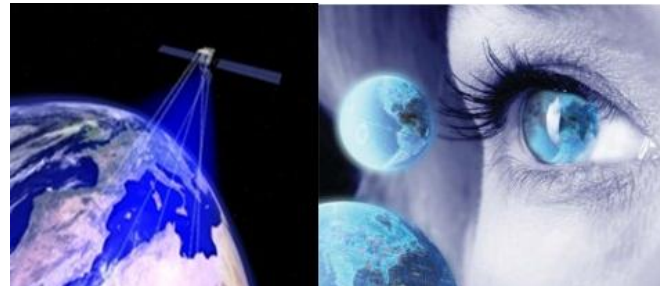


**Clama Consulting**

**Survey of the Economic Impact of Portugal's  
Participation in ESA from 2000 to 2009**

**Abridged version**

Lisbon, November 2, 2011



Study sponsored by *Fundação para a Ciência e a Tecnologia*

## 1. Introduction

The Survey of the Economic Impact of Portugal's Participation in the European Space Agency (ESA) from 2000 to 2009, awarded by *Fundação para a Ciência e a Tecnologia* (FCT) to Clama Consulting in September 2010, characterises the impact of Portuguese ESA membership, not only in the space sector in Portugal in the last ten years, but also in other related industrial sectors where space competencies have been applied to perform many kinds of projects. The study does not cover the activities of a purely scientific nature, such as those financed by FCT's national programmes. The study assessed the Portuguese companies and academia with ESA contracts in the space sector from 2000 to 2009 and was supported by a market questionnaire directed to a sample of entities presently with relevant activity in this sector.

## 2. The European Space Agency (ESA)

The European Space Agency (ESA), established in 1975, is an organisation dedicated to the exploration of space, currently with 19 member states. Headquartered in Paris, ESA has a staff of more than 2000 people with an annual budget of about 3600 M€ in 2009. Canada is the only non-European country with cooperating member status that participates in ESA programmes. The purpose of the agency is to provide and to promote for exclusively peaceful purposes cooperation among European States in space research and technology and their space applications, with a view to their being used for scientific purposes and for operational space applications systems:

- ❑ by elaborating and implementing a long-term European space policy, by recommending space objectives to the Member States, and by concerting the policies of the Member States with respect to other national and international organisations and institutions;
- ❑ by elaborating and implementing activities and programmes in the space field;
- ❑ by coordinating the European space programme and national programmes, and by integrating the latter progressively and as completely as possible into the European space programme, in particular as regards the development of applications satellites;
- ❑ by elaborating and implementing the industrial policy appropriate to its programme and by recommending a coherent industrial policy to the Member States.

Concerning industrial policy, it is important to emphasize ESA geographical return policy, a distinctive aspect of ESA procurements, which plays a decisive role in the balanced development of all Member States space industry. In each of its programmes ESA ensures that at least 85% of the Member State contribution, minus ESA's internal costs, will be returned to the State in the form of contracts covering ESA activities. ESA further ensures that when all programmes are taken into account, 94% of the overall contribution will be returned, in the form of contracts, to the contributing State. In ESA terms, this principle is called the *Industrial Return* or *geo-return*. In the context of the EU, this approach is called *juste retour*. This aspect is essential to ensure a fair return on the investment in the agency and to motivate the participation of smaller member states in space developments allowing for less competitive

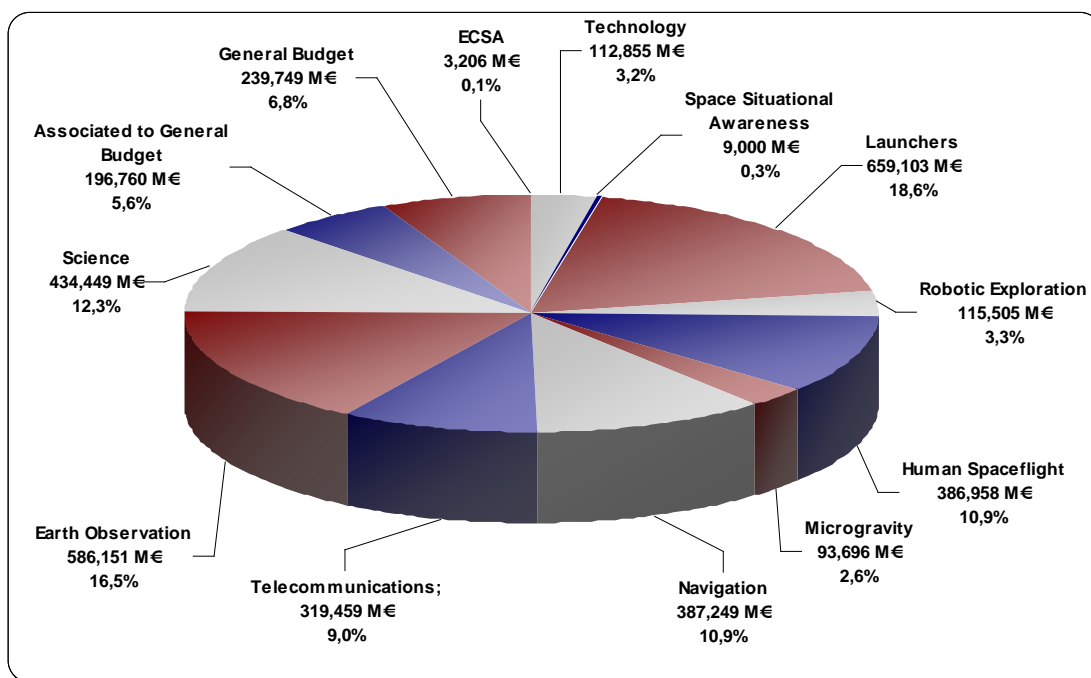
States to increase their industrial competitiveness. It should also be highlighted the governance model implemented by ESA where the decision making process involves the Member States in a step-wise approach. Although weighted votes will exist, only for optional programmes based on the level of contribution – especially in programmatic issues to avoid implementation delays – the major and most significant decisions are taken only once a consistent consensus is achieved. This means that Member States share the responsibilities and the lead of the Agency in a collaborative and interdependent basis. ESA represents, to Portugal, and for all practical matters, its Space Agency.

