All ITU Member States may participate in the activities of the ITU-T. All space-faring nationals that are members of the ITU, including a number of EU Member States have votes and there are also many industry member representatives.

The ITU's World Radiocommunication Conferences (WRC) takes place approximately once every four years. Its role is to review and where necessary revise the Radio Regulations which are part of the international treaty mentioned above. The Radio regulations also govern the geostationary and non-geostationary satellite orbits. The issue of access to radio spectrum is very sensitive since some radio frequencies are commonly used in military satellites.

According to a 2011 study by ESPI on the Economic and Policy Aspects of Space Regulations in Europe[39] '*the market for radio frequency spectrum has resulted in a highly regulated market that is struggling to accommodate the rapid development of telecommunications and the massive increase in spectrum demand'.* Clearly, ensuring the availability of radio spectrum free from political interference, or avoiding domination by particular commercial operators or groups of operators from particular countries is essential in order to ensure access to this important resource. This is important in enabling space companies (and especially commercial satellite operators) to operate efficiently and to be able to optimise the cost of operating satellite systems on a pan-European basis. Here, it is vital to maintain competitiveness that economies of scale are kept.

In the EU, a Radio Spectrum Policy Programme[40] has been developed by the European Commission's DG INFSO. It is imperative that as part of the development of an effective policy framework on radio spectrum, the EU contributes to the preparation of the World Radio communications Conference and ITU negotiations so as to defend the EU's interests in the field of spectrum allocation..

[38] Council Regulation (EC) No 428/2009 (also known as the EU Dual-Use Regulation)

[39] Economic and Policy Aspects of Space Regulations in Europe, European Space Policy Institute (ESPI), June 2011

[40] http://ec.europa.eu/information_society/policy/ecomm/radio_spectrum/eu_policy/rspp/index_en.htm

Detailed sectoral assessment E

E. Detailed sectoral assessment

E.1 The space economy

According to ASD-EUROSPACE[41], turnover in the European space manufacturing industry was €6.1bn in 2010 (USD 7.8 billion). . This is relatively low compared to other space-faring national, especially the US. It can be explained by the relative small institutional demand in Europe compared to its competitors. In 2010, the US institutional demand (civil and military) amounted to USD 48.3 billion out of a global total of USD 71.5 billion, The EU, ESA and its Member states and participating countries accounted for roughly USD 9 billion and Japan for USD 3.2 million. The rest of the world accounted for around USD 10 billion. It is important to point out that those figures do not reflect the true Russian and Chinese public expenditure as those are difficult to assess due to the secretive nature of their defence spending under which much of the space budget is taken from.

There are an estimated 35,000 full-time jobs across the European space sector to which one can add an estimated 5,000 institutional employees as well as 5,500 researchers employed in other types of research institutes and laboratories, for a total of 45,500. This must be compared to an estimated 248,000 in the US, 260,000 in China, 6,300 in Japan and an estimated 300,000 in Russia[42]. This may be an under-estimate, since it depends on the definition used[43] of the space industry (and whether this only covers upstream or also ground elements).

The European upstream space sector is dominated by a small number of globally-recognised companies, which have been transformed through industry consolidation from national champions into pan-European entities, often multinationals. There is consequently a high level of market concentration, and comparatively few SMEs. Those SMEs that are successful in growing are usually bought out by larger companies, often multinationals. This is partly due to the significant upfront investment needed to enter the market, the capital-intensive nature of the sector and the fact that larger manufacturers feel the need to secure the supply chain of some critical components. A small number of EU Member States, such as France, Germany, Italy, the United Kingdom, Spain and Belgium dominate the European space industry. The 6 major ESA contributors represent circa 90% of sectoral employment, with France and Germany accounting for over 50% of the total.

Breaking down the European space sector into the main categories described above, there is one launch service provider (Arianespace) which recorded sales of €897 million ($1.095 billion) in 2010[44]. There are three main satellite manufacturers in Europe (ThalesAleniaSpace, EADS Astrium and OHB)[45]. In 2010, the sector represented € 3.1 billion ($4.23 billion) in sales, including €1.15 billion in exports. Over the same period, global revenues for satellite manufacturers amounted to $10.8 billion. While sales and revenues are not exactly comparable, those figures provide an interesting ballpark figure to understand the weight of Europe's satellite manufacturing industry. Looking

[41] The European Space Industry Association representing 90% of the European industry by Turnover.
[42] OECD- The Space Economy at a Glance 2011, Paris, 2011, SIA, Eurospace, the Society for Japanese aerospace
[43] The difficulties in obtaining reliable data in this regard are highlighted by the fact that the UK's space sector was estimated to employ 24,900 directly and to support a further 60,000 jobs across a variety of industries which is an overestimate compared to the figures presented here but include a higher share of employees in the downstream sectors.
[44] Arianespace annual report 2010
[45] Other manufacturers of smaller payloads and micro-satellites do exist outside of the main three; some previously independent manufacturers such as SSTL are now part of larger groups.

Detailed sectoral assessment E

forward, in 2010, 28 commercial GEO spacecrafts were ordered; the US accounted for over half of the total (57%), followed by Europe (22%), Russia (14%) and China (7%)[46].

In Europe, the market is more geared towards commercial applications, with for instance all 8 European launches in 2010 carrying commercial payload.

Operating satellites and downstream services accounts for a significant share of employment and value added. The 11 major satellite operators in Europe run 153 communication satellites out of a total of between 250 and 280, and employ 6,000 people per year[47]. With regard to the division of sectoral turnover between European and international clients, the European space manufacturing industry derives 78% of its revenue from EU markets, and the remaining 22% from global markets.

The downstream sector can be divided into three main segments; SatCom (representing approximately 75% of global revenue), SatNav (20%) and Earth Observation (5%). A number of studies, especially the OECD's Handbook on Measuring the Space Economy have underlined the difficulties in assessing the size of the **downstream sector**. Although a number of smaller SMEs are expected to emerge, a study commissioned by the UK Space Innovation and Growth Team UK Department for Business, Innovation and Skills (BIS) provides some interesting insight into the sector[48]. In the case of the UK, the downstream sector is heavily concentrated. In 2007, the total turnover of the sector was 4.8 billion, with the largest company (BSkyB) making up 71% of revenue, the ten largest companies accounting for 92% of revenue and the top 15 companies making up 99% of the sector's total turnover.

With the inclusion of such Direct-to-Home services, the UKSA estimates the ratio of upstream to downstream services to be 1:6 in the UK (£930 million upstream to over £6.6 billion downstream[49]) and roughly the same in Europe as a whole.

According to Euroconsult data, the ratio climbs to 12:1 in the USA, showing the potential for growth in the European downstream sector. That being said, in the UK, the downstream service has been growing at a speedier rate than upstream services at an average of 9.5% per annum between 2000 and 2009 (as opposed to 6.5% for upstream services). Furthermore, only in the EO field, the Booz report estimates the total *benefit* of the programme to be around €70 billion in the period 2014-2030 once again showcasing the potential of downstream applications and services.

Upstream employment rose 56% between 2000 and 2009 and downstream 76% over the same period. In the field of EO, there were a reported 151 companies involved in the downstream sector in Europe in 2009, 91% of which were SMEs, the majority with less than 10 employees. EARSC has estimated that the number of SMEs involved in the remote sensing downstream sector to be at least 220. It is important to reiterate the lack of rigour in collecting such data on downstream companies. One can however note that while for SatCom and SatNav, the global turnover of downstream activities far outweigh the upstream sector, this is not the case for EO.

[46] SIA – Satelitte Industry Association
[47] SpaceNews, 2009, employment based on the addition of the employees of the European FSS operators.
[48] Sunwynd, Relationship of the UK Space Industry Upstream and Downstream Sectors, November 2009
[49] UKSA, The Size and Health of the UK Space Industry, 2010

Detailed sectoral assessment

E

The **upstream** segment is one which is very capital intensive, historically required public intervention (in the development of launchers or satellite manufacturing capabilities for instance); as a result, it is one with a high level of concentration and relatively low return on investments (compared to other segments). It is nevertheless crucial in terms of enabling other products and services to develop.

The **midstream** segment is very varied comprising of both operators, with very high EBIT but only representing few companies and companies involved in ground equipment segment in which a large number of companies are involved.

Finally, the **downstream** segment is the most high value-added of the three, with a high development potential. There are important differences amongst the companies involved in the segment which includes large multinationals such as television channels of telecom operators (SatCom) as well as small SMEs developing business models based on EO data.

The Space Foundation, Futron and the SIA estimate that global space revenues are between US$160 and US$170 billion. Table 2.2 shows the revenue, number of companies and EBIT of the different space segments.

Table E.1 – Global Structure of the Space Economy (2010)

Area	*Service*	*2010 revenues (USD bn)*[50]	*Number of companies*	*EBIT*
Upstream	Satellite manufacturing	10.8	<10	2% - 8%
	Launch service provision	4.3	<10	1% - 6%
Midstream	Lease / sale of satellite bandwidth	10	50	30% - 40%
	Ground equipment	51.6	millions	N/A
Downstream	Value-added services	101.3	Telecom operators > 1,000 Internet Service Providers (ISP) >1,500 TV Channels > 10,000 VSAT51 & Professional service providers - 500 Digital TV platforms - 50	from negative to very high

Source: CSES interpretation, OECD data, ITU, ThalesAleniaSpace, Satellite Industry Association (SIA),

[50] Transactions in the global space sector are made in US dollars. Consequently, the figures provided throughout the report are presented in this currency.
[51] Very Small Aperture Terminal are used in satellite communications of data, voice and video signals, excluding broadcast television

Detailed sectoral assessment

E

According to ASD-EUROSPACE[52], turnover in the European space manufacturing industry was €6.1bn in 2010 (USD 7.8 billion). This is relatively low compared to other space-faring nations, especially the US. It can be explained by the relative small institutional demand in Europe compared to others. In 2010, the US institutional demand (civil and military) amounted to USD 48.3 billion out of a global total of USD 71.5 billion. The EU, ESA and its Member states and participating countries accounted for roughly USD 9 billion and Japan for USD 3.2 million. The rest of the world accounted for around USD 10 billion. It is important to point out that those figures do not reflect the true Russian and Chinese public expenditure as those are difficult to assess due to the secretive nature of their defence spending under which much of the space budget is taken from.

The **upstream sector**, especially the launching sector is one where there is a high level of market concentration. Currently few space faring national have the capability to launch payloads into orbit, with those capabilities varying in terms of reliability and price. Between October 2010 and September 2011, 96 launches were recorded, including 40 Russian launches, 21 for the US, 14 for China, 12 for Europe and 9 others (including Japan, India and Iran)[53]. Commercial launches paint a different picture, with only 21 launches over the same period, including 17 for Russian (Proton and Soyuz), 8 for Europe, 3 for the US (marking a re-entry into the commercial market) and one for China. However, despite only accounting for 30% of commercial launches between April 2010 and March 2011, Europe made up 53% of commercial launch revenue over the same period.

