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The Challenges for European Policy on Access to Space

Anna Veclani, Nicolò Sartori and Rosa Rosanelli

Abstract

The EU is one of the major space actors in the world and, like other principal space faring nations, relies on an independent access to space system for implementing its space policy. Indeed, for more than thirty years, the European launcher Ariane has guaranteed the success of numerous institutional and commercial missions, both for civil and military purposes. Given the importance of the EU's space policy for the effectiveness of the Union's internal and external action, an autonomous, reliable and cost-effective access to space is a fundamental and strategic necessity. This paper presents the main challenges faced by European institutions and industry in maintaining an independent access to space. As satellite technology quickly evolves and new space competitors rise, the EU needs to step up its launch capabilities and to effectively confront international competition. To these ends, the main European space actors must renew their approach to the policy on access to space, in particular by addressing the problems affecting the launch company Arianespace, for which the paper provides policy options.

Keywords: *European Union / European Space Policy / European Space Agency (ESA) / Satellites / ESA Launchers*

The Challenges for European Policy on Access to Space

by Anna Veclani, Nicolò Sartori and Rosa Rosanelli*

1. Introduction

Over the past decade, the significant results obtained in the field of space have allowed Europe to increase its scientific and technological prestige, strengthening its independence and position as global actor. The growing commitment and close cooperation between the principal European actors in the field of space, namely the European Union (EU), the European Space Agency (ESA) and their respective Member States, have allowed for the conception of a specific European space policy (2007)[1] and for the establishment of the new role for the EU foreseen by the Lisbon Treaty (Arts. 4(3) and 189 of the Treaty on the Functioning of the European Union (TFEU)).[2] At the same time, two ambitious flagship programmes, Galileo and Global Monitoring for Environment and Security (GMES), have been launched, dealing respectively with navigation/positioning and Earth observation. The services provided by these systems and other space technologies contribute to the effectiveness of EU policies and to the improvement of the wellbeing of European citizens. Indeed, the development and use of complex space systems and the services connected to them contribute to the achievement of different objectives in various policy areas, such as the external action of the EU in the context of the Common Foreign and Security Policy/Common Security and Defence Policy (CFSP/CSDP), development cooperation, climate change and the environment. In the case of conflict or natural disaster outside Europe, one might think for example of the usefulness of constantly updated satellite images for peace-keeping operations and/or the planning of humanitarian aid, the estimation of damage to infrastructure and the environment, or post-crisis reconstruction. Internally as well, in sectors such as agriculture or fisheries, transport or energy, the contribution of space technologies is not negligible: one might think for example of the support provided to agriculture, one of the most important Community policies, by earth observation systems which are capable of providing harvest forecasts, monitoring droughts and floods and analysing soil composition. Finally, space activities offer the opportunity to improve the competitiveness and innovativeness of European industry, stimulate economic growth and increase scientific

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[1] See Commission of the European Communities, *European Space Policy* (COM(2007) 212 final), Brussels, 26 April 2007, COM (2007)212, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0212:FIN:EN:PDF.

[2] Art. 4(3) specifies furthermore that "... the exercise of that competence shall not result in Member States being prevented from exercising theirs".

and technological knowledge, in line with the new *Europe 2020* strategy for smart, sustainable and inclusive growth for the EU.

Today, the EU finds itself confronted by two imperatives as regards its space policy which are not mutually exclusive: firstly, the completion of the Galileo and GMES programmes; and secondly, the maintenance and enhancement of a European access to space which is independent, reliable and cost-effective[3]. The latter is a necessary condition for any other European space activity. Indeed, all the major space powers dispose of an autonomous launch system for their space programmes. The lack of such an asset in Europe would have serious consequences from both the political and the economic points of view: on the one hand, all the institutional activities which characterise European space policy (such as for example Galileo and GMES), as well as national space policies, would be entrusted to third countries, creating dependence on those countries, including as regards missions of a strategic nature; on the other hand, the European aerospace industry and its niches of excellence would be weakened in favour of the growth and development of extra-European industry.

For thirty years, the European launcher **Ariane**, in its different versions, has allowed both civilian and military European institutional satellites to be put into orbit and, thanks to the launch services company Arianespace, has been the global point of reference for commercial launches. Furthermore, over the past decade, ESA has begun a process of diversification of launch systems, with the development of the launcher **Vega** and the adaptation of the Russian rocket **Soyuz**, whose inaugural launches will take place at the end of 2011, thus enlarging the Ariane family of launchers.

Nevertheless, these successes have not been enough to guarantee an independent European access to space for the future. Indeed, the ESA, the EU and their respective Member States must meet two challenges which are fundamental for the sustainability and effectiveness of European policy on space access. The first concerns the modernisation of the available family of rockets: on the basis of the evolution of satellite technologies and characteristics, the current generation of launchers will require modernisation and updating so as to remain competitive on the global level and respond to the most complex European institutional missions.

The second challenge derives from the growing international competition in the sector, which involves both public and private actors and which sees the traditional space powers and the emerging new actors trying to strengthen their own launch capabilities and to capture large shares of the global market. In order to ensure the sustainability of the programmes of technological research and launcher development necessary to keep the European capacity for space access alive and competitive in the new global system, it will be necessary to find a solution to the problems of finance and governance which afflict the launch company Arianespace.