### **2.1. The European Space Agency Programmes**

ESA's activities can be split into two distinct categories – 'mandatory' and 'optional'. Programmes carried out under the General Budget and the Science Programme Budget are 'mandatory'. ESA's mandatory activities are funded by a financial contribution from all Agency's Member States, calculated in accordance with each country's relative gross domestic product (GDP). In addition, ESA conducts the following optional programmes: Technology, Space Situational Awareness, Launchers, Robotic Exploration, Human Spaceflight, Microgravity, Satellite Navigation, Satellite Telecommunications, and Earth Observation. ESA Member States decide in which optional programmes they wish to participate and the corresponding contribution amount according to their interest and industrial and financial capability.

As shown on Figure 1, the programmes Launchers, Earth Observation and Science stand for almost 50% of the total income from Member States to ESA programmes, including both optional and mandatory. Analysing only the "optional programmes", launchers, Earth observation and navigation programmes stand for 57% of the total contributions to this category. The programmatic family with the highest budget corresponds to the launchers programmes, representing 18,6% of the overall investment on ESA space programmes and the one requiring the most expensive investments.

**Figure 1 – ESA Budget by Programme in 2009**



Source: ESA

The contribution from each ESA Member State to the Agency's 2009 budget is subject to important standard deviations. French and German contributions alone stand for 48% of the total contribution from ESA member States, with 25% and 23%, respectively, with a total amount of 1364 M€, in 2009. Portuguese contribution stands for 0.56% (or 15,671 M€) of the total contribution of Member States to ESA budget in 2009.

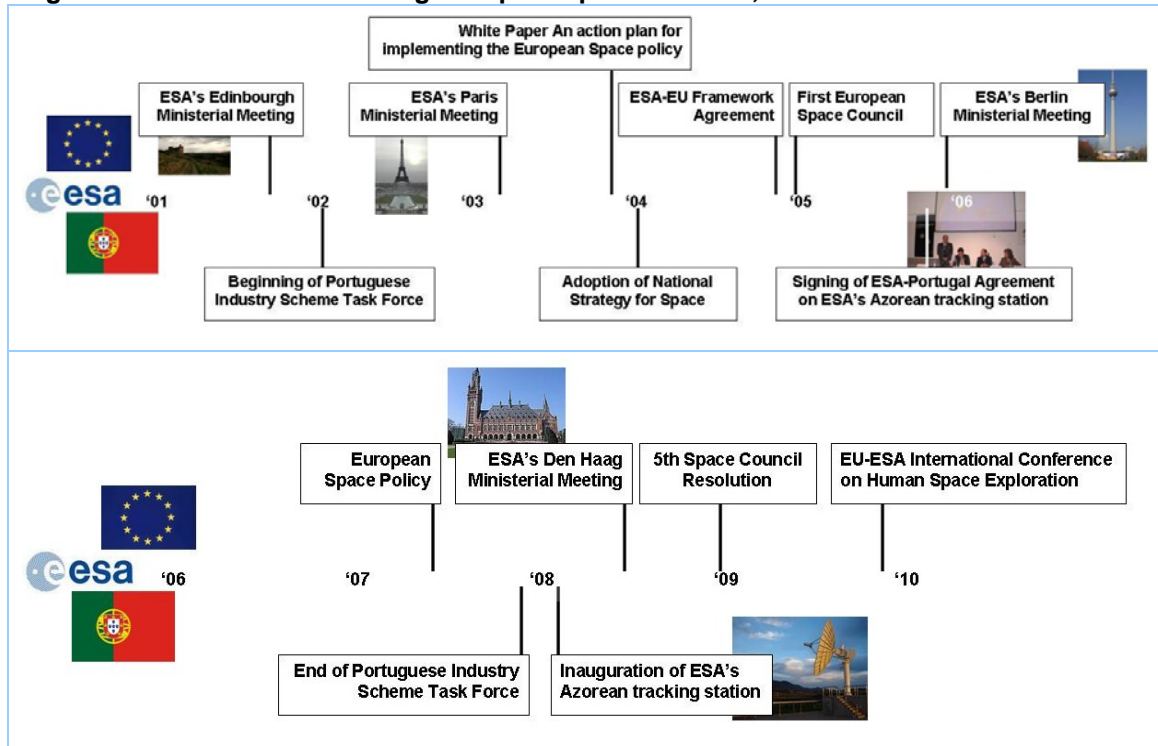
### 3. Key Milestones and Special Initiatives for the Space Sector in Portugal

#### 3.1. Key Milestones

In 1999, Portugal and ESA signed the Agreement on Portugal's accession to the ESA Convention and in late 2000 the country became a member of ESA (Figure 2). In the transitional period 2002-2007, the Portuguese Task Force assumed a critical role, pursuing to maximize the industrial return and to guarantee the best possible adjustment of the industry. A special focus was given to mandatory programmes, since a Portuguese contribution would still have to exist after 2007 regardless of the ability of the Portuguese industry to promote its return.

Key milestones include the adoption of a Portuguese National Strategy for Space in early 2004 and among others the installation of a ESA tracking station in the Azores in 2008 and the launch of the demonstration on board the Proba-2 satellite of the first commercial Portuguese satellite equipment.