Based on the typology developed in section 1.4, one can provide some basic specificities of the different areas. Breaking down the European space economy into the main categories described above, there is only one launch service provider (Arianespace) which recorded sales of €897 million ($1.095 billion) in 2010[54]. There are three main satellite manufacturers in Europe (TAS, EADS Astrium and OHB)[55]. In 2010, the sector represented € 3.1 billion ($4.23 billion) in sales, including €1.15 billion in exports. Over the same period, global revenues for satellite manufacturers amounted to $10.8 billion. While sales and revenues are not exactly comparable, those figures provide an interesting ballpark figure to understand the weight of Europe's satellite manufacturing industry. Looking forward, in 2010, 28 commercial GEO spacecrafts were ordered; the US accounted for over half of the total (57%), followed by Europe (22%), Russia (14%) and China (7%)[56]. With regard to operators, in 2008 (the last year for which figures are publicly available for the top 25 fixed satellite operators) EU operators accounted for 41% of global revenues[57].

[52] The European Space Industry Association representing 90% of the European industry by Turnover.
[53] FAA semi-annual launch report, 2011
[54] Arianespace annual report 2010
[55] Other manufacturers of smaller payloads and micro-satellites do exist outside of the main three; some previously independent manufacturers such as SSTL are now part of larger groups.
[56] SIA – Satellite Industry Association
[57] SpaceNews, 2009

Detailed sectoral assessment E

The upstream European space industry is characterised by a **high level of concentration and vertical integration.** EADS for instance is present throughout the value-chain of the space sector, including the fabrication of launchers (Ariane), provision of launch services (Arianespace), manufacturing of satellites (Astrium Satellites), exploitation of data (Infoterra and SPOT image) as well as more downstream services through Astrium Services. Overall, four large firms account for more than 70% of total space sector employment. The European space industry accounts for 40% of the international commercial market. In recent years, emerging space powers, such as China and India, have emerged as potential becoming significant competitors, while more established ones, especially the USA have re-entered the commercial market following a change in the strategic direction of their space programme.

The following table provides an indicative breakdown of the space budgets of the six largest MS contributing to ESA's budget.

Table E.2 – Public space budgets (USD million)

2010-USD	*ESA*	*Other*	*Total*
France	967.6	1,402.0	2,369.6
Germany	888.6	1,170.4	2,059.0
Italy	525.4	468.6	994.0
UK	361.7	156.1	517.8
Spain	277.2	N/A	277.2
Belgium	227.2	32.7	259.9
Other participating states	697.9	N/A	697.9
Total	**3,945.6**	**3,229.7**	**7,175.3**

Source: DLR, CNES, ASI, UKSA, ESA

In 2010, while Europe only accounted for 6 of the 29 commercial launches worldwide, this represented 53% of global revenues from commercial launches, against 34% for Russia and 13% for the USA. The difference between the share of launches and the share of global commercial turnover is explained by a number of factors. Ariane 5 is a high- capacity launcher able to carry heavy payloads e.g. two large satellites in addition to other smaller ones and demonstrators. Second, there is premium on the high level of reliability and transparency in the period leading to and following the launches provided by Ariane 5. The reliability and transparency of Ariane's operations come at a preium compared to other launchers.

The Ariane family of launchers has a very good commercial reputation due to a number of factors: its reliability, the transparency of the launch service provider, which provides feedback of previous launches to its customers; the low level of institutional payload, ensuring that, unlike other launchers, commercial users have the certainty that their payload will be sent to space and not replaced unexpectedly with an institutional one (as is the case in the US or Russia). After the US shuttle Challenger catastrophe in 1986, a number of commercial users turned to European launchers (Ariane 4) and have remained clients ever since.

Finally, the success rate of the Ariane 5 launcher, which has been a contributing factor in its appeal, has recently been emphasised in contrast to the increasing part failures and failures experienced by the Proton launcher (6 failures since 2006, as opposed to one between 2000 and 2005). Due to the low institutional demand for Arianespace's services – estimated at around 1.5 per annum, the company by necessity must remain a leader in commercial services. With around 25 commercial satellites launched a year and a minimum of 6 to 7 launches necessary to ensure the technical viability of the Ariane 5 launcher, the company must secure 10 to 12 commercial payloads per annum (as Ariane 5 can launch two separate payloads). In the short-medium term, Ariane will remain highly competitive globally. This will be supported by the development of Ariane 5 ME (Mid-life Evolution) , which is currently under development, with the first flight planned for 2016-2017.

Further investment will however be needed in the development of 'next generation' launchers and discussions are presently ongoing as to whether national funding can be secured (led by France but with contributions from other Member States) for the development of Ariane 6 by 2030.

The main competition still comes from ILS with 9 Proton in 2011 (including one failed launch). Furthermore, following the retirement of the US Space Shuttle and the new policy of encouraging the development of private launchers, SpaceX is in the process of demonstrating the capability of its Falcon 9 launcher and already has at least 29 launches scheduled to 2015. Increased market concentration is being driven by an **ongoing process of industry consolidation leading to a monopolistic or duopolistic situation** in some market segments. The pace of consolidation has accelerated markedly in the past 10-15 years.

Commercial users of satellites will generally opt for the best price/ quality ratio and will not take into account Europe's best strategic interests.

Table E.3: Launcher Pricing Policy

Launchers pricing policies

Arianespace is a launcher services provider, in charge of procuring the launchers, provide the overall services related to the launch and the operation of the launch. It is controlled by both representatives of some European member States and the space industry.

Currently, Arianespace provides three launchers, Ariane 5, Vega (developed with European public funds), and a modified version of Soyuz. Overall the development of a European launch capability is the result of public investment.

The Board of Arianespace shareholder regularly determines a minimum price at which launches can be carried out. This takes into account, among others, the costs of the launch operations, the procurement of the launchers and the participation to the operation and maintaining of the Kourou spaceport (a cost for instance that competitors do not pay as they use military installations). As such, Arianespace is given a minimum launch price by its shareholders ensuring that launches do not operate at a loss. However, due to the minimum price those services can be sold at, a number of European institutional actors procure their launch services outside of the EU.

With regards **satellite manufacturing**, according to SIA, the global **Satellite** Industry Association, the manufacturing sector represented $10.8 billion in 2010, with the US accounting for $5.6 billion (52% of total). Out of the 28 commercial GEO satellites ordered in 2010, EU manufacturers accounted for 22% of orders (down from 29% in 2009). With the consolidation that has taken place over the past two decades, there has been a **transition in funding dependencies towards European and international markets** for satellite manufacturers. This is especially the case among larger companies that now operate on a pan-EU and multinational basis. Large space companies had previously tended to align themselves with what was taking place at national level. Their first point of contact was commonly with national delegations that were members of ESA. Secondly, large firms focused on ESA itself, and on EU programmes for which procurement has been delegated to ESA.

Detailed sectoral assessment E

With regard to the division of sectoral turnover between European and international clients, the European space manufacturing industry derives 78% of its revenue from EU markets, and the remaining 22% from global markets. Operating satellites and downstream services accounts for a significant share of employment and value added. The 11 major satellite operators in Europe run 153 communication satellites out of a total of between 250 and 280, and employ 6,000 people per year[58].

A number of studies, especially the OECD's Handbook on Measuring the Space Economy have underlined the difficulties in assessing the size of the **downstream sector**. Although some smaller SMEs are expected to emerge, a study commissioned by the UK Space Innovation and Growth Team UK Department for Business, Innovation and Skills (BIS) provides some interesting insight into the sector[59]. In the case of the UK, the downstream sector is heavily concentrated. In 2007, the total turnover of the sector was £4.8 billion, with the largest company (BSkyB) making up 71% of revenue, the top ten firms accounting for 92% and top 15 companies making up 99% of the sector's total turnover. This trend is not uncommon, with the largest downstream company in Italy (Sky Italia) and France (CanalSat).

A UKSA-Euroconsult report from 2007 carried out for ESA classified downstream services for each of the three main satellite segments (SatCom, SatNav and EO) into different degrees of maturity. The report also provided an interesting typology of market segments in which services have developed and were expected to develop. The detailed table can be found in Appendix D. The five technology categories in which the services and applications were classified included: (i) technology where the market is not proven; (ii) growth characterised by a high growth; (iii) mature where the market has found and established customer based; (iv) cyclical, where following the mature phase, the application is subject to continuous development, and finally (v) the phase where the application is replaced by new technologies. Satellite Communications is the segment with the most maturity, with the first satellite launched in 1962. It can provide some insights into the future development of both SatNav and EO. According to ESOA, the European Satellite Operators Association, the segment generates €47 for each public euro invested in the technology[60].

Table E.4 - Downstream sector maturity

	Technology	Growth	Maturity	Cyclical	Decline
SatCom	In-flight entertainment	Mobile	Direct To Home television (DTH)	Messaging	Trunk telecom
	Digital Camera	Rural	Hyperbolic In-Air Tracking System(HITS)	Asset tracking	
	Telemedecine	Defence / security	Satellite News Gathering (SNG)	Corporate networks	
	Tele-education	Broadband		Content management	
		DAB/DMB			
EO	Consumer Services	Homeland Security	Energy and mineral resources	Meteorology	
	Disaster management	Defence	Agriculture	Land use	
	Humanitarian relief	Forest and water resources		Cartography	
	Environmental monitoring	Marine transport			
	Marine engineering	Private weather forecasting			
		Law enforcement			
SatNav	LBS	Aviation	Surveying	Defence	
	Telematics	Personal navigation	Fleet management	Time and frequency	
	Advanced Driver Assistance Systems (ADAS)	Machine control	Asset tracking	Maritime	
	Rail	Workforce tracking			
		Leidure boats			

Source: EUROCONSULT / ESA

[58] SpaceNews, 2009, employment based on the addition of the employees of the European FSS operators.
[59] Sunwynd, Relationship of the UK Space Industry Upstream and Downstream Sectors, November 2009

[60] It is however unclear whether this figure also relates to historical investment.

Detailed sectoral assessment E

While the table above seems to indicate that there is a similar number of sectors for the three types of downstream applications (Satcom, Satnav and EO), EO is the least developed. In order to identify the areas and ways in which they can develop, one might look at some of the space-based services with heritage such as SatCom (especially television broadcasting and telecommunication). For satellite operators, the development of smaller and lighter satellite propulsion engines such as plasma propulsion is extremely interesting as it allows for more band capacity weight for weight. European programmes such as FP7 have helped identify and demonstrate the capabilities of such small propulsion engines; one example is HiPER.

Table E.5 - Industry perspective: satellite mobile phone operator

A mobile satellite company which provides services to ships, planes and in remote areas of the globe, stressed the importance of reduced costs in their business model. They believe they have reached a point where the development on new services on their satellites is being hit by the law of diminishing returns and are trying to cut on costs. The costs of providing such services have dramatically reduced; while before the company could only viably provide services in areas in which mobile phone networks were not available (sea, desert areas etc), it is now becoming competitive even in certain 'non-remote' markets. In order to continue having a viable business plan, the development of new hardware is constrained by cost issues. In this respect, their interest lies in technologies reducing the costs of launching space crafts and those allowing to increase the payload.