The aim of this paper is to highlight the main problems concerning European policy on access to space and to evaluate different policy options for the maintenance of a European system which is independent and competitive on the global level. To this end, the first part of the paper will analyse the two challenges referred to above,

[3] See Commission of the European Communities, *European Space Policy*, *cit*., p. 9.

addressing the inherent industrial, technological and commercial aspects; the second part will address the issue of the governance and funding of Arianespace, one of the biggest limits to a credible and effective answer to these challenges.

2. The origins of European policy on access to space

The awareness of the strategic value of an autonomous European capacity for space access predates not only European space policy, but also the creation of the ESA and the EU themselves (1975 and 1993). Indeed, from the 1970s onwards, the pioneer countries in space activities, such as France, Germany, Italy and the United Kingdom, made a start on intergovernmental cooperation with the European Launcher Development Organization (ELDO, 1962) and the European Space Research Organization (ESRO, 1964). The interwoven history of these two organisations was particularly stormy, dominated by coordination difficulties, financial problems and, above all, political disagreements.

At the beginning of the 1970s, France cast doubt upon the American desire to launch European satellites able to compete with their own, announcing the development of the L3S launcher (*Lanceur à Trois Etages de Substitution*). In those years, the policy of the National Aeronautics and Space Administration (NASA) on launch services provided to third countries became progressively more rigid in terms of the scheduling of launches and the eligibility of satellites for launch. Therefore, in 1973 France proposed transforming the L3S launcher into a European programme within the newly-created ESA, into which ELDO and ESRO were combined in 1975. The resulting launcher was called Ariane, and flew for the first time in December 1979 from the space port of Kourou. Following this success, the undertaking Arianespace was created in 1980, with the aim of managing and commercialising the launcher.

From that time, as many as five different rockets, Ariane 1, 2, 3, 4 and 5, have succeeded one another in the family of European launchers, carrying out more than 200 launches and winning a significant share of the global commercial market.

3. The challenge of renovation

Today, the family of launchers includes the heavy-lift Ariane 5, the medium-lift Soyuz, and the lightweight Vega. The synergy between different categories should ensure performance and flexibility, allowing the entire range of launch requirements to be covered. Nevertheless, the evolution of satellite technologies and characteristics, as well as the global demand for launches, demand an appropriate policy of diversification and modernisation of the fleet of launchers at the disposal of the EU.

Ariane 5, operational since 1999, carries out the most complex institutional and commercial missions in its two configurations: the first, with a launch capacity of 10 tonnes for geostationary transfer orbit (GTO), is used for the launch of heavy telecommunications satellites; the second, with a capacity of 20 tonnes in low-earth

orbit (LEO), for the launch of the Automated Transfer Vehicle (ATV) which supplies the International Space Station.[4] Ariane 5 can provide both launches with two satellites (double launches) and single launches with heavier loads. Double launches allow for lower prices for clients but require greater efforts in terms of the pairing of satellites and the scheduling of launches. These two problems affect the current competitiveness of Ariane 5 on the international market.

The successor to Ariane 5, for now known as the Next-Generation Launcher (NGL), is the subject of debate and will not enter into service before 2025. The issue to be resolved concerns the possibility of developing another heavy-lift launcher for double launches, and a medium-lift launcher which can carry out single launches. The second option, which could reduce costs by adapting itself to the growing demand for launch services for medium-weight satellites, appears to be the favourite and could, in the long term, be a replacement for the European version of the Russian rocket Soyuz (see further below).[5] The ESA Ministerial Council due to be held in 2012 will not only have to make the choice between the two options, but will also have to decide whether or not immediately to launch and finance a related preparatory programme.

Meanwhile, work has begun on the development of a medium-term solution, namely Ariane 5 Midlife Evolution (ME). The new motor VINCI will increase the launch capacity by about 20% (two more tonnes). Furthermore, once a satellite is in position, the re-ignitable engine will allow for double launches over a wider range of orbits.[6] Ariane 5 ME would gather in a single launcher the functionalities of the two current configurations of Ariane 5, thereby reducing costs. The inaugural flight is due for around 2016-2017[7] if the ESA Member States currently participating in the preparatory programme approve its financing during the above-mentioned Ministerial Council. If this were not to happen, Ariane 5 would run into serious difficulties as regards the international competition.

The Russian-manufactured rocket **Soyuz** joined the family of European launchers following an agreement signed by ESA and Russia in 2005.[8] The European version has been adapted to launches of satellites of up to 3.2 tonnes from an equatorial latitude into medium-earth orbit (MEO) and LEO, including the launch of constellations

[4] See *Launcher family*, official website of Arianespace, http://www.arianespace.com/launch-services/launch-services-overview.asp.
[5] See Bernard Bigot, Yannick D'Escatha, Laurent Collet-Billon, *L'enjeu d'une politique européenne de lanceurs: assurer durablement à l'Europe un accès autonome à l'espace*, Paris, Premier ministre, 18 May 2009, http://www.ladocumentationfrancaise.fr/rapports-publics/094000223/index.shtml. See also Peter B. de Selding, "Astrium To Lead Studies of Successor to Ariane 5", in *Space News*, 7 July 2010, http://www.spacenews.com/contracts/100707-astrium-studies-ariane-successor.html.
[6] See *Vinci Rocket Engine - Thrust Chamber, Cryogenic propellant rocket engine for the ESC-B upper stage of Ariane 5*, official website of Astrium, http://cs.astrium.eads.net/sp/launcher-propulsion/rocket-engines/vinci-rocket-engine.html.
[7] See *Ariane 5 development*, official website of Astrium, 6 January 2010, http://www.astrium.eads.net/en/news2/ariane-5-development.html.
[8] See *International cooperation*, official website of the European Space Agency (ESA), http://www.esa.int/esaMI/Launchers_Home/SEMCDI1PGQD_0.html.