**Figure 2 - Timeline of the Portuguese participation in ESA, '01-'09**



### 3.2. The Portuguese Task Force

The Agreement on Portugal's accession to the ESA Convention included a six-year transitional period during which ESA should use three million Euros (at 1998 economic conditions) per year, out of the Portuguese contribution for mandatory activities, to finance activities aiming at adjusting the Portuguese industry to the Agency's requirements (the period was extended by one year through an exchange of letters without financial implications on the financial envelope of the initiative). These activities included not only the placing of contracts with Portuguese industry and academia but also training and workshops, among others. Within this framework, a task force was set up in 2001 to advise ESA's Director General on the use of the mentioned amount. It was made up of representatives designated by ESA's Director General and the Portuguese Government and co-chaired by an ESA representative and a Portuguese one. The executive of the Task Force (its secretary) was also nominated by ESA's Director General.

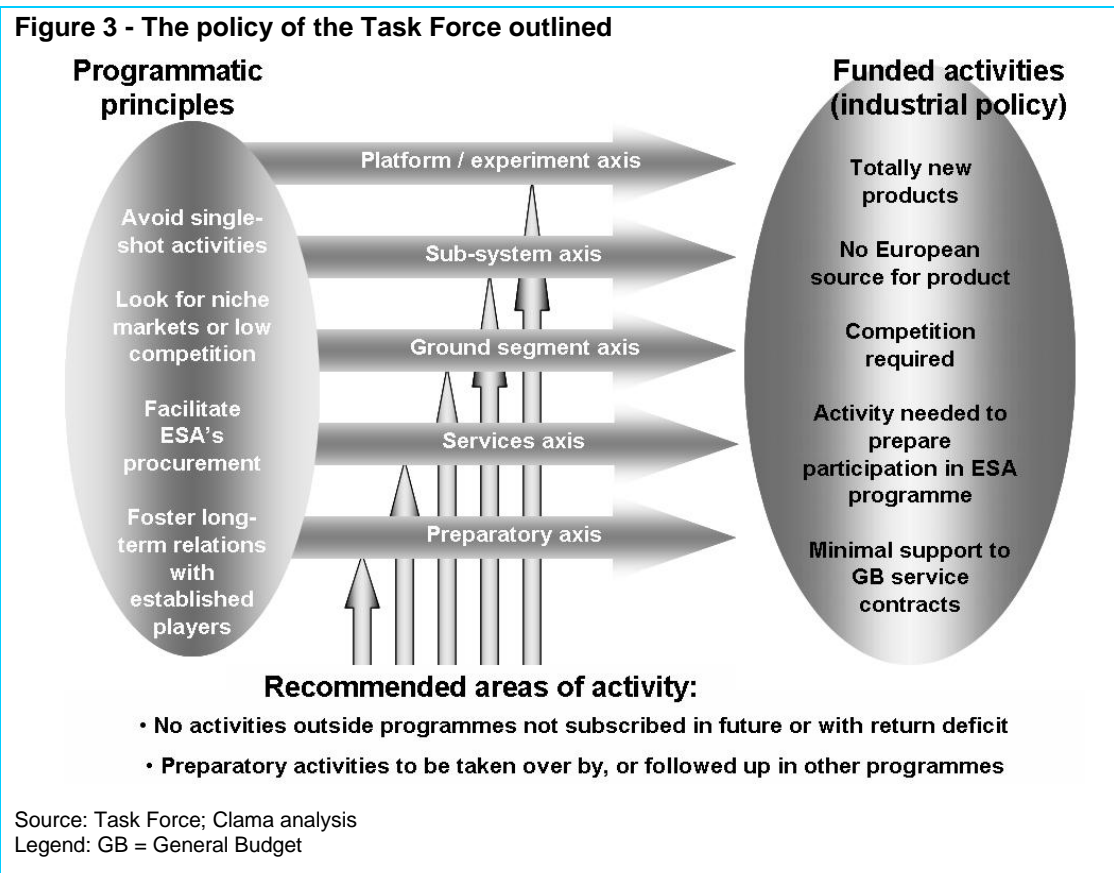
The Task Force's main goal was to maximise the Portuguese industrial return and to guarantee the best possible adjustment of the industry, so that at the end of the transition period there would be no critical issues to tackle.

The Task Force's industrial goal was to produce work that would lead to actual products and it identified five main axes for achieving that goal as referred in Figure 3:

- ▶ Platform/experiment axis: To create the physical and intellectual infrastructure leading to the production of a small payload (either instrument or system);
- ▶ Sub-system axis: To create or develop the capabilities to implement and supply space-qualified elements of sub-systems;

- ▶ Ground-segment axis: To develop Portuguese know-how in connection with the ground segment;
- ▶ Services axis: To foster the supply of the specialised services to ESA that are usually provided through frame contracts;
- ▶ Preparatory axis: To prepare institutions for integration in future space activities in different programmes, in particular those with societal benefit.

The Task Force also strived to become a facilitator of Portuguese accession to the normal ESA procurement procedures and to foster long-term relations between Portuguese firms and well-established European space firms.



### 3.3. Ciência Viva Programme Outreach – Space Activities

*Ciência Viva* promotes and supports activities in connection with space scientific and technological awareness since 1999. It periodically collaborates with the Portuguese delegation to ESA and its executive director is the Portuguese representative at ACE (ESA Advisory Committee on Education).

Regarding space, *Ciência Viva* has the following set of regular activities, most of them stemming from the participation of Portugal in ESA activities:

- ▶ A space webpage [www.cienciaviva.pt/rede/space](http://www.cienciaviva.pt/rede/space), including events, news, educational resources.