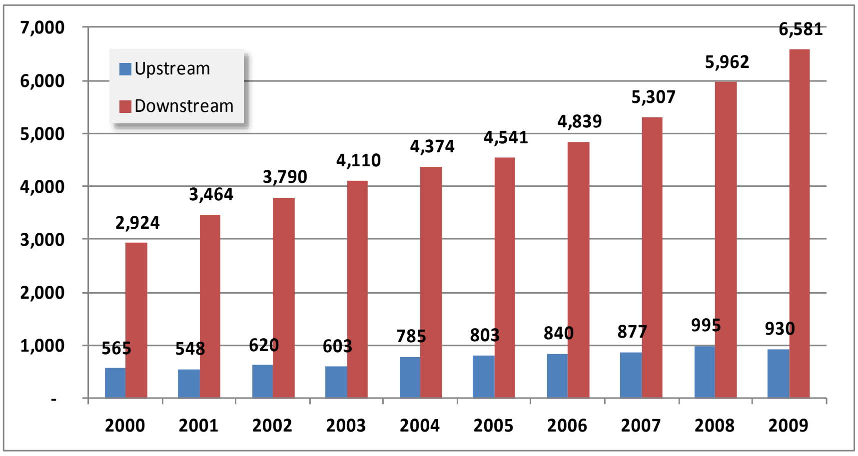
A study commissioned by the UK Space Innovation and Growth Team in 2009 provides interesting insights on the relationship between the upstream (space sector) and downstream (wider space economy) sectors. While in the SatCom sector, the link between upstream and downstream is well known (with the first Sky broadcasts made from the Orbital Test Satellite demonstrator built for ESA) it is doubtful that such commercial successes can be replicated in EO and SatNav. Interestingly in EO, established companies involved throughout the value chain of the space sector have played a role in the development of downstream services. Astrium is such an example, owing SPOT image and Infoterra. However, most of the customers are still institutional at this point. Finally, the SatNav sector lies somewhere between SatCom and EO. One study by GSA estimated that the benefits of SatNav would be equal to €90 billion over the next twenty years. This is a reliable estimate but refers to "benefits" rather that direct economic figures, such as turnover.

The UK has a well-developed downstream sector. This is partly due to the lack of strong upstream players in the country. The UKSA and its previous inceptions have promoted downstream uses of space applications and services through organising events, promoting research and innovation in the industry. Through such activities, the agency believes it has proven to investors that investing in the downstream sector is relatively safe and potentially highly profitable. With the inclusion of such Direct-to-Home services, the UKSA estimates the ratio of upstream to downstream services to be 1:6 in the UK (£930 million upstream to over £6.6 billion downstream[61]) and roughly the same in Europe as a whole. According to Euroconsult data, the ratio climbs to 12:1 in the USA, showing the potential for growth in the European downstream sector. That being said, in the UK, the downstream service has been growing at a speedier rate than upstream services at an average of 9.5% per annum between 2000 and 2009 (as opposed to 6.5% for upstream services). The trend is similar in terms of employment, with upstream employment rising 56% and downstream 76% over the same period.

[61] UKSA, The Size and Health of the UK Space Industry, 2010

Detailed sectoral assessment E

Figure E.6 - UK Downstream and upstream space industry turnover 2000 – 2009 (GBP million)



Source: UKSA

The development of the downstream sector can benefit from active public intervention. An interesting case in this respect is the Japan GPS Council. The JGPSC was created in 1992, two years before the system became fully operational. It is composed of representatives of the user community and industries with an interest in developing GPS services, mainly automobile manufacturers. The council allowed industry to start working early and in cooperation with each other to develop the market for GPS systems and uses. This example is interesting in that in Japan, strong potential for developing high value-added applications and services using GPS was identified by large Japanese corporations that had the financial power to develop efficient products. Conversely, in the US, there was a less organised approach to commercialising downstream applications and services. It was expected that SMEs would develop applications and services based on organic development. However, this approach led to the US losing market share relating to some of its competitors.

An institutional interviewee explained that even though space-based, space infrastructure should be seen as an infrastructure in the same way as civil engineering projects are. The only difference is that European civil engineering projects benefit European citizen; it is important to ensure that they also benefit from the products and services derived from the European space infrastructure. Ideas to avoid such a development include:

- Ensuring that the data is only made available to EU companies from countries where a reciprocal data sharing agreement exists
- Public support in helping the European industry develop solutions and applications using the programmes at an early stage with possibly the involvement of private and public institutions and
- Individual providing finance to innovative SMEs.

Detailed sectoral assessment E

E.2 Market structure – the remote sensing industry

The number of VHR and high-resolution satellite operators and primary data distributors globally remains small, albeit growing. This reflects the significant level of investment required to develop upstream EO infrastructure and to develop, launch and operate EO satellites. An illustration of the current market structure and the relatively limited number of market operators (e.g. satellite operators and primary data distributors) directly subject to such legislation is provided below:

Table E.6: Market structure: high-resolution data distributors

Country	*No. and type of primary data distributors of high-resolution data**	*VHR and high-resolution primary data distributors*
France	1 VHR and high-resolution (optical)	Spot 5, Pleiades (Astrium / Spot Images)
Germany	3-5 distributors (mainly radar)	Terra Sar X (Astrium/ Infoterra), Rapideye (now Canadian-owned) European Space Imaging (distributor for DigitalGlobe's satellite constellation (WorldView-1, WorldView-2 and QuickBird)
Italy	1 distributor	Cosmo-Skymed (EGeos) Also distributor for GeoEye's satellite constellation
Spain	1 mid-resolution, next generation of satellites will be high-resolution	Deimos and Deimos-2 (expected Q4 2013)
UK	2 mid- mid-resolution, next generation will be high-resolution	DMCii leases satellite capacity in respect of different satellites e.g. DMC-3, international distributor of NigeriaSat-2 imagery
Canada	1 radar operator	Radarsat-II
US	2 – both optical, but potential new market entrants expected as part of the EnhancedView programme	GeoEye and DigitalGlobe are the two market leaders.

**The no. of primary data distributors is based on research by CSES. National authorities in some countries were unwilling to confirm the data, for reasons of commercial sensitivity.*

The total number of companies across the EU subject to licensing requirements and other regulatory obligations such as transactional monitoring and a declaratory regime remains small. However, in spite of high market entry costs, there are expected to be a number of new market entrants in the next 5-10 years, reflecting growth in demand for very high and high-resolution satellite data. The market will however only support a certain ceiling in terms of the number of high-resolution satellite operators in Europe before over-crowding in the market.

In the **US,** two companies, both market leaders in commercial remote sensing, benefited from the EnhancedView programme 2010-2019, which awarded contracts worth a combined $7.3 billion over ten years. EnhancedView is being implemented by the National Geospatial-Intelligence Agency (GSA) and one of its aims was to promote new market entrants from the aerospace and defence sectors. However, the allocation through this contract is currently under review in the Defence Department's 2013 fiscal year budget proposal. Moreover, while there were previously two main remote sensing satellite operators (Geo-eye and DigitalGlobe) but these subsequently merged in July 2012.

Detailed sectoral assessment

E

In Europe, there are only a few **very high and high-resolution commercial remote sensing operators (and primary data distributors).** Again, this reflects the fact that the commercialisation of EO data is a small but growing market. For instance, France currently has a single commercial high-resolution satellite operator and primary data distributor (SPOT images)[62]. Germany has a small number of high-grade radar satellites, such as Terra SAR-X and Rapideye. Italy has a single high-resolution dual use radar satellite system, Cosmo Skymed. In the UK, while the current EO capability is predominantly mid-resolution, from 2014, one company will operate high-resolution satellites on a fully commercial basis. There is evidence of strong industry concentration. According to Euroconsult, three companies have approximately 65% of the global market share: *DigitalGlobe; GeoEye*; and *Astrium Geo-Information Services.*

With regard to the **relative competitive strengths of Europe and its international counterparts**, it was observed by a major distributor of satellite data that the US currently has competitive advantage over Europe because it has very-high resolution (VHR) optical satellite capability. Although this will be addressed through the launch of VHR optical commercial satellites in future (e.g. Pleiades in France), there is a strong dependency on US commercial providers for optical data (e.g. Geo-Eye, Ikonos).

Since the GMES sentinels have not yet been launched (the first two are expected later during 2012), and there is funding uncertainty with regard to future sentinels due to the current GMES funding debate in the 2014-20 period, the US has developed a high market share of the commercial data procured for GMES pre-operational services and GMES Initial Operations 2011-13. Arguably, among the impacts of the lack of a European capability in very high-grade optical data are that the costs of such data are higher than they might otherwise be. This is not however the case in respect of radar imagery, since Europe has a strong competitive position due to the development of Terra Sar-X (DE) and Cosmo-SKymed (IT).

In both the EU and internationally, commercial data markets have grown in parallel with technological improvements in spatial and spectral resolution (and in the overall information content of satellite imagery) and as a result of progress in improving data processing capabilities on-board satellites. Nevertheless, the remote sensing industry remains strongly dependent on government customers and on defence spending.

In the EU, the development of EO remote sensing activities was initially driven by governmental demand for satellite data to address national security and to provide data to inform policy making and to fulfil wider public functions, such as environmental monitoring, disaster response and mitigation, land management and meteorological forecasts. However, technological improvements in the spatial and spectral resolution of high-grade remote earth sensing data has increased its commercial potential across a broad range of sectors, e.g. agriculture and forestry, energy, mapping, environmental monitoring and security.

The research found that the breakdown in revenue between (i) EU and international markets and (ii) public sector and commercial clients varies between remote sensing companies and primary data distributors. It is important to note that international data markets account for an increasing share of the annual revenue of European remote sensing companies and provide strong potential to promote growth and employment.

[62] The research suggests that a second operator has approached CNES, (in its capacity as the national competent authority for the distribution of radio spectrum) to obtain a license to apply for radar spectrum.

Detailed sectoral assessment

The growth of data markets in third countries is driven by a combination of public and commercial users of satellite imagery. Two illustrations of the growing importance to European firms of international data markets are:

- A contract awarded in 2011 to a commercial satellite data developer and data distributor in the **UK** to provide satellite data to a Chinese client over 7 years in a contract worth an estimated 170.2m US$.
- In **France**, more than half of the turnover of a provider of satellite data imagery is generated through international sales of radar satellite imagery, largely to meet demand for satellite imagery from national governments in third countries for defence purposes. Moreover, French national authorities and the Ministry of Defence today only account for a small proportion of total optical data sales.

In some countries, such as France and Germany, new recent and prospective market entrants have emerged in addition to the existing historical actors. The move form a nationally monopolistic situation to one where more actors are involved have prompted action to develop national regulatory frameworks to promote the growth and development of such markets.

E.3 The commercial potential of EO markets

The development of commercial satellite data markets has taken longer than had been anticipated by industry observers, due to uncertainty about the commercial applications of high-resolution data before satellite systems came on-stream and the need for sufficient time for awareness about the role of high-resolution EO data to particular industries. Despite this, from a low starting point, the global market for commercial high-resolution EO data has grown approximately 600% between 2001 and 2010.

The size of the market opportunity does nevertheless need to be set in context. Data markets remain small compared with the size of other areas of the space sector, including upstream investment in EO satellite infrastructure. Some of this investment is for commercial systems, but the majority is government expenditure programmes to develop EO satellite system capabilities, for instance defence purposes and for civil uses, such as environmental monitoring.