(two or more satellites). It is used for medium-weight telecommunications satellites, and for navigation, earth observation and scientific research.[9]

Soyuz will probably not be able to replace Ariane for missions having a higher political-strategic value.[10] Since Soyuz is not a truly European launcher, it is preferable to avoid transfers of information and technology when the load is of a military nature. Furthermore, since the commitment to provide the launcher on the part of Russia is limited in time, over the long term it could be replaced by NGL.[11]

The small launcher **Vega**, the result of an Italian initiative, became an optional ESA programme[12] in 1998. It is intended above all for the institutional small satellite market, and will be able in part to respond to the growing interest in micro-satellites[13], given that it will be able to put into low orbit several loads of use at the same time.[14] It will constitute the ideal solution to launch environmental scientific satellites or satellites for earth monitoring up to 1.5 tonnes in weight, or to replace satellites within constellations, avoiding the delays associated with double launches.[15]

The three European launchers are developed, produced and managed on the basis of a system of tenders within the ESA which foresees a prime contractor for each launcher responsible for the development and production of the rocket, which it then hands over to Arianespace. The latter is responsible for commercialising launchers and for operations, adapting the rockets to the needs of the different missions. The prime contractor industries likewise take part in the integration of components at the European space centre of Kourou in French Guiana, together with Arianespace's technical staff. The prime contractor for Ariane 5 is EADS-Astrium, that for Soyuz the Russian space agency RFSA and that for Vega the European Launch Vehicle (ELV), an Italian company owned 30% by the Italian space agency ASI and 70% by Avio. We should emphasise that both EADS-Astrium and ELV are at the same time shareholders in, and suppliers of, Arianespace, a difficulty which we will examine in greater depth below.

If in the past, as a result of technical and economic requirements and the absence of Soyuz and Vega, many institutional European missions, both civilian and military, were

[9] See *Soyuz Overview*, official website of Arianespace, http://www.arianespace.com/launch-services-soyuz/soyuz-introduction.asp.
[10] See Pier Giuliano Lasagni, "Politica industriale e ricerca italiana per lo spazio nel quadro della politica spaziale europea", presentation at the seminar organized by the VAST Committee of the Italian Chamber of Deputies on *Politica industriale e ricerca italiana per lo spazio nel quadro della politica spaziale europea*, Rome, 10 June 2005, http://vastxiv.camera.it/attivita/31/192/193/194/203/programma.asp.
[11] See Bernard Bigot, Yannick D'Escatha, Laurent Collet-Billon, *L'enjeu d'une politique européenne de lanceurs…*, *cit*.
[12] Member States participate in optional programmes on a voluntary basis through their national space agencies.
[13] The category includes satellites ranging from 10kg to 500kg.
[14] Vega will be able to carry out single launches of the heaviest satellites in the category (400-500kg), and multiple launches of the lightest satellites.
[15] See *Da Kourou a Vega*: *lavori in corso*, official website of the European Space Agency (ESA), http://www.esa.int/esaCP/SEMGD21A90E_Italy_0.html.

launched form the territory of third countries,[16] the seventh Space Council[17] in 2010 invited the institutional European actors to consider using launchers developed in Europe, in particular Ariane 5 and Vega, as a priority. Nevertheless, even when Vega and the European version of Soyuz, both very close to inauguration, are ready, it will be necessary at the time of the next ESA Ministerial Council in 2012 to establish a precise strategy for improving and modernising the current family. Indeed, the speedy evolution of launch and satellite technologies will mean that Ariane 5 will become an inefficient and expensive launcher. One should bear in mind that global launch demand will follow trends in space services, which are obtained in the main through large- and medium-scale satellites in GTO for telecommunications, and medium- and small-scale satellites in LEO for earth observation and scientific missions.[18] Further, the growing demand for space services does not coincide with the development of a higher number satellites or with an increase in launches, but rather with the development of **heavier, durable** and **technologically advanced** satellites, **organised in small constellations**. For this reason, the performance of the single-launch configuration of Ariane 5 is poor, while the double-launch configuration is inefficient. In such a context, only the choice of producing Ariane 5 ME and of starting a preparatory programme for NGL, which will probably replace Soyuz, will allow launch requirements and demand for the next 15 years to be met. As for the evolution of Vega, Italy has already set in motion a national programme, known as Lyra, aimed at increasing performances of the launcher, including for military missions.[19]

On the basis of estimates, Ariane 5, Soyuz and Vega and their possible evolutions would be able to satisfy global launch demand within the time period 2016-2018, but they will have to compete increasingly with the launchers of other countries and of private undertakings.[20]

