SPACE GOVERNANCE IN LATVIA: THE CURRENT STATE, FUTURE CHALLENGES AND PLAN OF ACTIONS

Policy Report

2018

UNIVERSITY OF TARTU
Johan Skytte Institute of Political Studies

Interreg
Estonia-Latvia

SPACE GOVERNANCE IN LATVIA:

THE CURRENT STATE, FUTURE CHALLENGES AND PLAN OF ACTIONS

Policy report

Prepared in the framework of EstLat Project "SPACETEM - Training the next generation entrepreneurs with hands on methods in space STEM"

TARTU 2018

This report has been drawn up within the framework of the project “SPACETEM - Training the next generation entrepreneurs with hands on methods in space STEM” and was funded by the Interreg EstLat Program.

This publication has been produced with the assistance of the EstLat Program.

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The authors extend their thanks to all the participants of the project without whom this report would not have been possible.

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EXECUTIVE SUMMARY

This report aims to situate Latvia`s space potential, current developments in the space sector and its policy gaps within the larger context of the future of space economy. The space sector has seen remarkable developments globally (rise in annual revenue, number of jobs created, expansion of the sector into neighboring industries) in the recent years. While the mature space markets` barriers for entry are growing, new emerging markets (such as small satellites manufacturing) offer opportunities for small states, such as Latvia, to diversify their economy, make it more sustainable and innovation-driven, as well as benefit from the commercial products developed.

Latvia has already taken important steps towards building its space capabilities (PECS[1] Charter, activities of the Green Technologies Cluster, creation of an Association of space companies) and fulfilling a strategic goal of becoming a high-tech economy, but at the moment it finds itself at the crossroads: Latvia can either chose to build off of what has already been achieved in the space sector and move forward together with other European nations, or to stay at the current level. This means not only being bypassed by old and emerging space powers, but also losing the investment that has already been put into cooperating with the European Space Agency (ESA).

A concrete understanding of benefits of full membership in ESA has to be developed. The report provides an overview of such benefits, including the prospected rate of return on investments and the degree to which ESA membership could contribute to Latvian Smart Specialisation Profile. **Based on recent evaluations, the rate of return of investments after joining ESA for small states**, like Norway, Denmark and Czech Republic, **was double on average**. Estonia for its part, is expecting a 1.5 rate of return based on the current evaluations. Additionally, based on rough estimates, **ESA has supported 43 projects in areas of Latvian Smart Specialisation**.

The report points out several negative effects of Latvia`s status as a PECS state in the European Space Agency (ESA)**.** Most importantly, it prevents Latvian entrepreneurs and researchers from competing equally for ESA tenders. As a result, **Latvia faces multiple negative consequences**:

- Direct financial damage from not participating in ESA calls and not receiving contracts for developing products;
- Continuing unawareness and lack of access to the newest space technologies and data, gathered by ESA;
- Lack of experience of national researchers in the European-level competition;

[1] Plan for European Cooperating States, European Space Agency

- Resulting absence of connection with European space sector professionals;
- General inability of Latvian space sector to compete on the European level;
- Stagnation of other innovation-driven sectors as compared to other EU countries (whose space sectors consistently contribute to their economies).

Therefore, the report suggests a Roadmap for ensuring that Latvian space sector`s potential is used having the Latvian economic development goals in mind:

Space policy

⇒ Establish a clear timeframe for joining ESA
⇒ Define the niche potential of the Latvian space sector
⇒ Define overall objectives for the space sector
⇒ Engage with discussions on European Space Policy

Engagement with interest groups

⇒ Join the European Interparliamentary Space Conference and participate in its activities

Space governance

⇒ Move the space policy and governance away from the Ministry of Education and Science and place it under the jurisdiction of the Ministry of Economics (as is done in Estonia and many other European Countries)
⇒ Link space sector to the Latvia`s Smart Specialization Profile (ICT)

Engagement with ESA

⇒ Establish and enforce one concrete and proactive contact point for communication with ESA
⇒ Appoint one ambassador to the government and one to the parliament to advocate on space affairs on both levels

Cooperation with industry and academia

⇒ Order an assessment of the impact of PECS on the Latvian economy
⇒ Order an impact study of ESA membership vs. PECS for Latvia

CONTENTS

INTRODUCTION

The processes of technological acceleration are putting more and more pressure on European economies to innovate and grow, and several sectors are expected to be the drivers of the future economic development. One of them is the space sector, which has seen remarkable developments globally since 2013 (rise in annual revenue, number of jobs created, expansion of the sector into neighbouring industries)[2]. In 2016 many countries, e.g. Denmark, Turkey, Czech Republic, Poland, took a historical decision to establish concrete frameworks for the coordination of space activities under respective ministries - either space offices or other[3]. This move was motivated by an understanding that, while it may seem that the space sector is already dominated by "big actors" (US, China, UK, etc.), its recent expansion in visibility, popularity and revenue signified that there are still opportunities to be used. Space sector activities and technological advancements also trickle down into other sectors (such as IT, biomedicine, logistics, etc.), for example, commercial satellite navigation, an essential part of almost all devices we use, currently is the driver of the space sector`s growth[4].