European and international demand for satellite has grown especially from the defence sector and intelligence agencies. Demand is also growing for high-resolution commercial satellite images across a wide range of sectors, such as agriculture, forestry, insurance, energy and shipping. Many EO companies, especially the largest global market players have developed new commercial markets, but government clients remain their main customers for high-resolution satellite data.

The earlier generation of commercial EO satellites were able to provide generic data that can be used for a wide range of applications across different sectors. The new generation of very-high grade EO satellites provides higher levels of accuracy and spatial resolution. This opens up scope to provide imagery products that allow for the development of downstream services and applications customised to meet the specific to the needs of particular industries.

Another potential area for Europe to develop new commercial markets is through exporting servies to emerging markets in which spacefaring nations are seeking to operate satellites or to develop their own medium-resolution satellites through technology transfer, drawing on the expertise of satellite prime contractors, including those established in the EU. There is for instance, a growing satellite export market from Europe to Africa in countries such as Nigeria and Algeria. Euroconsult points out the fact that first-generation missions have led to second-generation replacement satellites.

Detailed sectoral assessment

It is important that this potential is fully maximised in order to promote jobs and growth. This is particularly so given the substantial strategic investment made to date in some Member States to develop satellites capable of producing data that have commercial value because of their high-information content and the possibility of real-time access.

As noted by ESPI in their 2011 report on the Economic and Policy Aspects of Space Regulations in Europe.[63] *'The distribution of EO data and the development of derivative EO products have high commercial potential through their capacity to generate EO products. In this regard, space agencies have quickly developed channels to commercialise EO data and derivative products adopting data policies that try to balance both the public interest and the commercial potential of their technologies'.*

E.4 Investment in the commercial remote sensing sector and policies to promote the development of the commercial remote sensing industry

In this sub-section, policies to promote the development of the commercial remote sensing industry – including investment subsidies - are examined. In particular, the different operating conditions for the commercial US remote sensing industry compared with its European counterpart are considered. Since some of the European satellite systems are dual-use or have been developed through PPP, it has not been possible to obtain data on their development and operational costs. However, it is clear that the scale of public support for the remote sensing industry is much greater in the US than in Europe.

The US has had a **formal Commercial Remote Sensing Space Policy** 64 (CRSSP) in place since 2003. The policy's aim is *'to protect U.S. national security and foreign policy interests while maintaining the nation's leadership in remote sensing space activities, and by sustaining and enhancing the U.S. remote sensing industry'.* The new policy defined commercial imagery as an essential element of US national security policy and a critical factor in influencing the US' global scientific and technical competitiveness. The policy states that U.S. government will "rely to the maximum practical extent on U.S commercial remote sensing space capabilities for filling imagery and geospatial needs for military, intelligence, foreign policy, homeland security and civil users." The CRSSP also commits to the "development of a long-term, sustainable relationship between the U.S. government and the U.S. commercial remote sensing space industry."

In line with this policy, the US government has recognised the importance of nurturing the commercial remote sensing industry through direct industry support first and foremost for strategic reasons relating to strengthening national security and homeland defence and secondly, to promote growth and jobs in the high-value added space sector.

[63] Economic and Policy Aspects of Space Regulations in Europe, European Space Policy Institute (ESPI), June 2011 (Parts 1 and 2)

[64] http://crssp.usgs.gov/

Detailed sectoral assessment

E

Through the framework of the CRSSP, the National Geospatial-Intelligence Agency (NGA) [65]has invested public subsidies in the ClearView, NextView, and EnhancedView programmes. It announced in March 2003 that it intended to support the continued development of the industry by sharing the costs for the engineering, construction and launch of the next generation of commercial imagery satellites. These programmes have provided significant-scale sequential investment to support the development of commercial high-grade remote earth sensing satellites and long-term funding support for their operations. The timeframe and level of investment required is provided below:

- **ClearView programme -** 2003 and 2004 the NGA committed the US government to purchase up to $500 million in high-resolution satellite imagery from two commercial companies i.e. a total investment of $1bn.
- **NextView programme -** the GSA also committed in 2003 to a further five-year, one billion dollar procurement programme to support the early stage development of next-generation imaging satellites. Some of the new satellites have been fully operational since 2009.
- **EnhancedView programme -** $7.3 billion in contracts were originally awarded to two U.S. commercial remote sensing firms over the 10 year period 2010-19. However, the contract value may be reduced due to budgetary cuts.

The long-term commitment from the US government to fostering the industry's development will help to strengthen the competitiveness of the US remote sensing industry by providing a steady long-term income stream. In addition, the CRSSP also mandates US government's civil agencies use commercial imagery to the greatest extent possible. This will help to stimulate demand for HR space imagery over time.

The approach in the US can be contrasted with that in Europe. There is of course EU support through the flagship GMES programme to support the development of EO satellites and to procure high-grade EO data prior to the operational readiness of the first GMES sentinels, which are expected to be launched in 2013. There is also policy support through the European Space Policy and the European Space Strategy to promote the development of downstream services. However, there are clearly lower levels of direct public support for investment in high-grade EO satellites in the EU compared with the US. Nevertheless, it should not be forgotten that significant investment has been made in the development of high-grade EO remote sensing satellite capabilities by national governments in a small number of EU countries *(e.g. France, Germany and Italy).* For instance, the TerraSAR-X satellite in Germany (2007) was 80% funded by the DLR within the German space agency. The cost of building and launching the satellite was 130m EUR and a further 55m for the first five years of its operations. No data was available on Cosmo Skymed.

There are different ways of interpreting this however. On the one hand, the US benefits from generous subsidies in comparison to European remote sensing firms. However, US remote sensing firms have a high dependency level on their main domestic government customer (National Geospatial-Intelligence Agency - NGA). More than 70% of US companies' revenues are from U.S.-based customers, whereas in comparison, 70% of SPOT Image's 2009 revenues are from non-European entities. The ability to grow international data markets, and to diversify client bases may represent a real competitive strength for the EU commercial remote sensing industry. This is demonstrated by the contract mentioned earlier won by a UK satellite developer to provide high-resolution satellite imagery to China over a 7 year period.

[65] Among the functions of the National Geospatial-Intelligence Agency (NGA) is supplying large volumes of satellite images to the Department of Defense (DoD).

Space Downstream Sector

F

F. Space downstream sector

	Macro segment	Market segment
Satnav	Transport	Commercial aviation Rail Maritime
	Consumer services	Leisure vessels General aviation Outdoor recreation Personal LBS
	Professional services	Surveying Asset management Scientific services Agriculture / fisheries Time & frequency dissemination
	Road	Telematics Fleet management Traffic management
	Government / institutional	Defence Public Safety
Satcom	Consumer broadband	IP Direct Access
	Mobile communications	Professional Mobile communications Messaging and asset tracking
	Satellite networks	Corporate networks Defence / security Rural Communication Telemedecine
	Video distribution	HITS DTH SNG Education TV Business TV Digital Camera
	Video contribution	Content management SNG
	Mobile entertainment	In flight entertainment DAB/DMB
Satnav	Natural resources Management	Environment monitoring Agriculture Forest Energy Water
	Defence and Security	Homeland security / law enforcement Humanitarian actions Disaster Management
	Land monitoring	Consumer services Cartography Land use/cover
	Oceanography	Transport Coastal Zoning / engineering
	Meteorological services	Professional services Weather forecasts

Space indicators G

G. Indicators

This appendix sets out key issues in the development of a monitoring and indicator framework to assess the future contribution of the European Space Industrial Policy to strengthening the competitiveness of the European space industry (manufacturing and services). The suggested indicator framework then sets out context indicators to monitor sectoral performance (and to alert the EC as to the need for policy action) are outlined and indicators to review progress against strategic policy objectives.

The main challenges, both methodological and practical, such as access to reliable sectoral data, and statistical gaps are also identified.

G.1 Purpose of a monitoring and indicator framework

In summary, the purpose of setting up a monitoring and indicator framework for the European Space Industrial Policy will be to:

- Monitor the European space industry's competitiveness over time (and its main segments e.g. manufacturing, services, data and individual sub-sectors within these);
- Identify when specific EU measures might be needed to address changes in space industrial competitiveness in particular sectors; and
- Monitor the implementation of the European Space Industrial Policy both overall, and in relation to specific policy measures, initiatives and activities.

G.2 The role of indicators and good practices

Indicators are used to monitor the performance of the implementation of policies and programmes. They are also used to foster accountability within frameworks such as evidence-based policy making. A summary of key considerations in the development of an indicator framework, drawing on good practices, is provided below:

Table G.1: Good Practices in the Definition of an Indicator Framework

- Indicators should **correspond with the standard evaluation framework** established by the EC for the evaluation of EU policies and programmes (e.g. differentiating between outputs, results and impacts).
- Indicators should contribute to monitoring the extent to which the future European Space Industrial Policy (and the ESP more widely) is achieving its general and specific objectives.
- Indicators should conform to the RACER criteria i.e. they should be : **R**elevant, **A**ccepted**, C**redible , **E**asy (to monitor) and **R**obust.
- Indicators need to be **supported by clear definitions** in order to ensure that the data collected is robust and reliable.
- There should be consideration of the **time and resources necessary** for the collection of the monitoring information needed and the possible data constraints.
- Indicators should be **proportionate** and not increase **administrative burdens.**
- Often, **too great** a **number of indicators are defined at the outset,** leading to practical difficulties in implementation and gathering data. This also risks inhibiting a clear overview of performance.
- Indicators should be defined in a way that enables evaluation issues to be assessed by external evaluators.

Space indicators G

Previous research and experiences in the development and implementation of space indicator frameworks to assess competitiveness need to be taken into account in the indicator system's design. Example of existing frameworks include Eurospace's annual report which provides a series of indicators on the upstream space sector,

In addition, the OECD Handbook on Measuring the Space Economy (2012), which sets out a methodology for assessing how well the space economy is performing overall. A chapter is included which provides an overview of space indicators. This differentiates between:

- **Readiness Indicators:** Inputs to the Space Economy - technical, financial and social infrastructures that enable the production of space-related hardware or the provision of services.
- **Intensity Indicators:** Selected Activities and Outputs in the Space Economy - the diverse outputs (products, services, science) that are produced or provided by the space sector. These outputs are very diverse, ranging from commercial revenues from industry, scientific productivity such as patents, to the number of space missions or space launches.
- **Indicators to Measure the Socio-economic Impacts from Space Activities.**

All three areas will be of interest to the Commission in assessing progress towards the ESP's general industrial policy objectives at a high-level, and its specific and more operational objectives. This is also true of the future proposed European Space Industrial Policy.

In respect of the third area - socio-economic impacts - the OECD notes the challenges in assessing impacts. *'Many space-based services have had positive impacts on society, but issues concerning economic data definitions and methodologies have to be resolved to allow the benefits to be identified and quantified more precisely'.*

The report provides interesting ideas on the development of context indicators that can provide information on how the industry is performing overall, such as the number of patents, skilled human capital, government budgetary allocation to the space sector and financial expenditure for R&D in civilian Space Programmes, new commercial and industrial activities. It also suggests downstream indictors such as the number of satellite TV subscribers, and so on, in order to shed light on the penetration of space enabled-technologies and services. While these are useful in comparing the space economy between different EU countries, they do not provide much value for the development of strategic indicators.