- ▶ A web-TV channel, with contents aimed at young people mainly, including conferences, experiments and interviews with scientists.
- ▶ A World Space Week, every October. Since 2001 *Ciência Viva* coordinates and publicises, in collaboration with the World Space Week national coordinator, nation-wide activities, such as astronomical observations, debates, workshops and exhibitions for the general public and for schools.
- ▶ Science Education Projects on Space Science. The Agency supports science education projects to promote scientific culture and practical work at school. Some of these projects were proposed by research laboratories in partnership with schools and have space science as the main topic (Astronomy, Astrobiology, Cosmic Rays and Microgravity).
- ▶ Space camps and parabolic flights. *Ciência Viva* has been supporting Portuguese teachers' and students' participation in international space camps and students' participation in ESA's parabolic flight campaigns.
- ▶ Astronomy in the summer. Every summer since 1997, it has promoted a nation-wide campaign of astronomical observations for the general public, in collaboration with the main astronomical observatories and the amateur astronomer's associations involving thousands of people every year, from all over the country.

### **3.4. ESA Portuguese Trainees**

An aspect of the impact of the Portuguese membership in ESA can be clearly demonstrated with the programme of internships (Advanced Training Programme for Portuguese Engineers in International Scientific Organisations) financed by FCT, on the basis of protocols signed by the *Agência de Inovação* (AdI), with the European Organisation for Nuclear Research (CERN), in 1996, with ESA, in 1997, and with the European Southern Observatory (ESO), in 2001.

The training runs for a minimum of 12 and a maximum of 24 months, and is according to the technological field, with particular emphasis on the project, the pedagogical framework and the future employment of the trainees in Portuguese companies. The scholarships are awarded by the FCT and the AdI is responsible for promoting the programme, selecting the candidates and monitoring the work carried out by the scholarship winners.

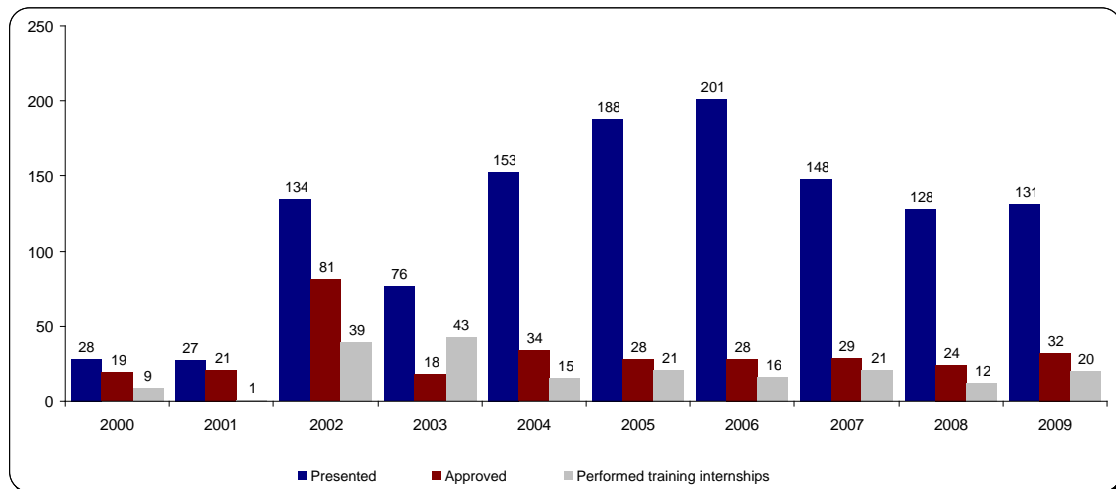
The fact that the success rate of the applicants is often as low as 10% reflects the demanding nature of the selection criteria and how rigorously they are applied. Furthermore, the interest shown by the international organisations in this programme is very clear from the fact that they provide hundreds of advanced training opportunities each year, in virtually every engineering area.

The programme is focused on the advanced training of engineers but does not rule out other possible career paths and the participants' options are always respected. Even though the participants opt for a wide range of different careers after training, the vast majority are employed in the private sector at home and abroad.



Since 1998, ESA has been receiving Portuguese graduates in Space Technologies, to give them valuable work experience and to prepare them for future employment in the space industry. Figure 4 shows the total number of applications for training, approved applications and finished training internships from 1998 to 2009. For the last 11 years, 538 applications have been submitted for the appreciation of ESA, 128 have been approved and 77 people have completed their internship.

**Figure 4 – Number of applications, approvals and finished training programmes per year**



Source: ADI

#### 4. Assessment of the Economic Impact of Portugal's Participation in ESA

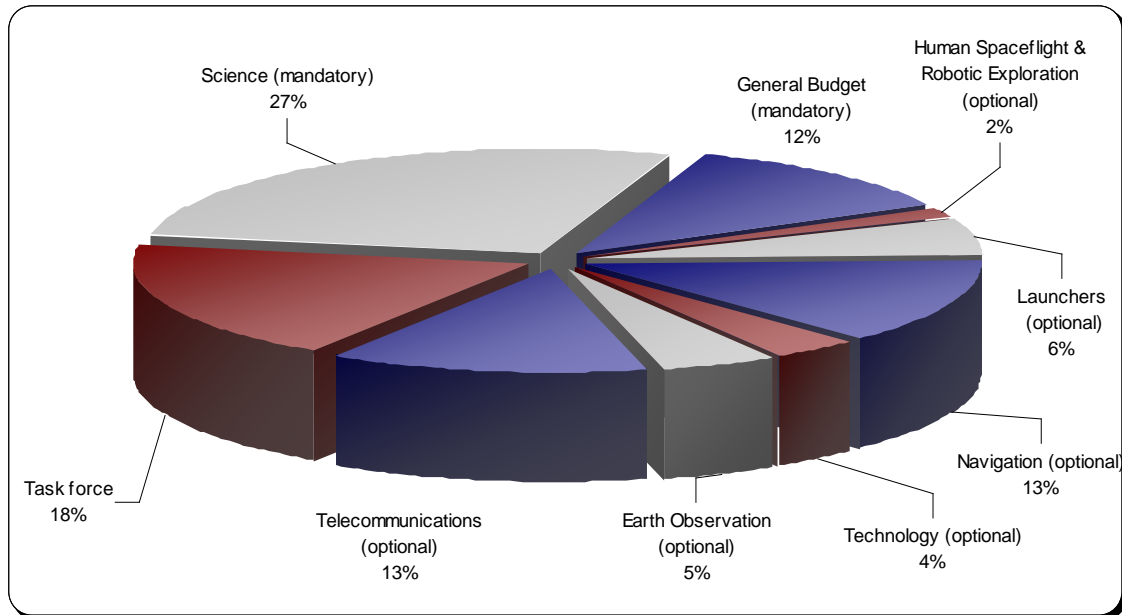
##### 4.1. Portugal's investment and return in the Space Sector