The main actor in the European space field is the European Space Agency (ESA), which unites, as of 2018, 22 members, one associate member and 7 cooperating states, and pulls together space capabilities of European member states, providing opportunities for European countries to cooperate – and be on an equal footing – with NASA, as well as to reap financial and social benefits from large-scale space programs that would otherwise be impossible for one European country to implement. The current philosophical framework of ESA – Space 4.0 – foresees the success of European space activities in close alignment with the needs of the European societies and economies. In other words, the space sector has moved a long way from pure scientific discoveries and "space travel for the sake of space travel". Conversely, satellite technologies and Earth observation (see Figure 1) provide multiple benefits in terms of mitigating natural disasters, managing the agricultural economy, forestry, transportation, navigation and rescue activities[5]. Moreover, the future of space exploration promises to open up ways to extract natural resources off the surface of the Earth (In-Space Resource Utilisation, ISRU) enabling self-sustained space economy.

[2] Eurospace, 2016
[3] OECD, 2016
[4] OECD, 2016
[5] ESA 2016, http://www.esa.int/About_Us/Ministerial_Council_2016/What_is_space_4.0

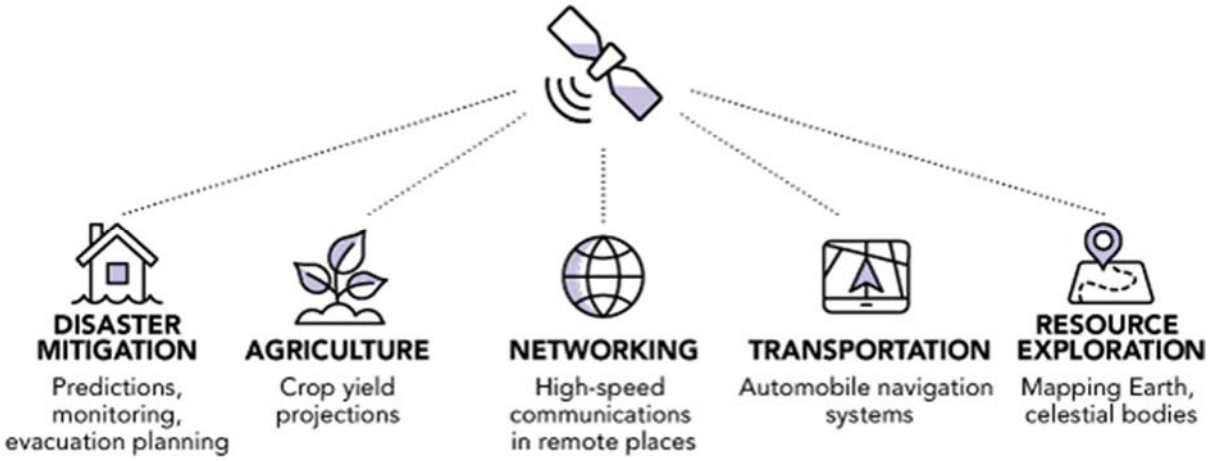


FIGURE 1. MODERN USES OF THE SATELLITE TECHNOLOGY

This report aims to situate Latvia`s space sector potential, current developments in the field and policy gaps within the larger context of the future of the space economy.

In the first chapter, an overview of the recent developments in the global space market and some projections of its future growth are provided, along with the current best practices of increasing the profits of the space sector to benefit national economies. In the second chapter, the developments in the space sector and its governance in Latvia are described. The third chapter gives an overview of the benefits of ESA (European Space Agency) membership for Latvia, with some best practices of interaction between a comparable regional actor (Estonia) and ESA. In the fourth chapter, an analyses the progress of Latvia towards ESA participation is presented. The last chapter outlines recommendations and provides a roadmap for the future development of Latvia`s space sector.

DEVELOPMENTS IN THE SPACE SECTOR AND THE FUTURE OF SPACE ECONOMY

1. GENERAL CONTEXT

The size of the space economy is far larger than many may think. In 2015 alone, the global market amounted to $323 billion (€291 billion). It can be hard to disaggregate how space benefits particular national economies, but in 2009 (the last available report), the Federal Aviation Administration (FAA) estimated that commercial space transportation and enabled industries **generated $208,3 billion** in economic activity in the United States alone.

The total global revenue of the space sector in 2016 amounted to $344,5 billion (€310,4 billion), of which the satellite industry accounted for $260,5 billion (€234.7). Satellite services and ground equipment accounted for around ¾ of the total revenue[6]. This reflects the fact that most of the revenue generated by the sector is grounded in activities related to communication/navigation, which is supported by the steady rise in devices needing navigation equipment, as well as increased cost-efficiency of the space satellites vis-à-vis their terrestrial alternatives. This is expected to give access to massive, underserved global markets, with resulting strong returns[7].

The global satellite industry revenues have been growing consistently since 2007.

[6] SIA (2017). *State of the Satellite Industry Report*. October 2017. Prepared by Bryce space and technology.

[7] Bryce (2017a). *Global Space Industry Dynamics*. Research Paper for Australian Government Department of Industry, Innovation and Science by Bryce Space and Technology, LLC.