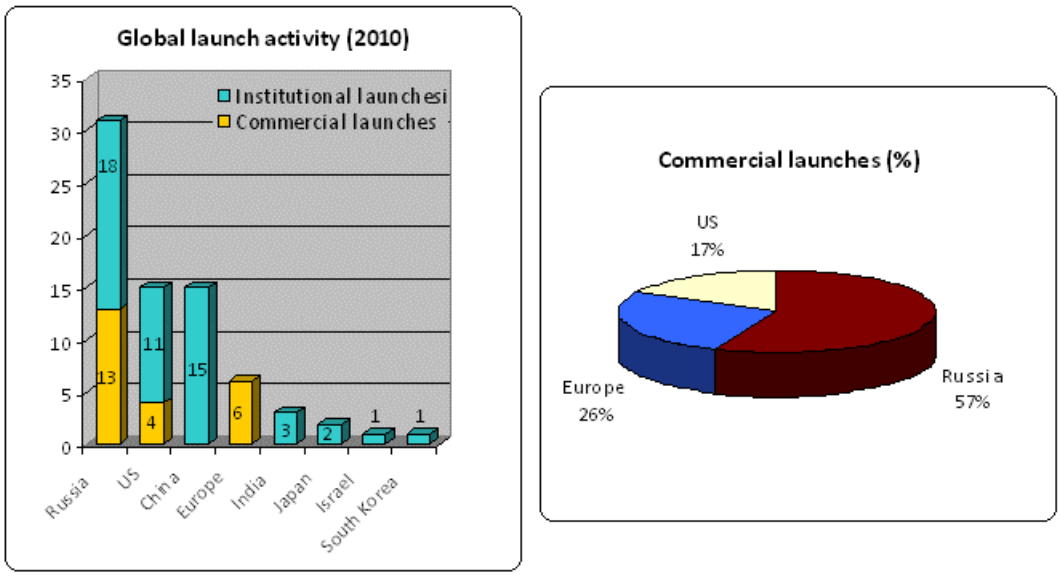
4. The challenge of international competition

The launcher market is one of the segments of the space technology market in which international competition is particularly strong, and which the EU must necessarily confront. In trying to maintain independent access to space, which they consider necessary to ensure national security, national governments play a central role in sustaining the sector with significant investment, regulations limiting foreign competition, and orders placed with national space industries.[21]

[16] For example, ESA missions such as Mars Express, Cryosat and Giove, and national satellites such as SarLupe (Germany) and COSMO-SkyMed (Italy).
[17] The Space Council is a coordination forum involving both the EU's Competitiveness Council and the ESA Ministerial Council.
[18] See David Berteau, Gregory Kiley (project directors), *National Security and the Commercial Space Sector. An Analysis and Evaluation of Options for Improving Commercial Access to Space*, Washington, Center for Strategic and International Studies, July 2010, http://csis.org/publication/national-security-and-commercial-space-sector.
[19] See Agenzia spaziale italiana (ASI), *Piano triennale delle attività 2010-2012*, Roma, February 2011, http://www.asi.it/files/ASI_PTA_2010-2012_3.pdf.
[20] See David Berteau, Gregory Kiley (project directors), *National Security and the Commercial Space Sector …*, *cit*.
[21] *Ibid*.

Institutional demand accounts for a large part of the global market: around 70% in 2009 and 2010. A good part of the demand for launches comes from the governments of the United States, Russia and China, and also from smaller players, while the number of institutional European launches has collapsed. Europe maintains nevertheless a significant international influence, together with Russia and the US, in terms of **commercial launches** (see Fig. 1).[22]

Figure 1. Global launch activities. Focus on commercial launches (2010)



The oligopoly in the aerospace industry at the time of the Cold War allowed Russia and the US (and to a lesser extent Europe) to develop capacities which made them the main actors in the launcher sector. Nevertheless, in recent years the market has opened up to competitors such as China, India, Brazil, Japan, Israel and South Korea.

Global competition depends on a certain number of factors, such as price, reliability, availability and security, as well as on the nature, public or private, of the client.

The **price** of the launch, which is often reserved and negotiated in the purchase phase, is not in and of itself a determining factor, above all if the purchaser is a government, whose main objective is the success of the mission. Other factors are equally, and sometimes more, important.

A launcher's **reliability** is ensured by at least five or six launches per annum, which allow the technical state of the art, research and development activities, efficient industrial cycles and the security of operations all to be maintained.[23] All these aspects

[22] See Federal Aviation Administration (FAA), *Commercial Space Transportation: 2010 Year In Review*, Washington, FAA, January 2011, http://www.faa.gov/about/office_org/headquarters_offices/ast/media/2010%20Year%20in%20Review.pdf.
[23] See Bernard Bigot, Yannick D'Escatha, Laurent Collet-Billon, *L'enjeu d'une politique européenne de lanceurs…*, *cit*.

contribute to the probability of success of the launch. Reliability is often a fundamental element: the owner, be it public or private, of a satellite whose launch fails will incur very high additional costs in terms of load reproduction or interruption to services. The latter complication is particularly serious in the case of military satellites, bearing in mind the possible consequences for national security.

Availability is connected to the scheduling of launches on useful and predetermined dates and without delays. For a public client who has to launch a military satellite, availability at short notice is a priority. This is to the detriment of the private client, who could be forced to wait for a long time or obliged to postpone the launch.