The study shows that during the last 10 years Portuguese investment in the space sector was carried out not only with ESA programmes but also with the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the European Union (EU) Framework Programmes. Portugal's contribution to the space sector from 2000 to 2009 has been invested, on average as follows: 74% in ESA, 21% in EUMETSAT and 5% in EU Framework Programmes. Regarding ESA, in 2009, the total amount spent in projects related to the Space Sector represented 0,0074% of the Portuguese GDP, with a total amount of 17,6M€.

During the period under review, 2000-2009, Portugal contributed to ESA programmes with a total value of 111,5 M€ both in mandatory and optional programmes, where 57% was related to the mandatory programme (Science, General Budget and Task Force) and 43% related to optional programmes (Figure 5). With a total amount of 30 M€, Telecommunications and Navigation programmes stand for 26% of total Portuguese contribution to optional programmes. Space Exploration and Launchers stand for less than 8% of the total amount.



**Figure 5 – Portuguese Contribution to ESA Programmes 2000-2009**

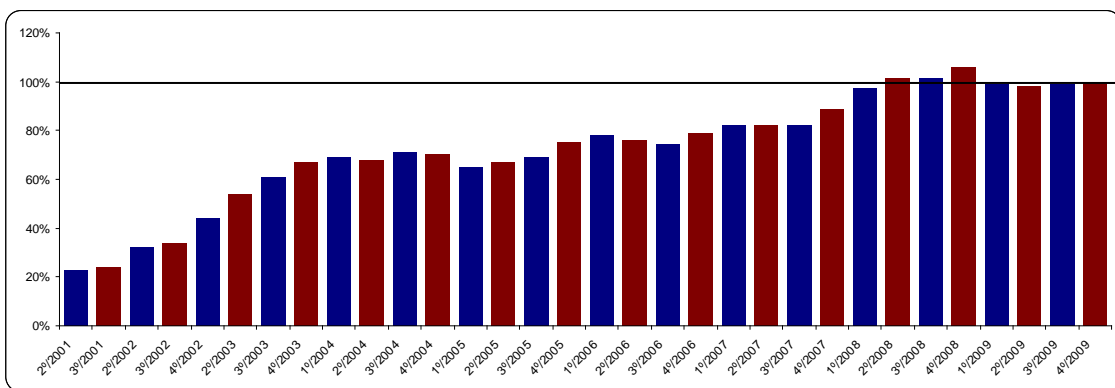


Source: FCT; Clama analysis

Regarding the fundamental geo-return principle of ESA, the value of contracts awarded to Portuguese companies and academia must be proportional to the Portuguese financial contribution.

The evolution of the Portuguese geographical return has been very positive, showing a steep learning curve. Considering the non-existence of previous space experience, 8 years (in 2008) were enough to reach the nominal return on ESA programmes (see Figure 6).

**Figure 6 – Evolution of the Portuguese overall geographical return coefficient in the period 2000-2009**



With regard to the total generated direct turnover, from 2000 to 2009, the study points out that Portuguese companies and academia achieved ESA contracts with a total value of 94,874 M€. Relating this value with the total investment in ESA, it can be concluded that the real overhead to Portugal was 15% covering ESA's internal costs.

For each ESA family programme, Table 1 shows the total number of contracts assigned to Portuguese companies and academia, the total value and the average contract-size in K€.

**Table 1 - Contracts assigned to Portuguese entities from 2000 to 2009 by Programme**


	Number of Contracts	Total Contract sum (k€)	Aver. Contract sum (k€)
GENERAL BUDGET (mandatory)	109	11715	107
SCIENCE (mandatory)	13	8150	627
TELECOMMUNICATIONS	36	11282	313
NAVIGATION	20	24096	1205
EARTH OBSERVATION	36	11381	316
LAUNCHERS	13	3570	275
TECHNOLOGY	13	2269	175
EXPLORATION	14	1220	209
TASK FORCE & Others	48	21191	331
<b>TOTAL</b>	<b>302</b>	<b>94874</b>	<b>298</b>

Navigation programmes have the highest direct impact on Portuguese ESA contracts, representing 45% of the total Portuguese projects developed in optional programmes.

As summarised in Table 2, the total number of Portuguese contracts with ESA increased from 4 in 2000 to 58 in 2009, corresponding to an increase of 1 M€ to 17,6 M€ in 2009. The number of organizations developing projects with ESA raised sharply from 4 in 2000 to 28 in 2009. 22% of ESA's Portuguese contractors (17 in total) are responsible for 80% of the total contracts' value. 45% of the contractors (45 in total number) represent less than 5% of the total contracts' value.