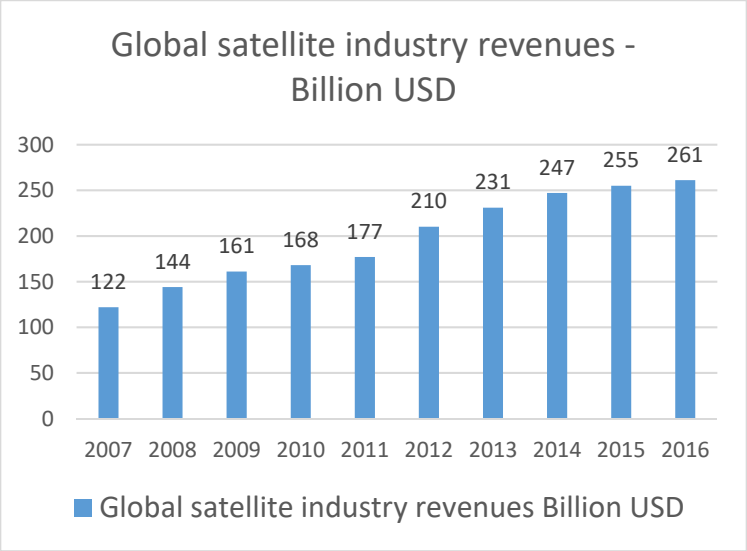


FIGURE 2. GLOBAL SATELLITE INDUSTRY REVENUES. SOURCE: SIA 2017.

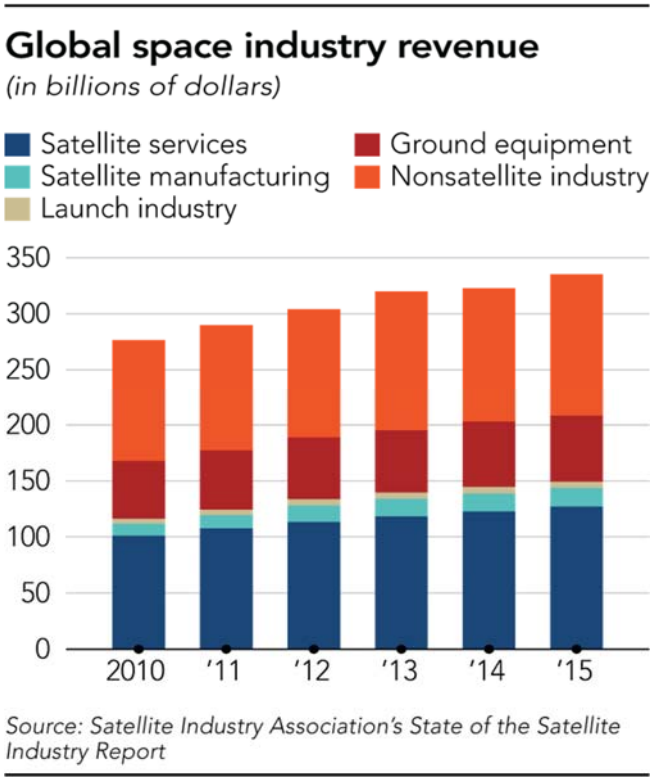


FIGURE 3. GLOBAL SPACE INDUSTRY REVENUE

Other sub-sectors also experienced increase in revenues - in 2016 the biggest growth was in the ground equipment sector – 7% (Growth in GNSS and network equipment, consumer equipment remaining flat), and the launch industry grew by 2%, while satellite services revenues remained at the previous years' level[8].

In Europe, with similar tendencies dominating the market, the space sector has ensured employment for a larger number of people every year[9].

[8] SIA (2017). *State of the Satellite Industry Report*. October 2017. Prepared by Bryce space and technology.

[9] Eurospace (2016). *The State of the European Space Industry in 2015.* Facts and Figures Press Release – June 2016.

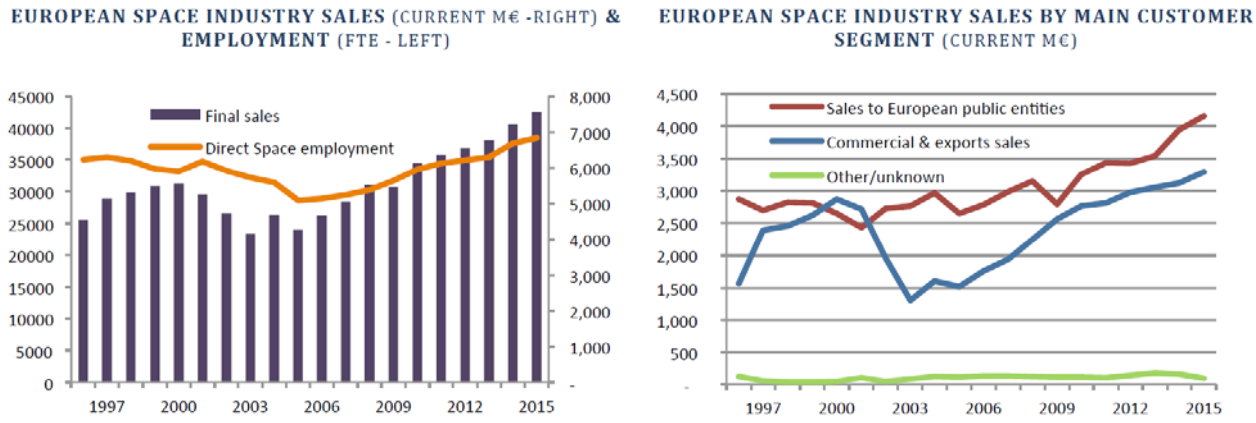


FIGURE 4. EUROPEAN SPACE INDUSTRY SALES AND EMPLOYMENT. SOURCE: EUROSPACE, 2016.