Earlier experience in assessing space competitiveness should also be taken into account. For instance, ESA carried out the **European Space Industry Survey from 2003-2007**. ESA, as mandated by its Convention, monitors the evolution of the European space industry and its markets. Three surveys have been completed to date. The results have been communicated to industry after each survey (1995-1997, 1999-2001, 2003-2007). The aim of such surveys has been to develop a better understanding of the changing environment. The data produced through these surveys could feed into monitoring of the European Space Industrial Policy's implementation.

ESA's intention is to update the reports more frequently in order to improve strategic dialogue between the space industry and ESA. To this end, two studies are under preparation, but have not yet been published e.g. an Analysis of the European Space Industry 2008-2010 and a Forecast of the European Space Sector. The objective is to map out the situation today, the evolution over the period and its causes, and scenarios for future developments. Such studies could play a useful tool as part of the overall monitoring framework for keeping track of market developments.

Space indicators G

The **European Association of Remote Sensing Companies (EARSC)** has not yet done any work on indicators, but intends to do in the future. It has developed a typology of EO services as a precursor step towards developing indicators and better monitoring data on the EO industry (space data and services). One of the difficulties is that survey work in the EO sector.

G.3 Development of a monitoring and indicator system – building blocks

Introduction

In devising an appropriate monitoring framework, there will need to be three main indicator types:

- **Indicators of sectoral performance** – e.g. context, trend and strategic indicators for assessing the competitiveness of the European space industry and international benchmarking
- **Policy indicators –** setting out the link between objectives, the achievement of policy goals and the criteria needed to measures progress towards these.
- **Indicators linked to the implementation of specific measures –** indicators that measure progress towards the achievement of goals linked to specific activities.

We now explore these different types of indicators in further detail.

- **Context and trend indicators** - providing information on the performance of the European space industry overall, and in particular sub-sectors over time series. Although not directly related to policy measures, such indicators help to monitor the competitiveness of particular sub-sectors within the European space industry and will provide an 'early warning system' of the need for policy actions linked to a decline in competitiveness. Those indicators are also interesting inasmuch they can be used for international benchmarking against the main space-faring nations.
- **Strategic indicators** – future estimates / forecasts of market size, scope and structure. These will provide foresight about expected future trends across space manufacturing and services. Europe's % share of the market is an especially important indicator.

Sectoral performance indicators over time series will allow for the identification of trends, which will provide a proxy of progress towards strengthening the competitiveness of the European Space Industry. Sectoral performance should also be benchmarked against global competitors (e.g. the EU versus the US). Possible indicators for international benchmarking are provided later in this section.

Within the monitoring framework, indicators should also be included to assess the performance of the implementation of measures implemented directly through the European space industrial policy. However, the main problem at this stage is that these measures are not defined in detail. **Operational indicators can only be produced at the point when operational measures have already been drawn up**. Given this limitation (no concrete measures are yet on the table), only general indicators can be suggested at this stage.

The main types of indicators that should be taken into account are:

- **Inputs** – indicators that monitor the level of resource requirement to implement a particular policy measure, initiative or action.
- **Outputs** – indicators that monitor immediate outcomes and are useful for internal management purposes.

Space indicators G

- **Results –** indicators to assess medium-term, intermediate policy outcomes. It should also reflect the intervention logic of the specific objective under which measures / initiatives have been supported.
- **Impacts –** longer-term indicators that relate to the achievement of high-level global objectives and their effects (e.g. economic and employment impacts, impacts on innovation, technology transfer and progress towards strengthening space industrial competitiveness).

The indicator system should avoid imposing any disproportionate administrative burdens on space stakeholders (especially industry).

A number of principles should apply in respect of the development of indicators to assess progress towards the achievement of the future European Space Industrial Policy's objectives. Among these are that the indicator system should:

- Avoid imposing any disproportionate administrative burdens on the space industry.
- Allow for both qualitative and quantitative assessment.
- In relation to qualitative indicators, include appropriate assessment criteria to judge success;
- Take into account the existing strategic framework provided by the DG ENTR's Management Plan (MP), which has a section on space;
- Build on existing strategic progress indicators in relation to space research and innovation programmes (e.g. FP7 SPA);
- Take into account previous experience in developing space indicators (e.g. OECD space economy handbook, the C-Space Project FP7, experience of space-related industry associations).
- Allow for benchmarking the performance of the European space sector against its global competitors (China, India, Russia and the US).

It will not be **straight forward to assess the *direct* contribution of the future European Space Industrial Policy quantitatively** because indicators to capture policy achievements are by their nature more difficult to measure. They are best assessed qualitatively, for instance, through regular review by the Space Policy and Coordination Unit, or with external support through evaluation.

Nevertheless, in relation to specific sectors / subsectors within the upstream, midstream and downstream segments of the economy, there is **scope to include a number of quantitative indicators** to provide indications of progress. The indicators developed will provide an assessment of sectoral performance across the European space industry and wider space economy, rather than assess the impact of public intervention.

The use of context indicators on sectoral performance – assuming that statistical gaps can be overcome through joint work between the Commission's DG ENTR and Eurostat - will be helpful in providing information as to whether the EC needs to take action to address competitiveness issues in particular sectors of the European space industry. The use of context indicators will enable the EC to take action, for instance, if there is a major decline in turnover in a particular market segment. This could serve as part of an 'early warning system' to flag up particular problems. For instance, a decline in the turnover of the strategically important launchers sector may be indicative of problems in terms of heavier subsidies of development costs and possible price dumping by international

Space indicators G

competitors.

However, sectoral performance indicators are and as such, provide proxy indicators for the health of particular areas of the space industry and wider space economy. They cannot be used however to monitor and measure the specific impacts of policy measures or specific initiatives being implemented through the new European Space Industrial Policy. It is important that **context indicators** are incorporated into the framework as proxies for the competitiveness of the European Space Industry over time series.

An example of a quantitative indicator already measured that relates to one of the likely objectives of the future space industrial policy (maintaining Europe's strategic non-dependence) is the number of critical technologies identified and developed. For example, a joint EC/ESA/EDA Task Force was set up bringing together European industry and research actors to work on the identification of critical technologies (CTs). The Task Force has developed a list of 17 CTs and a future call in FP7 SPA will fund the development stage to help bring these CTs to market.

Wider context indicators relating to the level of investment across different Member States and between Europe and its international comparators may also be possible, such as the number of patents, national and European expenditure (public and private) on space-related R&D activities.

In respect of the strategic launcher sector, the number of European v. non-European launchers per year, their payload, prices provide important context indicators connected with the aim of ensuring independent access to space. Likewise, assessing progress towards technological non-dependence will require both quantitative and qualitative assessment.

Here, quantitative sectoral performance data should be available, broken down between space manufacturing and services, and further disaggregated by sub-sector (e.g. within upstream: launchers, satellites – SatCom, SatNav, EO – including meteorological). As a minimum, data should be available on the following variables: *turnover, value added and employment*. A key problem however is the lack of up to date and reliable sectoral data to give a real-time snapshot of the state of health and competitiveness of the European Space Industry. For instance, Eurostat's Structural Business Statistics data tends to lag at least 3 years behind as a minimum. Context indictors must also be benchmarked against both international and sectoral comparators.

Measuring changes in sectoral performance over time through **trend indicators** will shed light on what progress is being made towards key objectives. Of course, it will not be possible to directly attribute changes in sectoral performance *directly* to the role of the European Space Industrial Policy within the ESP. However, the policy's role in influencing the 'direction of travel' could be useful. The use of trend indicators is especially relevant to assess progress towards the achievements of strategic aims, namely (i) developing a competitive, stable, efficient and balanced industrial base in Europe and (ii) supporting the European Space Industry's global competitiveness.

Since the framework will mainly include qualitative indicators (or in the case of quantitative indicators, these will be indirect, proxy indicators to provide context), it is also important that appropriate assessment criteria are developed to assess progress qualitatively. Since policy impacts cannot be measured easily quantitatively, the criteria through which *'success'* should be measured needs to be determined. The OECD work notes that assessing progress towards strategic objectives in the space sector is complicated. Here, the important role played by evaluation in interpreting data and in assessing overall progress and should be stressed.

Space indicators

G

Secondly, the indicators should take into account the strategic framework provided by DG ENTR's Management Plan (MP), the link between the Commission's overall objectives and political priorities and the detailed objectives of activities at an operational level. It has a central place in the Commission's Activity-based Management system, establishing the overall general objectives for space research and the impacts that action is expected to generate. It also specifies lower level objectives and the corresponding anticipated results. In addition, the MP sets out more specific targets, mainly at the programmatic level. These indicators should help in the assessment of how far progress is being made through the implementation of space research and operational programmes towards the achievement of programme objectives and how far this in turn is contributing in aggregate level to the goals of the ESP. There is already quite a detailed set of space-related performance reporting as part of the MP (see Annex 1.1).

The OECD had advocated international benchmarking across a range of 'intensity indicators' across selected activities and outputs in the space economy. For instance, turnover and employment by European space companies, export revenue from international sales (disaggregated by major geographic region), and the evolution of space-related patents.

Thirdly, the indicator system will need to build on existing **strategic indicators** of progress with a forward looking dimension. These sets of indicators should focus on forecasts and estimates of the industry in future years. They should include a scenario-based analysis taking into account the different variables of the sector. This forward looking set of indicators will allow identifying early threats to the position of the European space economy, including demographic trends, the development of non-European space sectors and the development of markets for space applications and services and so on. Because of their forward-looking nature, these sets of indicators will tend to quantitative and less objective that the one mentioned above.

In assessing progress towards the achievement of some strategic indicators, notably those that depend on context indicators in order to shed light on progress made (e.g. supporting the global competitiveness of the European Space Industry), the counter-factual should be taken into account i.e. what would have happened in the absence of intervention? For instance, longitudinal sectoral performance data may show that the sector has remained stable over a 5 year period or has even contracted. This does not mean that the ESP and future ESIP has had no impact or been a failure. The situation may have been worse had there been no space industrial policy.