As mentioned in Chapter 3.4, the number of Portuguese trainees within ESA in the last ten years reveals recognition from ESA about the high quality of work developed during the internship. Finally, the level of impact of Portugal's participation in ESA for each indicator (low or high) has been evaluated against other countries' evolution after ESA membership.

**Table 2 – Evolution of key indicators characterising Portugal's participation in ESA**

	Key Indicators	2000	2009	Impact
ESA	Contribution to ESA	4,6 M€	15,7 M€	
	Geographical Return	23%	99%	
	Number of contracts with ESA	4	58	
	Total value of Portuguese contracts with ESA	1,0 M€	17,6 M€	
	Total number of organizations developing ESA projects	4	28	
	Average value of Portuguese contracts	250 K€	303 K€	
	Trainees at ESA	77		


 High impact    
  Low impact

Table 3 presents a comparison between companies and academia regarding their contracts with ESA. It should be noted that since ESA performs mainly the industrial implementation of space missions, the involvement of academia is mainly limited to research supporting technology, definition of scientific requirements of scientific missions and as users of scientific data. For this reason, the expenditure of the ESA budget across its member states in academia and research organisations is typically around 10%. The results shown in Table 3 indicate further that Portugal has achieved a performance similar to all other ESA Member States.

**Table 3 - Comparison between companies and academia in ESA contracts**

Companies	Academia
<input type="checkbox"/> 57 companies developed projects with ESA with a total budget contracts reaching more than 86 M€.	<input type="checkbox"/> 19 Academia worked in ESA projects, representing almost 9 M€
<input type="checkbox"/> They represent 75% of the total number of entities that have been working with ESA since 2000 (66 entities)	<input type="checkbox"/> They represent 25% of the total Portuguese players with ESA contracts since 2000
<input type="checkbox"/> The total amount represents 91% of the total contract sum between 2000 and 2009.	<input type="checkbox"/> Their contract value represents 9% of the total contract sum between 2000 and 2009.

## 4.2. Space Sector Impact in the Portuguese Economy and Spin-off Factor

### 4.2.1. Methodology and main assumptions

In order to complete the analysis of the data from ESA and FCT about the space sector in Portugal, a questionnaire was sent to 45 organizations (26 companies and 19 academia) and a set of interviews were performed with many of the main players of the sector. The questionnaire

and the face to face interviews were conducted to receive as many inputs as possible on each of the organizations' views on the following subjects:

- ▶ Direct and indirect impact on the organizations' activities of the participation of Portugal in ESA
- ▶ Key factors of success of Portugal's participation in ESA
- ▶ Benefits of being involved with ESA projects

The reply rate vis-à-vis the universe of research was of 64% that can be considered a very successful rate, above 20% that is considered to be the minimum ratio for statistical representativeness, even though only 42% of the academia responded to the inquiry.

### **Gross Value Added (GVA)**

Estimates of Portuguese GVA generated by space companies have to be indirectly calculated because there is no organized information that allows calculating it. It was necessary netting off purchases of goods and services from space revenues, to avoid double counting of the contributions made by a company and its suppliers. Oxford Economics (2009) have suggested that a relatively high percentage of turnover (about 50%) in the space sector is accounted for by value added.

### **Assumptions considered calculating GVA:**

- ▶ Values considered: total value of ESA contracts
- ▶ Total value of sales provided through the survey
- ▶ Only considered internal workers – information provided through the survey
- ▶ Data on annual turnover was provided by the organizations and analyzed by Clama
- ▶ 50% of the respondents answered the question of indirect impact value
- ▶ For the remaining 50% respondents, we used the information related to ESA projects crossed with Oxford Economics assumption to calculate GVA

$$GVA_{SpaceSector} = \frac{DirecTurnover(ESAcontractsum) + IndirecTurnover - PurchaseofGoods}{NumberofEmployeesSpaceSector}$$

### **Spin-off factor**

#### **Assumptions considered calculating the spin-off factor**

As far as spin-off factor is concerned, it indicates the return-on-the-investment in ESA contracts to Portuguese companies in the period 2000-2009 and represents as well the impact on the Portuguese economy for each Euro invested in the ESA contributions. It can be calculated with:

- ▶ Investment: the aggregated value of Portuguese ESA contract placed among the companies included in the analysis in the period 2000-2009;
- ▶ Return: the turnover directly created by these contracts plus the indirect impacts. The indirect impacts are additional turnover generated by the initial ESA contracts on new or

existing markets due to accumulated expertise, capabilities, competitiveness, reputation, networking, etc.

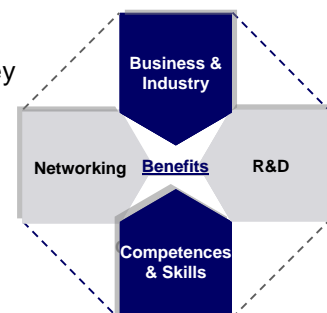
- ▶ The indirect turnover considered was the same used for the calculation of GVA

$$SF_{2000-2009} = \frac{DirecTurnover(ESAcontractsum)_{2000-2009} + IndirecTurnover_{2000-2009}}{DirecTurnover(ESAcontractsum)_{2000-2009}}$$

The main outcomes from the analysis were the following:

- As far as employment is concerned, the analysis shows that the number of people working in the space sector in Portugal grew strongly, from 6 people in 2000 to 208 people in 2009. The turnover has therefore directly generated a total employment equal to 202 full time employees in the period.
- Compared to the generated direct turnover, the study shows that a contract sum of 1 M€ on average generates 2 full time employees.
- With regard to Gross Value Added (GVA), the value added per worker in the Space Sector in 2009 was 129 K€, compared to an average of 32K€ for the GVA/worker in Portugal in 2007.
- With regard to the total generated indirect turnover (ICT, aeronautics, oil, automotive, electronics, textile), the study underlines the fact that the ESA contracts have generated a total turnover of 95 Million Euros, thus creating a spin-off factor of 2, meaning that for each million Euro of Governmental support through ESA, the Portuguese space sector companies on average attained an additional turnover of 1 million Euros. It should be said that a factor of 2 is already quite remarkable since it was achieved in a period of 8 years. Similar studies in Norway and Denmark, that have been ESA Members for a very long time, have shown spin-off factors between 4 and 5. The lower value for Portugal is most likely due to the long periods necessary for satellite development (typically 10 to 15 years).