2. EMERGING MARKETS AND SMALL STATES` STRATEGIES

Different sub-sectors of the space sector have various barriers, expected returns and potential for growth. A recent overview by Bryce (2017) compared *mature* space markets (where the barrier to entry is high and the returns are high) to the *emerging* ones (where the barriers are low and the market is small, but the potential returns remain promising). The subsectors most relevant for both groups are depicted in Figure 3. Of note are the last three in the list, all of which have either direct (small satellite launch and manufacturing) and indirect (EO driven data analytics) connections to the subfield of small satellites.

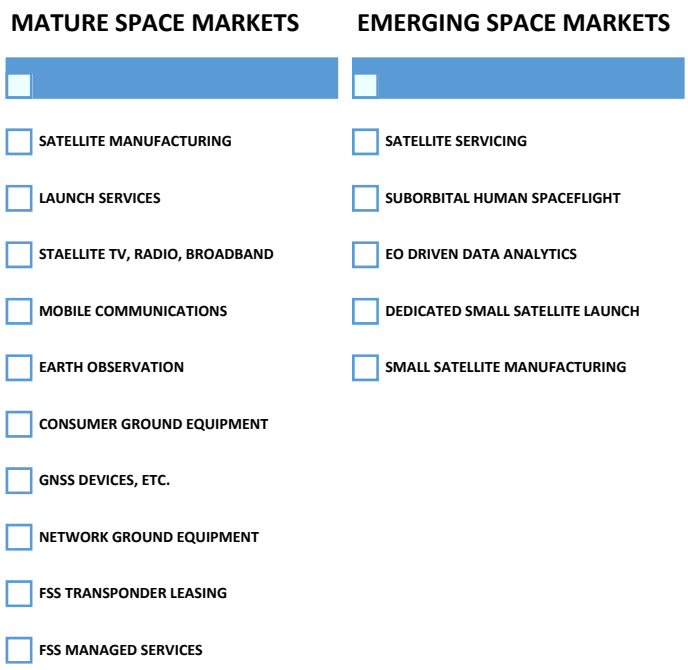


FIGURE 5. EMERGING SPACE MARKETS (BRYCE 2017A)

The market of small satellites is growing and has a potential for small states Latvia and Estonia.

The market of small satellites is growing and seems to have a potential for small states, like Latvia and Estonia. It is an emerging field that does not require massive investment as most other sectors in the space economy do. Arianespace, being the dominant commercial launch service provider, might become a potential carrier for the satellites to orbit, making it easier and more cost-efficient to engage with this sector[10]. The data being gathered by present and future small satellites also needs innovative analysis methods and applications, **driving innovation in sectors such as ICT and big data analytics.**

[10] Bryce (2017a). *Global Space Industry Dynamics*. Research Paper for Australian Government Department of Industry, Innovation and Science by Bryce Space and Technology, LLC.

3. BEST PRACTICES OF ADVANCING THE SPACE SECTOR FOR THE BENEFIT OF NATIONAL ECONOMIES

Despite all the promise that this sector offers, there are important barriers that can prevent full participation in the space economy. These include high capital requirements, technology risk, and longer development timelines. **Public–private partnerships are common in the space economy and can be an effective method for overcoming these barriers[11].** Therefore, the government has an essential role to play in advancing innovation through the space sector. Public-private partnerships usually include some co-investment between government industry and/or government anchor tenancy, in which the government agrees to procure sufficient quantities of a commercial space product or service needed to help ensure that the commercial venture is made viable. These have been seen as particularly important approaches to encouraging the private sector to invest in space-based capabilities.

It is important to note that this is not charity but instead can be a wise investment. As pointed out by Bryce (2017), downstream applications (space-enabled products or services) offer the potential for high economic returns for a relatively low level of government investment.

The involvement of the government in space activities makes the most sense if the government has a clear understanding of the exact sub-sector of the space economy it wants to develop by becoming a key customer. This, in turn, usually depends on the country's capabilities and ambitions. That is why a **comprehensive and objective analysis of a country`s space potential**, executed in alignment with the dynamics of emerging space markets and other global economic trends, is **essential for a development of effective space governance[12].**

For countries seeking to build up a domestic space capability, working with established space powers has proven to be a successful pathway. Such international cooperation might

[11] Bryce (2017b). *Global Space Strategies and Best Practices*. Research Paper for Australian Government, Department of Industry, Innovation and Science by Bryce Space and Technology, LLC.
[12] Ibid.

take the form of agreements between governments to pursue a specific mission or set of missions[13].

Cooperating with foreign companies, e.g. in the field of building satellites, has proven to be a useful practice for newcomers to the field. The Korea Advanced Institute of Science and Technology (KAIST), a publicly funded research university, built South Korea's first satellite with hands-on assistance from Surrey Satellite Technology Ltd. (SSTL) of the UK (2013). **Regional cooperation has enabled European nations to collectively become global space leaders, through the ESA[14].**

Most countries do not actually have the resources to develop a full range of space capabilities (launch, satellite building, navigation, downstream applications, etc.). Consequently, many countries tend to choose a specific field, where they already have some expertise built, and focus on developing it. As a rule, countries usually do not attempt to build some specific space capability from zero, especially if it is launch-related. **Smaller countries developing their space sector (such as South Korea, the UAE, Israel) have had better success with growing an independent satellite and component manufacturing capability[15].** The payoffs come in the form of economic diversification and potential export revenues.