Lastly, previous experience in the development of indicators to measure progress in the space economy and in respect of space policy objectives needs to be taken into account. Relevant publications in this regard include the OECD Handbook on Measuring the Space Economy and specific initiatives such as the FP7 Space funded **C-Space project**[66] which sought to analyse drivers of space policy in Europe and point towards indicators to measure progress towards strengthening industrial competitiveness. Examples of indicators suggested through this project are provided below with additional potential source of data added by CSES:

[66] http://www.c-space-eu.org/events/index.php

Space indicators G

Table G.2: C-Space Project – Indicators and Criteria

Socio-economic theme	Specific theme	Criteria	Indicator	Source of the indicator
Measuring the contribution to the political development	European identity / governance	Capacity to justify the EU role in the space sector	Legal and political basis	Feedback from national authorities
		Capacity to fully exploit the new competences in the space domain since Lisbon Treaty entered into force	MS and European political and financial will to implement new EU role	ESA, EC and MS space budgets
		Capacity to attract interest and support	Communication and attractiveness of ESP	Eurobarometer / survey
		Capacity of the EU to have a recognized status at international level via space	Perception of the relevance of EU as a space partner by third countries	Survey / ad hoc interview programme
		Capacity of impacting EU decision making processes	Capacity of impacting EU decision making processes	Survey of institutional users
	Cohesion of European societies	Capacity to impact on the structure of European societies and individuals	Pan European trends regarding Education and resulting "quality of Jobs	Eurospace / Eurostat / OECD
		Capacity to contribute to European and international security through European space programs	Operations, effects in crisis –cooperation, data sharing	Number of activation of European funded crisis management space assets
Measuring the contribution to the economic development	Industrial criteria	Establishing a sectoral policy that will meet the industrial needs in support of the new EU space competence	Assessing the elements of a space industry policy	Number of CT developed Number of projects funded aimed at developing CT ADD
	Innovation	Capacity to estimate the most precisely as possible spin-offs and spin-over in order to account those impacts in the cost-benefits analysis for the development of space technologies	Leverage effect	Existing studies (Futron, Euroconsult), survey of downstream services and applications
	Employment level and nature	Capacity to ensure the long-term level of employment in the space	Employment in the space economy by type	Eurospace, ESOA and other industry association report, OECD, Eurostat

Space indicators G

		sector and economy		
Measuring the contribution to the society/culture development	Science/Knowledge /Education	Capacity to educate and train high professionals in Europe in the field of space along the whole range of expertise	Evaluate the awareness of space sciences	Number of projects funded dealing with space science; Number of researchers in the field of space science; Number of PhD and post-doctoral researcher in the field of space science receiving funding through European, national or local funding
	Media/Circulation of information	Establishing the media link	Interest in space	Number of specialised publications; Number of articles published in national mainstream media

Although the C-Space project provides some useful elements and an interesting starting point, the indicators proposed are difficult to attribute back to the policy itself.

A general point on indicators is that qualitative assessment will often be required at the level of *results* and *impacts*. This is especially the case for policy indicators. Also, in the absence of appropriate quantitative data to assess direct outcomes, *proxy data* on sectoral performance data to provide appropriate context is also important. For each area of the space sector, performance data will need to be broken down by space sub-sector[67].

Science and Technology

Consideration should also be given to including some existing indicators from space research programmes (e.g. FP7 SPA) in order to provide supporting information as to what has been achieved through the frame of the ESP.

For example, it may be possible through existing monitoring activities to collect **context data** on the economic value generated through EU funded projects that have led to technology transfer from the space to the non-space sectors (and vice versa). Data may also be available based on existing indicators used at the project level and collected by the REA, which has monitoring responsibilities in managing day to day programme management and implementation.

For instance, there may be data on indicators such as the number of spin-offs created, the turnover generated from spin-offs, the number of patents and other forms of IP developed and exploited, the turnover generated through IP exploitation, etc.

[67] Upstream - launchers, satellite manufacturers, propulsion systems, components, midstream – ground segment / system operators, data distributors and downstream – application and service developers.

Space indicators

G

G.4 Proposed indicators

In the table on the following page in landscape, proposed indicators to assess progress towards the industrial competitiveness aims within the existing ESP and the future Space Industrial Policy are set out. Each of the general policy objectives are summarised, and the proposed indicators to measure progress at the level of outputs, results and impacts are then described. This is followed by an indication as to which assessment criteria will be used to measure success.

As noted earlier, under Art 189 of the TFEU, the EC should assume a role in monitoring space industrial competitiveness in order to regularly assess the sectoral health of the industry both overall and in respect of specific sectors. Below are some suggested indicators. While some indicators are purely quantitative, others will either be purely qualitative or will be and mixture of both. In the case of downstream sector for instance, it is unlikely that an exhaustive list of services and applications can be drawn up at this point. Consequently, a list of targeted fields will have to be assessed. Furthermore, additional work needs to be carried out to develop an accepted typology of the sectors, and especially a scoping exercise of downstream products and services. This can be built on existing literature such as that developed in Appendix F (Eurospace) or EARSC's recent paper on uses of EO. In the meantime, an ad hoc monitoring system will have to be put in place.

Space indicators

Table G.4: Monitoring the competitiveness of the European space industry and sectoral performance

Area of space activity	*Indicators*	*Data sources*	*Notes*
Upstream	•Number of commercial and institutional launches •Share of launchers sales (and trends) •European satellite manufacturing market share (commercial and institutional) •Number of potential international clients with which there are trade barriers (in public procurement and other barriers) •Value of orders (by sector) •EU upstream trade balance	ESPI, Eroconsult, companies data Arianespace data Company data , Euroconsult Ad hoc analysis Company data Eurostat	The data should be benchmarked against other space-faring nations as well as against other sectors (telecoms etc...)
Midstream	•TO from SatNav, SatCom and EO data •Employment in midstream sector •EBIT / EBITDA of operators •Level of vertical integration between space actors	Companies data Companies data, ASD Eurospace Ad hoc qualitive analysis	
Downstream	•Employment •Share of SMEs in total firms in the sector / TO •Number of patents developed in downstream services •Ease of access to finance for start-ups •Number of application and services developed	Ad hoc qualitive analysis	In the case of EO, such indictors should, at least initially, be developed according to field specific activities (Energy, transport etc...),

As explained in Section 4.6, given the global nature of the space industry, there is a need for regular international benchmarking. Possible indicators for comparing Europe's performance against international spacefaring nations are provided in the following table*:*

Space indicators

Indicators	*Sub-indicators*	*Source*	*Frequency*
The EU's global market share	*Manufacturing (e.g. disaggregated by segment e.g. launchers, satellite manufacturing)* *Services and applications (e.g. disaggregated by types of service and applications; one-offs, or on-going)* *Data (e.g. number of data providers, divided between public and private data)*	*ASD Europspace* *Eurostat SBS* *Non-European Space trade associations (SOA, etc)* *Surveys* *Industry associations (EARSC...)* *Eurostat SBS* *Surveys* *Industry associations* *EEA and other data providers*	*Annually* *Annually* *Annually*
Turnover and employment	•*Total employment (FTE) in the upstream space sector*	*ASD Europspace* *Eurostat SBS*	*Annually*
The level of public investment in space research and innovation	•*Amount invested in space science and technology (European, National and private)*	*National Space agencies,* *EC,* *Companies annual reports*	*3-5 years*
The level of public investment in the development phase	•*Amount invested in the development of phase (European, National and private)*	*National Space agencies,* *EC,* *Companies annual reports*	*3-5 years*
Socio-economic impacts (largely to be assessed indirectly).	•*Level of education of employees in the space economy* •*Share of the population receiving satellite-based internet access (reduction of the digital divide)* •*Productivity gains in indifferent economic sectors (fisheries, logging and forestry, airlines, etc.)*	*OECD* *ASD Eurospace* *Eurostat* *Satellite internet providers* *Survey*	*3-5 years* *Annually* *3-5 years*

Space indicators

	•Regional economic growth of space regions *• Number of national and European legislation that can be monitored through space-enabled applications and data*	*Regional authorities* *NEREUS network* *National authorities* *EEA and other European agencies*	*Annually* *3-5 years*
Space research	*•No. of breakthrough technologies developed* *•No. of patents developed* *•No. of other forms of intellectual property (i) developed and (ii) exploited;* *•No. of spin-offs and spin-overs, the number of patents and other forms of IP generated, etc.* *•No. of researchers and related indicators in respect of skilled human capital;* *•National expenditure on Space research and innovation Programmes (civilian, military, dual-use/ joint)* *•Overall budgetary allocation to the space sector by Member State government among spacefaring nations*	*Survey* *IP Offices* *IP Offices* *Survey* *IP Offices* *ASD Aerospace* *OECD statistics on research* *National space agencies* *National space agencies*	*Annually* *Annually* *Annually* *biannually* *Annually* *Annually*

It should be noted that while some wider socio-economic impacts could be assessed quantitatively, because of the question of establishing attribution (i.e. causal relationships), there will need for interpretive analysis of impacts as part of evaluations of progress in implementing the future space industrial policy.. The table below presents a series of indicators by theme that could be covered by a Euroepan Space Industrial policy as well as a section with overarching policy indicators for the policy. A number of those are based on the C-Space projet, with additional indicators added.

Space indicators

Table G.6: Possible indicators for the future European Space Industrial Policy

	Indicators				
Objective	*Input*	*Output(s)*	*Result(s)*	*Impact(s)*	*Measurement tool / assessment criteria*
Establish a coherent EU regulatory framework.	EC resources (time, expenditure) invested in the development of a more coherent space regulatory framework at national level - QLV	•No. of EU initiatives linked to promoting a more coherent space regulatory framework at national level. - QLV	•No. of Member States that have adopted: -General space legislation -Specific enabling legislation e.g. on commercial satellite data. - QLV	Strengthened space regulatory framework at national level Wider adoption of enabling legislation in new and emerging areas of space services (e.g. commercial satellite data) - QLV Increased scope for the development of a common EU regulatory framework in future (subject to Treaty change) - QLV	Quantitative and qualitative review of evolution in space legislation. Assessment of: • Progress towards strengthening the EU regulatory framework. • Progress towards encouraging the Member States to put in place an enabling regulatory framework in respect of high-grade Earth Remote Sensing Data. - QLV QTT
Further develop a competitive, stable, efficient and balanced industrial base in Europe (and to support SME participation).	•Amount invested in space science and technology (public / private) – QTT	Context indicators Sectoral performance data disaggregated between: -Manufacturing and services -Space sub-sectors. - Key sectoral variables (e.g. turnover, Value Added and employment. Employment in the space manufacturing sector	Data on market structure e.g. -% of turnover from institutional and commercial markets -% of turnover from EU vs. international markets -% SMEs vs. large firms QTT	Strengthened and more balanced European industrial base. Higher levels of SME participation in the space industry (overall, manufacturing and services, by subsector)	Longitudinal assessment of performance of space industry. Quantitative review of context indicators e.g. key sectoral variables *Sources: Eurospce, AIA, SJAC, SIATI, Companies annual report, Eurostat*

Space indicators

		Consolidated sales of the manufacturing industry (Europe v. RoW) – QTT Structure on the industry (vertical integration , concentration) – QLV			
Support the global competitiveness of the European Space Industry.	•Number of people having successfully completed at the tertiary level in an S&T field of study (according to the Canberra manual) - QTT	<u>Context indicators</u> Sectoral performance data disaggregated between: •Manufacturing and services •Space sub-sectors. Key sectoral variables (e.g. turnover, Value Added and employment. QLV QTT <u>Specific indicators</u> • No. of breakthrough technologies developed • No. of patents developed • No. of other forms of intellectual property (i) developed and (ii) exploited; • No. of spin-offs and spin-overs, the number of patents and other forms of IP generated, etc. • No. of researchers and related indicators in respect of skilled human capital; • National expenditure on Space research and	•Number of companies developing in the downstream sector (enabling the downstream segment) Multiplier effect, amount leveraged in the downstream sector per euro (private and public) invested in the upstream sector - QTT	Increase the number of European breakthrough technologies. (benchmark against international competitors) Change in sectoral performance data across key sectoral variables Change in market share of European enterprises •Manufacturing and services •Space sub-sectors. QTT	*Sources: WIPO, EPO, Eurostat, ESA,MS national accounts, OECD data based on data from the Canberra manual* *QTT*