Finally, **security** is related to technology transfer, given that the operator of the launch has to gain access to a certain amount of information to be able to integrate the load with the launcher. A government which does not dispose of the ability to launch a military satellite must necessarily turn to a country which it considers reliable. For commercial satellite operators, the possibility of access to foreign launch services will depend also on national legislation.[24]

The principal operator on the **American market** is United Launch Alliance (ULA), a joint venture set up in 2006 by Lockheed Martin and Boeing, which today acts as a monopolist for the American government's heavy- and medium-weight launches. ULA operates two medium/heavy-lift non-reusable rockets which are very similar, namely Delta IV (designed by Boeing) and Atlas V (produced by Lockheed Martin), as well as the medium-lift launcher Delta II, which will soon be discontinued.[25]

The dominance of ULA on the institutional launch market distorts competition on the US market for commercial launches as well. Lockheed Martin and Boeing are not interested in the domestic commercial sector, evidently satisfied by the lucrative orders from the federal government. As a consequence, private American satellite operators are obliged to look for launch platforms on foreign markets.[26] The emergence of new American projects such as Orbital and SpaceX, or of the international consortium Sea Launch (although just recovered from bankruptcy), could encourage a greater degree of competition on both the domestic institutional and the international private markets.[27] In particular, with the launchers Taurus II (whose inaugural launch is due within the first half of 2011) and Falcon 9 respectively, Orbital and SpaceX are aiming at penetrating the monopoly on heavy- and medium-weight launches enjoyed by ULA. At the moment, these two American undertakings are active on the lightweight launch market with the launchers Minotaur IV, Taurus and Falcon 1.

[24] Being characterised by a noteworthy technological proximity to intercontinental ballistic missiles for military use, launch products and technologies are particularly sensitive. Some countries have for this reason adopted regulations precluding their transfer, or subjecting it to particular authorisation procedures.
[25] See *Over 100 years combined launch history*, official website of the United Launch Alliance, http://www.ulalaunch.com/site/pages/About_ULAHistory.shtml.
[26] In particular, due to restrictions imposed by the ITAR regulation, launches of American satellites cannot take place in China, and can find an outlet only in the Russian (ILS) or the European (Arianespace) markets.
[27] See David Berteau, Gregory Kiley (project directors), *National Security and the Commercial Space Sector …*, *cit*.

Russian launch capacity is in the hands principally of two types of launcher, Proton and Soyuz. Both are able to provide extremely reliable services at relatively low cost, Proton operating in the heavy-weight and Soyuz in the medium-weight launch sector. Proton's launches, carried out from the cosmodrome of Baikonur in Kazakhstan,[28] are operated by International Launch Service (ILS).[29] Soyuz's launches are instead operated by the Russo-European company Starsem,[30] which has entered into a close collaboration with ESA for the launch of its satellites.[31] To respond to current developments in the satellite market, the launcher family will be updated with the development of the new Angara launchers.[32]

Furthermore, the first launch of the lightweight launcher Rockot, commissioned by ESA, is programmed for July 2012.[33] The rocket is operated by a Russo-European consortium, Eurockot Launch Services GmbH.[34]

Ukrainian launchers are also active on the market. The medium-weight launcher Zenit, operated by the international consortium Sea Launch,[35] is generally launched from a sea-based platform positioned on the equator (which ensures better launch conditions and reduces the security and liability problems associated with operations). The launcher Dnepr-1, operated by Russia and Ukraine, with the logistic support of Kazakhstan, through the company ISC Kosmotras, carries out launches for space agencies and commercial operators from several countries.[36]

The **Chinese** launcher market has expanded considerably in recent years as a result of the fact that the Chinese government has made independent space access a strategic objective. China is gaining ground on the international stage thanks to the increasing reliability[37] and low cost of its launches. Today an increasing number of international players, both institutional and commercial, are addressing themselves to the Chinese Great Wall Industry Corporation[38] (CGWIC), which is developing the heavy-weight

[28] See *ILS Legacy, History of ILS*, official website of International Launch Services, http://www.ilslaunch.com/about-us/ils-legacy.
[29] ILS is a joint venture between the Russian entities RSC Energia and Khrunichev and the American company Space Transport Inc.
[30] Starsem is 35%-controlled by EADS Astrium, 25%-controlled by the Russian space agency, 25%-controlled by the Samara Space Center, and 15%-controlled by Arianespace.
[31] See official website of Starsem, http://www.starsem.com/starsem/starsem.html.
[32] See official website of Khrunichev Space Center, http://www.khrunichev.ru/main.php?id=44.
[33] See *Business Profile*, official website of Eurockot, http://www.eurockot.com/joomla/index.php?option=com_content&view=article&id=20040650&Itemid=58.
[34] Eurockot Launch Services GmbH is a joint venture between EADS Astrium (51%) and the Khrunichev space centre (49%).
[35] Made up of the American company Boeing (40%), the Russian company RSC Energia (25%), the Norwegian company Aker Solutions (20%) and the Ukrainian company SDO Yuzhnoye/PO Yuzhmash (15%).
[36] See official website of ISC Kosmotras, http://www.kosmotras.ru/en/company.
[37] In 2010, CGWIC carried out all its 15 planned institutional launches with success.
[38] See David Berteau, Gregory Kiley (project directors), *National Security and the Commercial Space Sector …*, *cit*.

launcher Lunga Marcia 5, able to compete directly with Ariane 5 and the American rockets Atlas V and Delta IV.[39]

India is also demonstrating growing entrepreneurship in the launcher sector, thanks to the lightweight launcher PSLV (Polar Satellite Launch Vehicle) for launches in low-earth orbit, and the rocket GSLV (Geosynchronous Satellite Launch Vehicle) for launches in geostationary transfer orbit.[40] Nevertheless, Indian launch capacity is not currently comparable to that of the main global space powers.[41] The preeminent role of the public sector on the supply side and the absence of a true industrial production chain in the field of space mean that India's ability to capture the commercial market is currently limited. In this context, the recurring technical problems encountered in the launch phase of GSLV, which effect the launcher's reliability, do not help.