While some countries have dedicated space agencies located in the Ministries of Education, the leading countries in space exploration and R&D - such as the UK, Luxembourgh, Canada - have it under the Ministry of Economics. Additionally, sometimes the space governance is supervised by the Ministry fo Defense (France) or by the federal government (Germany).

[13] Ibid.
[14] Ibid.
[15] Ibid.

ANALYSIS OF THE LATVIAN CONTEXT

1. DEVELOPMENTS IN SPACE GOVERNANCE IN LATVIA

Latvia began to make an active effort to govern space policy in 2009, when the leadership of the Ministry of Education was assigned the task of developing space policy. The Ministry of Education is the primary contact point between Latvia and ESA (24 organizational visits took place between 2009 and 2013). As a result of these efforts, in 2013 Latvia signed the Cooperating States Agreement (Plan for European Cooperating States – PECS Charter). PECS is a 5-year program of basic research and development activities aimed at improving the nation's space industry capacity. At the end of the 5-year period, the country can either begin negotiations to become a full member state or an associated state or sign a new PECS Charter. **Thus, 2018 is an important year for Latvia, as it should decide whether it should continue on as PECS country or if it should pursue ESA membership.** In the framework of PECS, Latvian companies have submitted bids and carried out 27 projects, while other space related institutions participated in collaborations within different ESA initiatives.

In 2010, the Space working group was established under the Ministry of Education and Science, consisting of 15 members (representatives of ministries, private sector and scientific institutions). The working group has focused on promotion of the implementation of the Cooperation Agreement between Latvia and ESA. This includes assuring cooperation and dissemination of scientific and technical information on space science, space technology and its applications in support of communication and coordinated action between research institutes, government and industry. The working group has also sought to encourage participation of research institutions and commercial companies in the European Space Agency and other R&D programmes.

The other participating ministries in the Space working group include the Ministries of Transport, Defense and Economics and the Investment and development Agency of Latvia. As of now, there is no specific budget dedicated to space research and development activities, instead they are supported through various frameworks (planned by the Ministry of Economics and implemented by the Ministry of Finance), such as Competence centers (R&D), Clusters (Internationlaisation) and Business incubators (Starting the business).

The main documents adopted in the process of building institutional capabilities of Latvia in the space domain were the *Space Strategy* (2012) and the *Latvia 2030 Strategy* (2010).

The former provides an in-depth examination of Latvian space potential and outlines the action plan for its realization, focusing on establishing firm connections between academia, businesses and public officials, as well as aiming at Latvia joining ESA in 2018 as a necessary prerequisite for making the country competitive in the European space research and development arena.

The main centre catering to and advocating for the interests of space related businesses has been the Cluster of Space Technologies and Services Sector, a structural unit under the Ventspils High Technology Park. Research prior to the creation of the Cluster was carried out in 2008 and resulted in an agreement between a number of Latvian enterprises and research organizations in 2009 to create the Latvian Space Technologies Cluster. The initiator of the Space Technologies Cluster was the Ventspils High Technology Park and it grew to include 44 other organizations In 2017 the Space Cluster joined the association of Green and Smart Technology Cluster, thus, becoming independent of the Ventspils High Technology Park.

Upon launching the Space Cluster in 2009, a Space Technologies Cluster strategy, action plan, and organizational model were elaborated. There however have been several challenging developments as regards to space governance in Latvia since the adoption of the Space Strategy in 2012.

- Firstly, **the focus for support and development of the Latvian space capabilities was never defined**. The niche profile of Latvia in the space sector is still not identified. The role of the state (as defined in the Space Strategy) is rather vague, and there is a considerable lack of political will to provide a clear framework for support of space activities in Latvia, or to proceed towards ESA membership. This is augmented by the fact that no comprehensive evaluation of current Latvian space capabilities or cost-benefit analysis of PECS participation or prospective ESA membership have been conducted.

- Secondly, there is a need for a public discussion on the role and connection of the space sector to the Latvia`s Smart Specialisation Strategy (Space was not included into the S3 in 2015). The EU`s contribution to Space (1.01 mln EUR) was estimated to be roughly equal to Biotechnologies, and bigger than to Materials (both were included into the S3)[16]. Furthermore, the space activities` success in FP7 Programs was higher than the EU average (35% LV success rate vs. 29% as an EU average). Despite these facts, Space is not mentioned in the Latvian Smart Specialisation Strategy, which makes it harder for space researchers to secure funds. **Lack of inclusion in Latvia's smart specialization strategy hinders development of its space sector by placing barriers to receiving funding, as compared to other sectors[17].**

[16] Latvia`s Smart Specialisation Profile, 2015

[17] Ibid.

! Third, unlike in other countries, space policy development has remained under the Ministry of Education, and not the Ministry of Economics. This has contributed to the relative lack of appreciation for the economic potential of the space sector. This is illustrated by the fact that the payment of membership fees (the last step necessary for ESA accession for Latvia) were postponed two times (in 2014 and 2015), which ultimately precluded Latvia from joining ESA when it was possible. **The positioning of space issues under the Ministry of Education ultimately makes space technology developers compete for the same funding with educators.** Space activities are still perceived more as a liability for Latvian economy, rather than as an opportunity.