Four main areas of benefit were identified through the study and they explain why this sector has been so successful in Portugal. Some conclusions about these areas can help to improve the sector in Portugal and they are related to a certain number of critical factors that have been influencing positively the Portuguese organizations.



 <p>Business &amp; Industry</p>	<p>Companies have profited from Portugal's participation in ESA in the last 10 years. Three key aspects prove that success:</p>
<ul style="list-style-type: none"> <li>▶ The evolution of the weight of the sector as a % of GDP</li> <li>▶ The turnover and volume of projects undertaken under ESA contract have strongly increased</li> <li>▶ Strong indirect impacts (spin-off effect of 2) on the economy (ICT, aeronautics, oil, automotive, electronics, textile) have emerged in the last 5 years</li> </ul>	
 <p>R&amp;D</p>	<p>Both companies and academia have taken advantage of Portugal's participation in ESA to leverage R&amp;D investment and develop scientific activities. Three key aspects prove that success:</p>
<ul style="list-style-type: none"> <li>▶ An increasing number of scientists, researchers and space engineers are collaborating with companies and academia</li> <li>▶ Companies are involved in cutting-edge technologies and working with ESA and other sophisticated international clients</li> <li>▶ There is an important number of projects rated 1 by ESA reference system, composed of activities non recurrent but innovative and with high added value (GSTP, TRP), originating investments with a strong Gross Value Added</li> </ul>	
 <p>Competences &amp; Skills</p>	<p>During Portugal's participation in ESA people acquired know-how and competences in the space sector developing new ways of working and impacting organizations performance. Three key factors prove that success:</p>
<ul style="list-style-type: none"> <li>▶ There has been an increasing number of candidates/trainees in ESA programmes</li> <li>▶ Organizations acquired competences in the sector during this period and were able to exploit other sectors based on these capabilities (spill over effect)</li> <li>▶ The ratio: number of request for proposal (RFP)/geographical return is very high. Every year companies submit large quantities of proposals in reply to RFP to ESA</li> </ul>	
 <p>Networking</p>	<p>Portugal's participation in ESA has definitely created a network of excellence in the space sector for Portuguese companies and academia based in ESA's best practices.</p> <p>Three key factors prove that success:</p>
<ul style="list-style-type: none"> <li>▶ The networking and collaboration with ESA and with other national and international entities (best practices) is a direct consequence of Portugal's participation in the Agency</li> <li>▶ SMEs have gained an international visibility, difficult to reach without ESA's network</li> <li>▶ ESA's global network has brought personal enhancement, international contacts, intellectual capital available worldwide, R&amp;D platforms, independently of Portugal's own contribution</li> </ul>	

## 5. Challenges and Opportunities for Portugal in the Space Sector

### 5.1. Constraints to the development of the Portuguese space sector

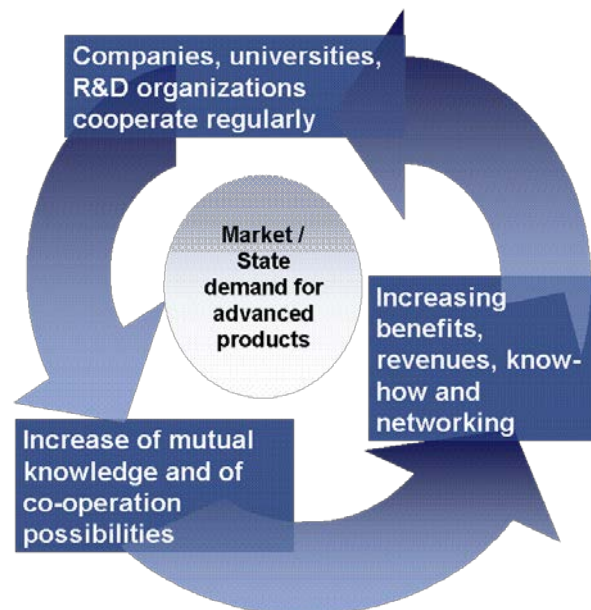
As soon as Portugal became a full member of the Agency, companies with activities in the space sector became acquainted with the process to respond to ESA's tenders. In the beginning, from 2002 to 2007, Portugal was in a privileged position as a newcomer and could benefit from a special incentive scheme allocated to Portuguese companies. Competition was then national. Since 2007, competition has become international and much fiercer as other countries/companies had already joined ESA many years before and had a long tradition in the sector. For the last ten years, several reasons were pointed out by Companies and Academia as obstacles to their development in the space sector or with ESA:

- |  |  |
|--|--|
| ▶ The small size of the Portuguese market (of the companies; of the national space market) | ▶ Lack of specific technology/know-how |
| ▶ Lack of support/State incentives to this specific sector                                 | ▶ Lack of partners                     |
| ▶ The poor articulation between universities and companies                                 | ▶ Competition                          |
|  | ▶ Projects' profitability              |

Players in this sector are very often facing cash-flow needs to invest in medium/long term projects as space sector is generally very demanding of cash-flow needs. The sustainability of a continuous investment is therefore critical to maintain a successful R&D activity in the space sector. Cooperation between universities and companies is also sometimes weak and a virtuous circle presented in Figure 7 would have to be continued with a clear indication from the market (in some cases, the State) that there are benefits both for universities and companies to co-operate.