The **Japanese** launcher market is noteworthy above all for the absence of significant political support for space issues, and for the importance of private players in the sector. In 2007, for example, the production and management of the rocket H2-A was privatised, with the handover between the Japanese agency for the exploration of aerospace (JAXA) and Mitsubishi Heavy Industries.[42] The public sector is however active in the development and use of the new launcher H2-B.[43]

Brazil, Israel and South Korea are also, with differing results, developing their own launch capabilities. **Brazil** is involved in the development of the *Veículo Lançador de Satélites* (VLS) for launches in low-earth orbit, which however is running into a series of failures and delays.[44] To tackle these problems, in 2006 Brazil set up a joint undertaking with the Ukrainian government for the use of the Ukrainian rocket Cyclone-4 at the cosmodrome of Alcantara.[45]

Israel can count on an independent launch capability thanks to the lightweight Shavit,[46] while the efforts of **South Korea** have for now been frustrated by two failed launches of the lightweight launcher Naro-1.

The great dynamism of the international launcher market requires of Europe a constant improvement of its launch capabilities in such a way as to keep up competition with the great powers and emerging new players in the sector. Thanks also to the exclusive role

[39] See "March 5 Will Have World Second Largest Carrying Capacity", in *Space Daily*, 4 March 2009, http://www.spacedaily.com/reports/Long_March_5_Will_Have_World_Second_Largest_Carrying_Capacity_999.html.
[40] See Académie nationale de l'air et de l'espace-Space Committee, *Space Transportation*, Toulouse, Académie nationale de l'air et de l'espace, 2005, http://www.academie-air-espace.com/miniCom/topics_det.php?varCom=4&varTopic=14, p. 7.
[41] See official website of the Indian Space Research Organization, http://www.isro.org/Launchvehicles/launchvehicles.aspx.
[42] See official website of the Japanese Aerospace Exploration Agency, http://www.jaxa.jp/projects/rockets/h2a/index_e.html.
[43] See official website of the Japanese Aerospace Exploration Agency, http://www.jaxa.jp/projects/rockets/h2b/index_e.html.
[44] See official website of the Agencia Espacial Brasileira, http://www.aeb.gov.br/indexx.php?secao=lancadores.
[45] See official website Alcantara Cyclone Space, http://www.alcantaracyclonespace.com.
[46] See official website of Israel Aerospace Industries, http://www.iai.co.il/14471-15689-en/BusinessAreas_SpaceSystems_Launchers.aspx.

of ULA on the American institutional market, one can foresee for Ariane 5 a significant international involvement alongside the Russian and Chinese launchers in the heavy-weight launch sector. However, as we have seen, the European rocket needs the technological flexibility to satisfy future industrial and commercial demands. In the lightweight launch sector on the other hand, the main carriers in use are the American Minotaur IV and Taurus, the Russian Kosmos 3M and Rockot, and the Chinese Lunga Marcia 2D, to which will shortly be added Falcon 1 and Angara 1.1, and possibly the Israeli Shavit and the South Korean Naro-1. The possibility for Vega, once operational, to win a significant share of the global commercial market will therefore be determined by its ability to compete in terms of reliability and cost with its international competitors.

In this context, the success of European launchers on the world market will depend also on the ability of Arianespace to keep up with international competition in terms of price, reliability, availability and security. The number of launches, both institutional and commercial, carried out every year will be fundamental. However, the difficulty for the European space sector comes exactly from the institutional side. Bearing in mind the widespread cuts to public spending in all the larger European countries, government launches are undergoing a certain decline. The completion of the observation system GMES and the navigation system Galileo could represent a partial change of track in that it would offer the opportunity to use European launchers more in order to put into orbit more than thirty satellites in the years to come.

In order to maintain the autonomy achieved in space transport, Arianespace will have to continue to gain a significant share of the global commercial market, given that the limited number of institutional launches will satisfy the minimum requirements of reliability with difficulty. Indeed, it is forecast that, between 2011 and 2017, Arianespace will, with Ariane 5, Soyuz and Vega, carry out the launch of an average of only six institutional satellites per year out of a total average of 27-28.[47] The latter number represents 20% of the forecast for global satellite launches in the period under consideration.[48]

Beyond the predictions, in order to remain competitive in the launcher sector, Europe will have to opt for a balanced strategy of institutional and commercial launches, identify the best launch conditions for institutional European players, and adopt a plan for the evolution of Ariane 5 and for the replacement of Soyuz able to respond to the technological and commercial requirements of the satellites of the future.