2. DEVELOPMENTS IN LATVIAN SPACE CAPABILITIES

According to Latvia`s Minister of Finance Dana Reizniece-Ozona`s speech during the European Planetary Science Congress in Riga in 2017, Latvian economic growth has to be more sustainable. There is a pressing need to increase productivity and added value manufacturing, especially given that at the moment more than 60% of manufacturing is classified as "low tech". Latvia indeed has one of the lowest research and development expenditures among the OECD countries, ranking 34th out of 35 countries with only 0,4% of GDP spent on R&D (OECD 2016).

Despite modest achievements so far, the Latvian government has set ambitious goals for the further development of space capabilities. A comparison of indicators (2013 versus expected for 2022) is presented in the table below.

	2013	2022
Space related technology turnover, MLN EUR	**3.98**	**14.50**
Export volumes, MLN EUR	**0,39**	**>2**
Jobs	**107**	**375**
Patents registered annually	**2**	**5**
Value added, mln EUR	**1.62**	**6.60**
H2020 proposals, successful vs. submitted	**5/34 (14.7%)**	**12/70 (17.1%)**

One of the major determinants of how Latvian space governance should proceed is the country`s performance under PECS. **Despite this, currently, no official evaluation study has been conducted, and only superficial conclusions can be made, which further underscores the need for a comprehensive evaluation.**

In terms of PECS performance, Latvia has focused primarily on Earth Observation (72%) in its participation, as well as on Education (23%) and Space technology (5%) (ESA PECS 2015). Altogether 27 projects submitted by Latvian companies under PECS were successful. The most active contributors from the Latvian side are:

Company	Project/s
Institute of Wood Chemistry	Rigid polyurethane foams for internal tank insulation for launcher upper stages; Light Weight Polyurethane Insulation for the Bulkhead of Arianne Rocket, produced with next generation Blowing Agents and Environmentally Friendly Catalysts

Riga Technical University	Development and Validation of methodology for assessment of damage to sandwich structure of European Space sector; Development of prototype for autonomous aerospace vehicle for comprehensive monitoring
University of Latvia and Ventspils Technology College	Evaluation and development of linear electricity converters with hydraulic or acoustic coupling & Ground station infrastructure development
Institute of Electronics and Computer Science	Dynamic land use monitoring by fusion of satellite data
Baltic Scientific Instruments	Development of miniature gammaspectrometre for remote sensing applications
Eventech	Event Timer for space missions
RD Alfa	Development of microcircuits for application in ESA missions
Institute of Environmental Solution	Simulation of sentinel-2 images

As for a more general assessment of Latvian space capabilities and areas of specialization, according to the most recent analysis (2013) based on the feedback from the Latvian authorities and businesses, Latvian R&D actors have relatively better achievements in space technology in the following primary market areas:

- Earth station systems and networks;
- Flight dynamics and GNSS;
- Space-based systems software;
- Mission and the earth system;
- On-board data systems;
- Life and operation of the equipment system.
- Derivative technology market.

Despite the many Latvian companies specializing in this area, the turnover and the number of companies in each of them remains small.

Based on the acquired international experience and contacts in space industry of Latvian companies (e.g. the Baltic Scientific Instruments co-operation with ESA, IWC research activities and materials production at EADS Astrium, Sattelite Laser Station equipment supply for China, Russia and other national partners), it can be concluded that Latvia has overall competence in the following fields:

1) Start equipment development, design and manufacture of space and delivery services (IWC manufactures cryogenic insulation materials that are used in the Ariane 5 launcher)

2) The space operating system development and production (including satellite systems - VeA and VHTP functioning satellite "Venta-1" in the development of space exploration and science system - AI LU, LU GGI);

3) Earth systems and related services, located on the Ground (VSRC, LU AI);

4) The space technology and assets related products and services (satellite service providers, manufacturers and developers - RD Alfa, Hansa Electronics Ventspils Electronics Factory, Baltic Scientific Instruments, Neomat, Dynamic Research, Jana Seta Map Publishers, LU GGI, LU AI LU FI, EDI, research project implementers - LGIA, Forest Owners Consulting Center, GeoStar IT Observer, University of GGI, LU AI, LU FI, IWC, VSRC, LU FGES).

The two main centers for space sector development are Riga and Ventspils.

Educational capabilities of Latvia have also been developing in the recent time period, building a base for scientific excellence in space technologies research. The following programs have been established:

- Ventspils University College Courses "Cosmic IT" and "Digital Cartography and GIS" program "Computer Science" program
- Courses "Signal Theory and Processing" and "Sound and image transmission principles" program "Electronics" program
- Latvian University of Geography and Earth Sciences Study Course "Geographic Information System" program "Environmental Science" program
- The course "Earth Science" program "Geology" program
- Riga Technical University Courses "Gobal pozicionāšanas system" and "Geographical Information Systems" program "Geomatics" program
- Courses "Satellite communications and radio-relay lines" and "Global Navigation Satellite System" program "Transport Electronics and Telematics" and "Computer Management, Information and Electronic Systems" program
- Transport and Telecommunication Institute Sections of global navigation systems and traffic organization of bachelor programs in electronics and electrical engineering within.

As for the infrastructure, the industry has a number of space technologies of world importance: Irbene VIRAC holding the 32-metre, fully steerable parabolic antenna (radio telescope RT-32), which is the largest in Northern Europe Eastern, the other, 16-metre parabolic antenna (radio telescope RT-16) has renewed its activity in 2010. On the basis of this infrastructure a satellite technology station was established in Ventspils.