Figure 7 – The virtuous cycle



Source: Clama analysis

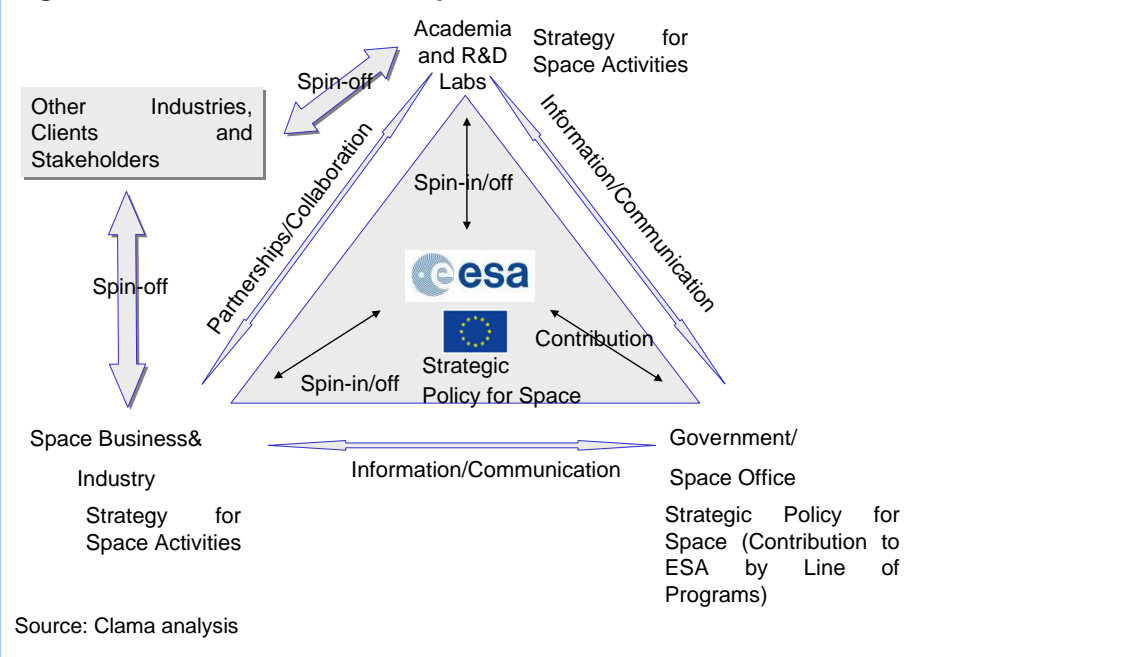
Portuguese organizations, regardless of being of an academic or business nature, all look at ESA as a source of opportunities in a much diversified array of areas, from access to markets and revenue streams to partnership-developing, know-how and technology transfer and spin-in. The main interesting area for both types of organizations for collaborating with ESA and identified during the study and questionnaire is Technology and the least interesting ones the International Space Station (ISS) and microgravity. Moreover, a set of opportunities were also mentioned by different stakeholders during the study and should be taken into account.

- ▶ An important number of projects are entering the operational phase: software operations and maintenance should be exploited
- ▶ Cooperation and merger&acquisition with international players should be analysed to enter protected markets (China, Brazil) and to reduce investment costs by sharing R&D development
- ▶ Synergies with other industrial sectors should be considered: spin-in and spin off (textile, aeronautic, biomedical)
- ▶ Market out of the institutional segment, nationally and internationally should be an option: private satellite operators
- ▶ Portugal's privileged relationship with African Countries of Portuguese Official Language could mean an opportunity for SMEs in the GMES and Africa project

## 5.2. Short/medium-term initiatives for Companies and Academia

The opportunities mentioned before should be taken as guidelines for future work. They will most certainly evolve in time and, therefore, more important than defining each and every one of the initiatives that are strategic to Portugal in the space sector, is the framework referred in Figure 8 within which they are defined. Paramount to this framework is the need for continuous communication between the stakeholders of the sector – Government, companies and academia. Between the latter two, integration should continue to be pursued, be it simple collaboration, spin-offs or strategic alliances.

**Figure 8 - Framework Model for Space**



Benefits to the broader economy and society take the form of spill-over of technology (mostly general purpose technologies) or services provided based on the space segment. This seems to be the only way to achieve the roll-out of an ever-evolving and reality-based space strategy, as has occurred thus far.

## 6. Main Conclusions

Throughout the study, there are many evidences underlining the fact that the Portuguese ESA membership has been fundamental to support the activity of Portuguese companies in the space sector and to leverage their skills and competencies in this high knowledge – intensive sector with a strong added value.

The Portuguese ESA membership has been a successful stake in the modernisation process of the country, and, as the study clearly shows, we are far away from taking full advantage of all the potential opportunities created by Portugal's participation in ESA.

One of the most important outcomes is related to the direct and indirect impacts generated by Portugal's contribution to ESA and returned to the country as contracts for Companies and Academia after competitive bidding. As far as indirect impacts created by ESA contracts are concerned, the study underlines their important contribution to Portugal's GDP in the period in analysis and the transversal effect of the space sector in the economy as a whole (characterised by the spin-off factor). And, as in other European countries, space activities in Portugal have proven to be strongly efficient when compared to the average level of the industrial sector.

Moreover, the space sector can be a strong enabler to help creating small and medium enterprises in a dynamic environment and contributing to Portugal's economic growth in terms

of exports and job creation. It could also represent an opportunity nowadays for many companies trying to be involved in projects with an international exposure and to take advantage of technology transfer. The Government has therefore a major role to play to keep sustaining the investment with a long term strategy and supporting and rewarding the best performing and collaborating companies and academia.