5. The governance and finance aspect

In order to address concretely the two challenges analysed above, namely the modernisation and efficiency of the European launcher family, and international competition, the main players in European space policy must solve the problems of finance and governance afflicting the company Arianespace. Indeed, only a rigorous and long-term investment strategy, as well as a clear division of tasks between the

[47] See European Space Agency (ESA) - Programme Board for Launchers, *Assessment of the Launch Service Market Demand*, Paris, ESA, March 2010.
[48] *Ibid*.

main actors, political and industrial, will be able to render the planning of programmes for launcher development and production clearer, and strengthen the presence of Arianespace on the international market.

Despite Arianespace's commercial successes, high losses beset the European colossus every year, forcing the shareholders to adopt exceptional and costly measures. For example, in January 2011, in the face of losses of €135 million over the last two years, the shareholders recapitalised the company to the amount of €80 million. At the proposal of the French government, the ESA Council of this March furthermore approved the allocation of €222.5 million over a period of two years by participating States to the Ariane 5 development programme for the maintenance and operations of the launcher's infrastructure.[49]

Nevertheless, considering the consistent contributions which they make to the launcher development programmes, many Member States have been, and continue to be, reluctant to write off Arianespace's losses. For example, in 2010 the European Guaranteed Access to Space (EGAS) programme was concluded, which for six years financed part of the production costs of Ariane 5 so as to make Arianespace self-sufficient, but without success. For this reason, at the next ESA Ministerial Council Member States will have to take decisions concerning the future financing mechanisms of Arianespace.[50]

Another reason for reluctance to support Arianespace economically is the lack of transparency in its financial management. ESA has recently launched an external audit to shed light on Arianespace's management and to address the causes of the poor economic performance of the consortium, which accumulates losses every year.

Arianespace's economic difficulties can be ascribed to different factors, as follows:

- the inefficiency of the industrial cycle, due to ESA's practice of "geographic return";[51]
- the conflict of interests involving certain companies which are at the same time shareholders in, and suppliers of, Arianespace;
- the need to maintain competitive prices on the global market but which do not cover the production cost of the launchers;
- the presence on the international market of competitors' launchers which benefit from the conspicuous financial support of their governments;
- the costs of production carried out in Europe and of the integration of components in French Guiana;
- the euro/dollar exchange rate, given that launch services are denominated in dollars, whereas Arianespace's costs are borne in euro.

[49] See *ESA's Council decisions*, ESA Press release, 22 March 2011, http://www.esa.int/esaCP/SEMGN71U5LG_index_0.html.
[50] Peter B. de Selding, "ESA Putting Arianespace finances under the microscope", in *Space News*, 14 January 2011, http://www.spacenews.com/civil/110114-esa-arianespace-finances.html.
[51] The distribution of industrial contracts between the different countries by means of a programme is proportional to the financial contributions made by the individual countries to that programme. This is the cardinal principle of ESA's industrial policy.

All these elements play against the sustainability, efficiency and competiveness of European launch capabilities. The first four are however closely connected to the governance and financing of Arianespace. It is therefore above all the public-private nature of the company's structure which is the object of serious reflection within ESA, from both the political and the industrial points of view.

Arianespace is an international undertaking whose capital is owned by 21 shareholders from ten different European countries.[52] The largest share is held by France, which through its seven shareholders controls 64.1% of the total shares,[53] followed by Germany with 19.84%.[54] The eight other countries, among them Italy,[55] control the remaining 16.05% with shares not exceeding 4% per shareholder.

From the point of view of the undertakings involved, the European aerospace giant EADS owns more than a third of the capital of Arianespace through no less than six companies controlled by it.[56] Next, with shares not exceeding 11%, are the French undertaking Safran (10.57%) and the German undertaking MT Aerospace AG (8.26%). This said, the relative majority holding (34.68%) is owned by a French public entity, CNES.

The economic difficulties which have been encountered seem to be solvable by opting for a different form of governance, ranging from a system of shareholding which is entirely public and dominated by the presence of national space agencies to one which is entirely private. Both solutions present problems which derive from the nature of the space transport sector and from the limitations of the European institutional market, which indeed make it extremely difficult to have launch activities in progress.

The first hypothesis would be to make Arianespace an **entirely public entity**. This would ensure a better control over the company's accounts by the national space agencies. Greater transparency, however, would not necessarily imply a reduction of the company's management costs, bearing in mind the consequences of the "geographic return" principle. In such a case however, given the strategic value attributed to independent space access and the interest of national governments in maintaining a European capability in the sector, the allocation of public money to cover the loss-making activities of Arianespace would be easier to justify. However, it is not clear whether the governments in question would be willing to invest in the company, nor, above all, whether they dispose of the necessary resources. For Italy, in particular, this could be an insurmountable obstacle: ad hoc legislation authorising such an intervention on the part of ASI and assigning it the necessary resources would probably be required. A partial alternative could be to include the EU as a shareholder. This would emphasise the strategic importance to Europe of access to space, and would ensure a collective commitment on the part of the Member States to accompany that

[52] The countries with an interest in Arianespace are, in order of the size of the holding, France, Germany, Italy, Belgium, Switzerland, Sweden, Spain, Holland, Denmark and Norway.
[53] CNES (34.68%), Astrium SAS (16.85%), Safran (10.57%), L'Air Liquide SA (1.89%), Clemessy SA (0.11%), EADS France SAS and Compagnie Deutsch SAS.
[54] Astrium GmbH (11.59%) and MT Aerospace AG (8.26%).
[55] The Italian share of 3.38% is controlled by Avio.
[56] The French undertakings Astrium SAS and EADS France SAS, the German company Astrium GmbH, the Spanish undertakings EADS Casa and Crisa and the Dutch company Dutch Space BV.

made by the main countries through their national space agencies, downplaying the involvement of the latter.