THERE IS A NEED TO CONDUCT A STUDY ON LATVIAN PERFORMANCE UNDER PECS (Plan for European Cooperating States)

PROSPECTIVE BENEFITS OF ESA MEMBERSHIP

«...Space technologies produced the biggest number of new commercial products in this timeframe [1990-2016] in Europe»

There is no way to achieve fast economic growth and high-tech developments without:

a) putting Latvian researchers and developers in equal conditions with other EU states (Latvia being the only EU state without ESA membership) and

b) initial investment into their product development.

It is rather usual that space topics are framed in the media as exclusively related to "science" – technical advancements, breakthroughs, discoveries achieved by space exploration missions. This, of course, helps to popularize STEM disciplines among the youth, however, it does little to convince the political leadership that space research and entrepreneurship are expected to become important drivers of economic growth in Western countries[18], with already documented large spill-over effects into sectors of computer technology, environment and resource management, health and medicine[19]. For example, ESA analysis shows that already in Europe, technologies developed and utilized in the space sector were resold and employed in air purification systems in hospital intensive care wards, medical automated surgery, radar surveying of tunnel work to improve safety of miners, and improved materials for a variety of sporting products[20]. Following the introduction of ESA Business Incubation Centres in 2003[21], space technologies officially produced the biggest number of new commercial products in this timeframe in Europe[22]. At the end of 2017, 18 ESA BICs in 15 European countries support yearly 140 start-ups. More than 500 new start-ups have been fostered creating thousands of new jobs and boosted regional economies.

[18] OECD 2017
[19] NASA 2016
[20] ESA 2016
[21] ESA 2018
[22] Szalai, B, Detsis, E, Peeters, W. ESA space spin-offs benefits for the health sector. Acta Astronautica. 2012;80:1-7.

Several more ESA BICs are under preparation.

ESA BIC	Country
ESA BIC Noordwijk	ND
ESA BIC Darmstadt	DE
ESA BIC Lazio	IT
ESA BIC Bavaria	DE
ESA BIC Harwell	UK
ESA BIC Wallonie Redu	BG
ESA BIC Flanders	BG
ESA BIC Sud France	FR
ESA BIC Barcelona	ES
ESA BIC Portugal	PT
ESA BIC Madrid Region	ES
ESA BIC Sweden	SW
ESA BIC Prague	CK
ESA BIC Austria	AU
ESA BIC Ireland	IE
ESA BIC Switzerland	SD
ESA BIC Estonia	EE
ESA BIC Finland	FI

Therefore, there is a general consensus that the space sector is innovation-dense and paramount for economic growth. However, in the Latvian context, numerous concerns have been voiced by the scientific community about repeated postponement of the decision to pay the membership fee (EUR 1.3 mln) by the Latvian government due to budgetary constraints[23], and, arguably, failure to comprehend the role of space sector in the modern economy and logic of its development.

The criticism legitimately pointed out that **there is no way to achieve fast economic growth and high-tech developments without**:

a) putting Latvian researchers and developers in equal conditions with other EU states (Latvia being the only EU state without ESA membership) and

b) initial investment into their product development.

[23] LSM 2015, http://www.vatp.lv/en/lsmlv-sandra-kropa-space-not-black-hole

FIGURE 6. ESA MEMBERSHIP

ESA has 22 Member States, marked in dark grey. The national bodies responsible for space in these countries sit on ESA's governing Council: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom.

Marked in mid grey: Canada also sits on the Council and takes part in some projects under a Cooperation Agreement. Slovenia is an Associate Member. Seven other EU states have Cooperation Agreements with ESA: Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta and Slovakia.

Negative examples illustrating each of these points are:

a) reported postponement of realization of the project between the Latvian State Institute of Wood Chemistry and the industry giant Airbus on the development of cryogenic isolation materials for spacecrafts, because Latvian researchers are not entitled to the same advantageous terms as their EU counterparts, and

b) continuous brain-drain of young space researchers from Latvia to Estonia which provides more advantageous conditions for those involved in the space sector.

To summarize, the risks of remaining a non-member of ESA for Latvia are as follows:

- Direct financial damage from not participating in ESA calls and not receiving contracts for developing products;
- Continued unawareness and lack of access to the newest space technologies and data, gathered by ESA;
- Lack of experience of national researchers in European-level competition;
- Resulting absence of connection with European space sector professionals;
- General inability of Latvian space sector to compete on the European level;

- Stagnation of other innovation-driven sectors as compared to other EU countries (whose space sectors consistently contribute to their economies).