Space indicators

G

		innovation Programmes (civilian, military, dual-use/ joint) • Overall budgetary allocation to the space sector by Member State government among spacefaring nations QTT			
Develop markets for space applications and services.	•Number of events organised to promote the use of space data •Number of match-makings (including number of firms involved) through events QTT	• No. of new space applications • No. of new services developed Comparison with the baseline situation (data availability may be problematic) QTT	• No. of users taking up EO services (through GMES) • No. of users taking up GNSS services (through Galileo) • Value of EO services generated through GMES • Value of GNSS services generated through EGNOS/Galileo Disaggregated by type of user - national and local authorities Number of companies developing in the downstream sector (enabling the downstream segment) Multiplier effect, amount leveraged in the downstream sector per euro (private and public) invested in the upstream sector - QTT	Increase the world-wide market share of applications based on EU satellite systems Strengthened capacity in breakthrough technologies Change in market share of European enterprises in: o EO applications o EO services o GNSS applications o GNSS services	<u>Assessment criteria:</u> Survey of companies, *Sources: surveys, Eurostat (to be developed see below)*

Centre for Strategy & Evaluation Services

Space indicators

Ensure technological non-dependence and independent access to space.		• No. of European launchers per year • No. of Critical Technologies developed • No. of standards developed	• Reduction in price differentials between European and international launchers • % of critical space components that cannot be obtained in Europe • % of critical space components that are subject to ITAR rules QTT - (data availability may be problematic)	• Reduced price dumping in the strategic European launcher sector • Strengthened European independent access to space. • Reduced technological dependence on US. QTT	<u>Assessment criteria</u>: Sectoral performance data on launcher sector Benchmarking between Europe and global competitors (China, India, Russia, US). Qualitative assessment of competitiveness of launcher sector. Strengthened technological non-dependence *Sources: Eurospace FAA launch report, ESA, ITAR list*
Overarching issues	• Total amount invested in the space sector • Amount of financing achieved by SMEs in the space sector • Number of Communications, regulation and directives affecting the European Space industrial sector	• Number of policies requiring space-enabled monitoring • Wider statistics on education and jobs throughout European regions and their cohesion	• Capacity for leverage in the space sector • Number of countries closing their public markets to foreign competition (indicator to keep track of extent to which there are trade barriers that may damage the competitiveness of the European space sector)	• Capacity to educate and train highly-skilled professional s in Europe working on space applications	Assessment criteria Surveys of companies in the space sector Wider statistics (Eurostat, national statistical offices)

Note: QLV – qualitative, QTT - quantitative

Space indicators

It will be important to develop indicators to allow for progress to be assessed in respect of the ESP's impacts on other sectors and in enhancing cross-fertilisation between the space and non-space sectors.

G.5 Statistical data sources and identified gaps

As noted earlier, in monitoring European Space Industrial competitiveness, it is important that context indicators on sectoral performance are analysed longitudinally in order to check the ongoing relevance of the future policy, and whether any amendments should be made during its implementation. However, in order to do so, good quality, timely and reliable sectoral information needs to be available.

There are three main types of sources of economic data on the space sector: (1) European space industry associations (e.g. Eurospace), (2) National Statistical Offices (NSOs) and (3) Eurostat, national space agencies and ESA. However, there are currently a number of weaknesses in the availability of space data. These can be summarised as follows:

- Data gaps within industrial NACE codes[68] in the disaggregation of data on the space sector, even following the transition to NACE 2 and the availability of 3 digit NACE code data, because these are not presented in an optimal way that would allow for detailed assessment of key space sectors (e.g. manufacturing, services including data).
- The current lack of reliable sectoral data on the EO industry (space data and services), although EARSC is addressing this.
- Challenges in collecting national and EU level data on emerging, non-traditional space sectors, particularly space-derived data and services, where the companies concerned are no longer formally part of the space sector.
- Too great a dependency on industry associations to provide space industry data rather than national and European statistical services (and a risk of data bias and incompleteness).
- The leading European industry association (Eurospace) tends to focus on capturing information about larger industry firms and on upstream space manufacturing. An advantage of the Eurospace surveys however is that the methodological process used to collect and report on industry data is transparent.
- Smaller space industry associations (e.g. SME4SPACE and national equivalents) face a lack of resources to collect sectoral data.

The suitability of existing statistics in Eurostat's Structural Business Statistics (SBS) database has been reviewed. One of the drawbacks of Eurostat data currently is that it is produced on an aggregated basis. This was confirmed in the OECD Handbook on Measuring the Space Economy, which noted that *'National industrial classifications to categorise economic activities are often embedded in larger aerospace, information and communications technology (ICT) and defence sectors. As a consequence, official data on the space sector tend to lack granularity and are aggregated within much larger industries (Lionnet, 2010)'.*

The table below shows a list of NACE Rev 2 codes encompassing the economic activities of the space economy.

[68] The NACE system ("Nomenclature statistique des activités économiques dans la Communauté européenne") is the statistical classification of economic activities in the European Community.

Space indicators

Table G.5 – NACE Rev.2 codes of Space-related activities

NACE Rev.2	*Description*
3030	Manufacture of air and spacecraft and related machinery
2630	Manufacture of communication equipment
2651	Manufacture of instruments and appliances for measuring, testing and navigation
4300	Specialised construction activities
5120	Freight air transport and space transport
5122	Space transport
6010	Radio broadcasting
6020	TV programming and broadcasting activities
6130	Satellite communications activities
6190	Other telecommunication activities
8422	Defence activities
6120	Wireless telecommunication activities

Source: Eurostat, OECD

The revised NACE code classification system was introduced in 2008 and replaced NACE Rev 1.1, so there is also an issue regarding the timeliness of data availability since 2008 is the latest year for which SBS data is available. The level of statistical classification within **NACE Rev. 2 codes brought in in 2008 and is at the 3-digit level**. However, further disaggregation is necessary for the data to be useful in monitoring space industrial competitiveness.

The table above shows the inadequacy of the current system. A problem in several of the NACE codes is that statistics on a particular segment of the space sector are often combined with wider industry sectors and not disaggregated. At the 3 digit NACE code level, NACE code headings are too broad. For instance, "TV programming and broadcasting services" includes space economy activities such as satellite broadcasting and television production. A common problem not only in Eurostat data but also sectoral data produced by industry associations is that space activities are often presented at an aggregated level as part of the aerospace industry, yet they account for less than 10% of total activities. This is a problem for NACE codes such as 30.30 Manufacture of air and spacecraft and related machinery. Producing spacecraft is a very niche activity with a much smaller market than producing aircraft.

Furthermore, Eurostat data on the space sector, in addition to being too aggregated in the upstream segment does not capture important emerging areas of the space sector and wider space economy, especially downstream space services and EO data distribution and derivative products and services. The deficiencies in data availability were recognised for instance by EARSC, which is intending to undertake a survey of its members following the development of a typology of EO service activities, which is intended to improve sectoral statistics in future.

Through dialogue with the Commission, Eurostat may in future be able to improve sectoral statistics on the European space industry (and in particular develop detailed disaggregated statistics by sub-sector both in mature areas of the space sector and in new and emerging sectors, such as commercial remote sensing. This would help to strengthen the evidence base for assessing progress against objectives in the future policy and facilitate the setting of baselines using context indicators.

Space indicators

A key research finding was that a number of the more detailed data exist in some Member States but are lost in Eurostat's aggregation process and in the presentation of the data. It would be helpful for monitoring purposes in future if these could be presented on a disaggregated basis.

The French *Nomenclature d'Activités Française* (NAF) classification system includes for instance a very detailed breakdown of the economic activity related to launchers with three different launcher-related classifications (manufacturing of Ariane 5 launchers, Parts of launchers, including boosters and other launchers aside from Ariane 5. An interesting possibility would be to develop a more detailed data gathering system similar to the one that exists in France for upstream activities.

Since the early 1980s, INSEE (Institut national de la statistique et des études économiques) has also conducted regular survey targeting space-intensive regions such as Guyane, Midi-Pyrénées and Aquitaine. Due to the existence of such "space regions" in Europe, extending those surveys to regions such as Bade Wurttemberg could help gather relevant data in a more targeted way.

Further shortcomings in statistical sources are that existing data on the upstream space sector is readily available through Eurospace and other global industry associations such as the SIA. An issue emerges when one seeks to assess the importance of the downstream sector. Up to now, all the studies looking at the relationship between the upstream and downstream sectors have made use of surveys and ad hoc tools to attempt to measure the size of the sector. This is especially true of the less developed parts of the space economy (especially EO downstream services and applications)[69].

A summary of existing statistical sources for indicators is provided below:

Source(s)	*Type of data*
Eurostat's SBS NACE Rev 2. Latest dataset available 2008 Data collected by Eurospace from its members.	Statistics on sectoral performance e.g. turnover, Value Added and employment disaggregated between: manufacturing and services, space sub-sectors within upstream and downstream areas of space activities
Sectoral reports by industry stakeholders, OECD, on behalf of the Commission and ESA. <u>Examples:</u> Eurospace (the European Space Industry Association) e.g. Facts and Figures for the European Space Industry 2010, Study on the economic situation of the European space industry and framework conditions affecting the sector (2009) Study on the economic situation of the European space industry and framework conditions affecting the sector, Final Report, 28 June 2010, contract SI2.508146 (Euroconsult) Competitiveness of the European Space Sector, Final Background Study, Rotterdam, March 2011 (Ecorys) Ecorys, Competitiveness of the European Aerospace Sector Ecorys, Competitiveness of the GMES Sector	General space industry trends

[69] These include studies from Vega, EARSC, the UKSA and Euroconsult.

SME4SPACE - a Panel of Space SMEs Associations of the ESA Member States and ESA cooperating States. http://www.sme4space.org/	Space industry trends among SMEs
OECD (2012), OECD Handbook on Measuring the Space Economy, OECD Publishing.	Methodologies for assessing the space economy
OECD Patent Statistics Manual (2009) www.oecd.org/document/29/0,3746,en_2649_34451_42168029_1_1_1_1,00.html	Statistics on patents
ITU Indicators on satellite usage	The OECD handbook on measuring the space Economy provides a list of ITU codes providing data and possible indicators for the SatCom segment of the downstream industry. They include Total number of multi-channel TV subscribers (965m), Number of terrestrial multi-channel TV subscribers (965c). DTH satellite antenna subscribers (965s), Homes passed by multi-channel TV (965cp), Other fixed broadband Internet subscribers (4213ob)
Patent offices, including IPO	Patents provide an indicator in that they cover technologies for which there are often no other sources of data; they are detailed in that they allow for a fine distribution of the origin of the patents (by location type of legal personality submitting it etc), however, they do not cover all new inventions and the number of patents is not always linked to the use one can make of them
Other sources	Due to their forward-looking nature, strategic indicators will need to be based on either existing reports or bespoke pieces of work assessing the challenges and opportunities faced by the European space economy.