The second hypothesis would be the **privatisation of Arianespace**, which could address a series of problems of both an economic/financial and a commercial nature, and lead to a reduction of "extra costs", in particular those induced by the "geographic return" principle. However, a completely privately-owned company would not, under European law of the single market, be entitled to receive public financing to cover its losses, and it would be difficult for those governments which might be willing to have recourse to the appropriate instruments to derogate from this regime. Finally, governments might be reluctant to pay the high costs of launches managed by Arianespace only in order to maintain the productive capacity of the companies forming part of it, and would have an incentive, whenever possible, to turn to cheaper third country operators. Privatisation could nevertheless be carried out in different ways. There are three options, as follows:

1. A floating of the company on the market. Despite the consortium's known financial problems, the possibility of finding private investors willing to acquire the 34.68% share currently held by the French space agency cannot be completed discounted.
2. An acquisition of the entirely of Arianespace by the biggest European aerospace group, EADS. This would leave complete control of European launch capabilities in French hands, with obvious political and strategic implications.
3. The constitution of a new company able to bring together the core of current European industrial capabilities in the space access sector, i.e. those of EADS Astrium Space Transportation and Avio. This would ensure a rationalisation of the European technological-industrial base, consolidating in a single entity, other than the production of Ariane and Vega, activities which are today broken up, such as the commercial activities of Eurokot and Starsem[57] and the industrial activities of Europropulsion and Regulus.[58] A similar approach would thus allow future technological and industrial challenges to be addressed in a unified way, in particular those connected to the development of NGL and the evolution of Vega. The new company should be responsible both for all industrial activity (research, development, industrialisation and production) and for all commercial activity (requests from both governments and private operators). It should, furthermore, be organised in national "subsidiaries" specialised in their current competences and subjected to supervision and control by the respective governments in such a way as to ensure the protection of the different national interests. This company would take on the current role of Arianespace, simplifying and making more efficient the European launcher sector. Its shareholders would be EADS (in which, in turn, the French and Spanish government have interests) and Avio (in

[57] Eurockot Launch Services GmbH, a joint venture between EADS Astrium (51%) and Khrunichev space centre (49%), operates the launches of the Russian launcher Rockot. Starsem is a Russo-European consortium (35% EADS Astrium, 25% the Russian space agency, 25% Samara Space Center, 15% Arianespace) which operates the launches of the Russian rocket Soyuz from the cosmodrome of Baikonur. For a fuller treatment, see p. 10.

[58] Through the company Europropulsion (owned 50% by Avio and 50% by the French company Snecma) and the company Regulus (controlled 60% by Avio and 40% by the French company SME), Avio has designed and specified, and is currently producing, solid propellant motors for the launcher Ariane 5.

which, in turn, Finmeccanica, itself 30% controlled by the Italian government, has an interest), or directly Finmeccanica. Thus, although it would be a private company, the interests of the governments of those countries having a greater involvement in space access would be protected.

The final decision as to a new form of governance, whether it contemplates one of the hypotheses outlined above or lies beyond them, should be taken by the end of 2011. However, given the complexity of the issue it might postponed to 2012, potentially in occasion of the ESA Ministerial Council.

6. Conclusions

Maintaining an independent space access capability is one of the hinges of European space policy, without which EU and Member State programmes would be entrusted to third countries. This policy, in turn, ensures that the EU can be active in different sectors, above all CFSP/CSDP, by which its international standing is principally measured, and that it can improve that action. Space applications for navigation and positioning, earth observation and telecommunications are therefore increasingly useful and necessary tools to make the EU's external action more effective.

However, the rapid technological evolutions in progress, and the redefinition of global politico-economic balances, risk undermining Europe's capacity to maintain an independent, effective and sustainable policy on access to space. In the wake of the successes achieved by ESA and Arianespace in recent decades, it will be necessary to respond quickly to the two main challenges in the European launcher sector in order to be able to continue to play a leading role in that sector. The first challenge is the need to modernise the family of carriers currently available at the European level in such a way as to anticipate the new commercial and technological demands of the satellite market and to continue to guarantee complete launch independence for European institutional missions, both civilian and military. The second challenge, closely connected, is the ability to compete in an international launcher market together with established powers, such as the US and Russia, and new players, such as China, who are ready to invest in launch technologies in order to strengthen their own strategic independence, as well as their international prestige, and to capture ever-greater shares of the global market.

The specificities of the European space transport sector, such as the reduced number of institutional launches programmed for the coming years, render these challenges particularly difficult, and require a renewed and shared approach to European space access policy. In particular, it appears necessary to improve the corporate and financial framework in which the European launcher industry operates. Indeed, the lack of transparency in the management of Arianespace and its recurrent economic losses limit the European launcher family's capacity for industrial programming and technological development, leading to a potential reduction in competitiveness before the hardening international competition. Only through a clear and definite reorganisation of the governance of the sector, and a precise definition of the tasks and roles of its main actors, both political and industrial, is it indeed possible to imagine maintaining a launch capacity at the service of European space policy and Member

States' programmes, not to mention the international image (and internal well-being) of the EU.

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