G.6 Making use of indicators and monitoring data – the role of evaluation

It is important that insofar as possible, indicators and monitoring data actually influence policy making. Although an obvious point, many indicator systems fail in this regard. An EU FP7 Research Project on the *'Policy Influence of Indicators Project' (Point)* notes for instance that most indicator systems focus on technical design and pay insufficient attention to how indicators will be used.

Once monitoring data has been obtained, it will be necessary in assessing progress to assess the **counter-factual** i.e. what would have happened in the absence of the existence of the ESP, the European Space Industrial Policy and specific measures / initiatives taken through the auspices of this policy framework?

G.7 Conclusions

Looking ahead to the future development / adoption of a formal European Space Industrial Policy, it is important that a monitoring framework – supported by appropriate indicators - is put in place from the outset.

Space indicators

- A monitoring framework and indicator system should be put in place from the outset of the European Space Industrial Policy, supported by appropriate budget for sectoral performance data where this is not available from public sources.
- The indicator system will serve a number of objectives, such as monitoring the European space industry's competitiveness longitudinally, taking into account new developments and emerging trends, identifying any problems and remedial actions to address these and when specific EU measures might be needed to strengthen industrial competitiveness in particular space sectors.
- Monitor the implementation of the European Space Industrial Policy both overall, and in relation to specific policy measures, initiatives and activities.
- A combination of quantitative and qualitative indicators should be incorporated in the monitoring system in order to assess progress towards policy objectives overall, and those linked to specific measures and activities.
- There are gaps in the availability and timeliness of sectoral statistics on the space industry through Eurostat and NSOs. Consequently, there is too great a dependence on industry associations.
- The NACE 2 industrial classification system within SBS introduced from 2008 is inadequate to meet the needs of the future monitoring framework. There is a problem with regard to two and three digit NACE code classifications that the data is insufficiently disaggregated and covers elements of the space sector encompassing data from much broader sectors.
- Even if problems linked to the lack of suitable disaggregation of Eurostat SBS data were to be overcome, there would remain a problem linked to the timeliness of data availability under SBS. Data often only becomes available through SBS 2 years after it has been collected. It then becomes out of date before the next scheduled updating exercise.
- There are specific statistical gaps in particular areas of the space industry, such as space data and downstream services. A particular difficulty is in identifying and then tracking through statistical systems the economic and employment impacts of the space sector on non-space sectors through the use of space-derived satellite images and services.

Space indicators

It is also worth noting that in DG ENTR's 2010 Management Plan, Space has its own general objective. The detailed objectives and indicators are provided below. It is noteworthy that the performance framework defines objectives and then users context indicators in order to assess the impacts :

General Objective	*Impact Indicator*	*Target*	*Current Situation*
To support the European presence in space and the development of innovative technologies through space applications	Increase the world-wide market share of applications based on EU satellite systems		2010: 21%

Under the respective General Objectives, the following Specific Objectives, governing operational activities, are set out for Space:

Space :

General Objective	*Specific Objective*	*Activity*
To support the European presence in space and the development of innovative technologies through space applications	To support research and the development of operational applications in the space sector	ABB 3
	To promote the operational use of EU earth observation-based services (GMES)	ABB 1
	To develop and provide global satellite-based radio navigation infrastructures and services (Galileo)	ABB 4
	To provide satellite-based services improving the performance of GPS over Europe (EGNOS)	ABB 4

For present purposes, we are concerned with actions under Activity ABB3. These give rise to the following result indicators :

Space :

Specific Objective	*Result Indicator*	*Target (mid-term)*	*Latest known result*
To support research and the development of operational applications in the space sector	*Result indicator relating to the Service component of Global Monitoring for Environment and security (GMES):* Demonstration and take up by users of GMES services in all thematic areas	GMES services ready for operation in five thematic areas at the end of FP7 (end of commitments in 2013)	Five GMES services (land, marine, emergency response, atmosphere and security) under development on the basis of the 2007-2008 Work Programme. These projects will end in 2011 – 2012. Follow-up projects for marine and atmosphere addressed in the draft

			2011 Work Programme Follow-up of Land and Emergency services foreseen in the new Regulation on Initial Operations
	Result indicator relating to the space component of GMES: Progress towards completion and launch of Sentinel 1, 2 and 3 A and B satellites projects	Completion of Sentinel 1, 2 and 3 A and B satellites and launch of 1, 2 and 3 A by end 2014.	Procurement contracts placed for development and construction of the satellites
	Increase of world-wide market share of GNSS (Global Navigation Satellite System) applications *2nd call FP7: 32 projects completed and contracts signed*	2020: Increase of world-wide market share from now 21 % to 28 %. 4th quarter 2010: Launch of 3rd call (on 2011 budget) 2012: increase to 90 million hand-sets	2nd call FP7: 32 projects completed and contracts signed 10/2008: Uptake of hand-sets 30 million

Policy Context H

H. Policy context - the European Space Industrial Policy

Following the adoption of Article 189 of the Lisbon Treaty and its entry into force in December 2009, the EU has the legal competence to develop a European Space Industrial Policy.

The **Europe 2020 Strategy** recognises the role of space as an instrument for addressing key EU internal and external challenges such as border security, climate change and wider environmental monitoring and transport. The April 2011 Communication ***Towards a Space Strategy for the European Union that Benefits Citizens***[70] outlines the importance of pursuing a European space industrial policy in promoting growth and jobs. The Communication also points to the scope for synergies with other EU policies such as innovation and research and development.

Two of the seven Flagship Initiatives in the Europe 2020 Strategy, the **Integrated Industrial Policy**[71] and the **Innovation Union**[72]**,** are highly relevant to the development of a European Space Industrial Policy. The October 2010 Commission Communication on an **Integrated Industrial Policy** has a dedicated section setting out the importance of a future sectoral industrial space policy based on the new Lisbon Treaty competences. The Communication states that a space industrial policy should be based on a solid industrial base *'and should cover the whole supply chain, including SMEs, to ensure greater international competitiveness and non-dependence in strategic sectors (such as launchers) and the development of a market for space products and services, notably new satellite-enabled services from GNSS, GMES and satellite communications infrastructures'.*

The Communication also notes that *'space is an important component of the Union's research and innovation policy'*. Moreover, some of the ten key actions are relevant in promoting European industrial competitiveness more broadly: fostering the creation and growth of SMEs (including access to finance and support for internationalisation) and strengthening European standardisation.

The Communication on an **Innovation Union** is also relevant to the future development of a European Space Industrial Policy. Aside from addressing a series of general challenges relating to how best the EU should promote innovation, the Communication mentions the need to tackle unsatisfactory framework conditions that may hamper innovation. Among the barriers identified are *'poor access to finance, high costs of IPR that may slow standardisation and ineffective use of public procurement'.* Although the issues mentioned apply across a broad range of sectors, they are relevant to the space sector.

In December 2010, the Competitiveness Council confirmed the role of the European space sector in promoting the EU's competitiveness and innovation and gave its support to the Commission's intention to propose necessary space policy measures and to pursue a space industrial policy.[73]

Looking ahead to the new MFF 2014-2020, space will continue to play a prominent role in the next programming period as part of the forthcoming **Horizon 2020 Programme** (2014-2020)[74]. The Programme's three overarching priorities are: (1) Excellent science (2) Industrial leadership and (3)

[70]Communication from the Commission to the Council, the European Parliament, The European Economic and Social Committee and the Committee of Regions towards a space strategy for the European Union that benefits citizens Sec(2011) 381 final

[71] Europe 2020 Flagship Initiative, An Integrated Industrial Policy for the Globalisation Era, COM(2010) 614

[72] Europe 2020 Flagship Initiative, Innovation Union, SEC(2010) 1161

[73] Council Resolution: "Global challenges: taking full benefit of European space systems, 25.11.2010

[74] Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)

Policy Context

Societal challenges. Evidently, space research and innovation has potential to contribute to all three. The specific objective of space research and innovation is to foster a competitive and innovative space industry and research community to develop and exploit space infrastructure to meet future Union policy and societal needs. A number of broad priority lines are identified in the proposal, such as: (i) Enabling European competitiveness, (ii) non-dependence and innovation of the European space sector, (iii) Enabling advances in space technologies, (iv) Enabling the exploitation of space data and (v) Enabling European research in support of international space partnerships.

Space features strongly as one of sectors that will be supported under the priority *'leadership in enabling and industrial technologies'*. The specific objective is to maintain and build global leadership in enabling technologies and space research and innovation, which underpin competitiveness across a range of existing and emerging industries and sectors. Within this priority, the EU will therefore provide dedicated support for research, development and demonstration on ICT, nanotechnology, advanced materials, biotechnology, advanced manufacturing and processing and space. An emphasis will be put on interactions and convergence across and between the different technologies.

US Strategic plan on EO

I. US Strategic Plan on EO

An interesting example of planning for the development of downstream services in the EO sector is that of the US where a Strategic Plan on EO was devised in 2005[75]. The plan identified nine societal benefits areas stemming for EO, namely

- Improve Weather Forecasting
- Reduce Loss of Life and Property from Disasters
- Protect and Monitor Our Ocean Resources
- Understand, Assess, Predict, Mitigate and Adapt to Climate Variability and Change
- Support Sustainable Agriculture and Combat Land Degradation
- Understand the Effect of Environmental Factors on Human Health and Well-Being
- Develop the Capacity to Make Ecological Forecasts
- Protect and Monitor Water Resources
- Monitor and Manage Energy Resources

It also sets out a roadmap on setting up the principles and guidelines necessary to address the policy, technical and societal benefits of an integrated EO system. The plan sets out the united States' contribution to GEOSS.

The plan was devised by the Interagency Working Group on EO involving various agencies and US Departments as a result of the recognition that the existing system of EO was fragmented and incomplete. By involving all public actors and keeping strong links with commercial users and providers, this system is supposed to allow for a greater visibility for commercial downstream services and applications. Indeed, the strategy sets out that it should refine and clarify the roles and opportunities for commercial observation networks.

As a result of the Strategic plan, USGEO was set up as a group including representative of 17 federal agencies and the Executive Office of the President. Despite the strategic plan, in 2007, an interim report from the National Research Council concluded that the outlook had significantly worsened and that the likelihood of a degradation in land imagery capability, affecting multiple societal needs was almost a certainty.

As a result, in 2008, the USGEO Strategic Assessment Group started developing a set of recommendations for national EO priorities. This translated into the development of 17 "near-term threats and major opportunities" that could be put in place an implemented in the short-term. Since then, the situation has gradually improved.[76]

Overall, while the Strategic Plan might not have been successful in developing uptake of products and services, it did play an important role in:

- Prioritising investments in the field of EO

---

[75] Interagency Working group on EO, Strategic Plan for the US Integrated EO Systyem, 2005
[76] Office of Science and Technology Policy, Achieving and Sustaining Earth Observations, 2010

US Strategic plan on EO

- Establishing US policies for EO and data management
- Develop the institutional and human capacity to enable the translation of EO into societal benefits
- Encourage inter-agency cooperation and coordination

Finally, in 2008, EO products were estimated to contribute a total of $30 billion annually to the US economy [77]

[77] L . Wigbels, G.R. Faith, and V. Sabathier, *Earth Observations and Global Change: Why? Where Are We? What's Next?*,Center for Strategic and International Studies, Washington DC , July 2008, pVII