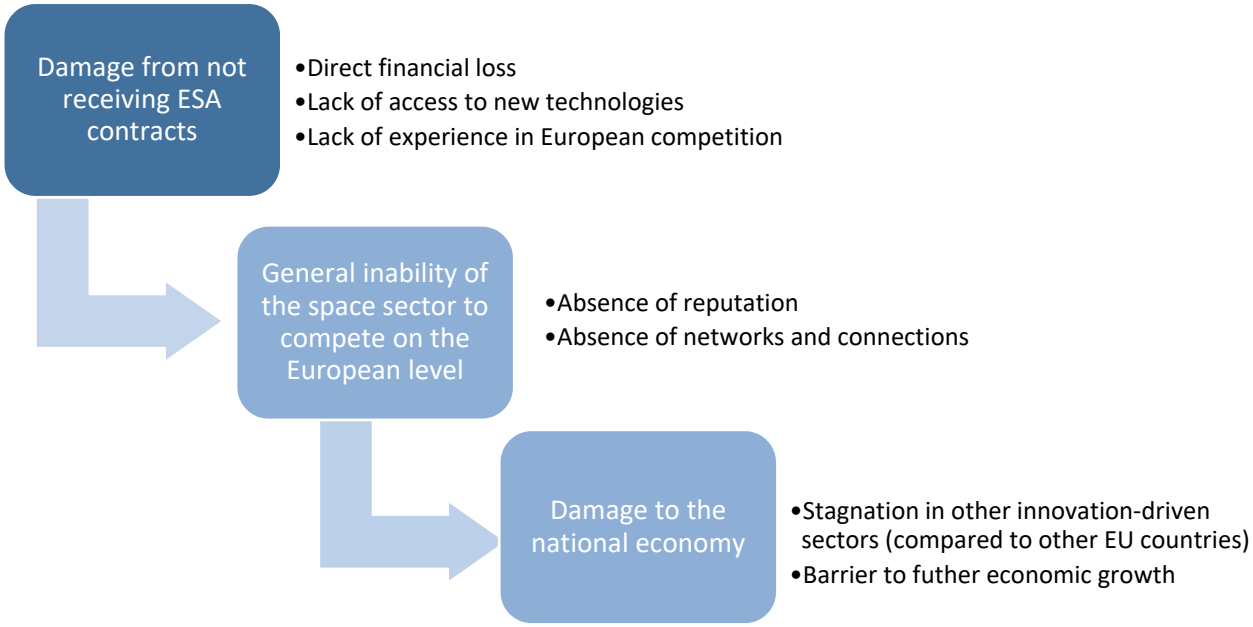


FIGURE 7. RISKS OF REMAINING A NON-MEMBER OF ESA FOR LATVIA

On the other hand, the **benefits from joining ESA** reach beyond simply mitigating risks, and offer a wide spectrum of opportunities for national researchers, businesses and the public sector:

⇒ **Competitive advantage for the national economy.**

ESA is the lead agency in Europe for space missions and other space-related projects, as well as for the overall development of the space industry. It has a clear role in developing and implementing major European projects such as the development of the EU's satellite network (Galileo, Copernicus), Arianespace launch vehicle development and others. That is why ESA has the most extensive access to the most promising developments and application methodology of the space technology area. ESA membership ensures the earliest access to the relevant technology, and this, in turn, creates a competitive advantage in the ESA Member States, which participated in the areas of project development and implementation.

⇒ **Access to ambitious European space projects, and technological advances achieved in these projects can be applied in various spheres of societal life.**

For Latvia, it can be argued that Earth observation presents the biggest opportunity to apply global solutions (enabled through ESA participation) on a national scale, as Earth Observation is most widely used in preventing natural

catastrophes and disaster mitigation (Guo 2010). In addition to that, Earth Observation is successfully used for more efficient land cover/land use mapping, carbon biomass assessment, food security, management of water resources, ocean and health and air quality (Kansakar & Houssein 2016). It also has additional applications in agriculture and forestry. Estonia, as a country comparable to Latvia in terms of space and economic capabilities, chose to participate in the Earth Observation Envelope Program (EOEP) with a view to apply its possibilities in disaster management and agriculture.

⇒ **Financial gains.**

ESA is practicing an *industrial return* or *fair compensation policy*, which means that each member state is guaranteed that all of its financial contribution to ESA will be returned in the form of procurements/contracts with national manufacturers. Therefore, there is a direct financial gain for each participating state from receiving ESA contracts.

Considering the PECS/Full membership fee ratio, the full member financial contribution is only marginally bigger than the cooperating state contribution (which Latvia is already allocating).

⇒ **Special instruments to build national space capacity.**

Each new member state is offered a special program (Industry Incentive Scheme, ESA IIS), through which ESA helps to prepare local industry to become competitive in the European space market. Therefore, through membership in ESA, each participating state is making their industry more attractive for investments and more innovation-dense.

ESA IIS is principally a preparatory phase for the target country organizations, in order to prepare local industry to be more competitive in European space market, in terms of participating in wide scope of ESA programmes and projects under the chosen programmes. Each member state participates in mandatory activities, which is the Science Programme, but can also participate in additional programmes on an optional basis.

ESA also continuously establishes Business Incubator Centres (BICs) in selected countries, aimed at supporting starting space entrepreneurs through offering them network and financial support of ESA.

Estonia successfully became the most recent country-host for an ESA BIC.

Therefore, national companies and start-ups will receive opportunity, training and necessary funding to participate in the European scale projects, which will give an additional boost to economy.

ESA has also supported technology transfer initiatives in certain ESA Member States through the National Technology Transfer Network Initiative (NTTI). Currently four countries have national technology transfer initiatives:

1. The Belgian Space Technology Platform
2. Space Technology Transfer Norway
3. Czech Republic Technology Transfer Programme
4. Hungary Technology Transfer Programme

National initiatives focus on their respective countries and facilitate transfers by matching requests for specialised technologies from the national non-space sector with technology descriptions provided by the national space industry. The NTTI also addresses the need for funding and other support and may involve local companies to provide this.

Technology brokers, part of the Technology Transfer Network (TTN), are the contact point between TTPO and the national initiatives. As can be seen in figure 9, there are currently no brokers in the region extending from Poland up to Finland.

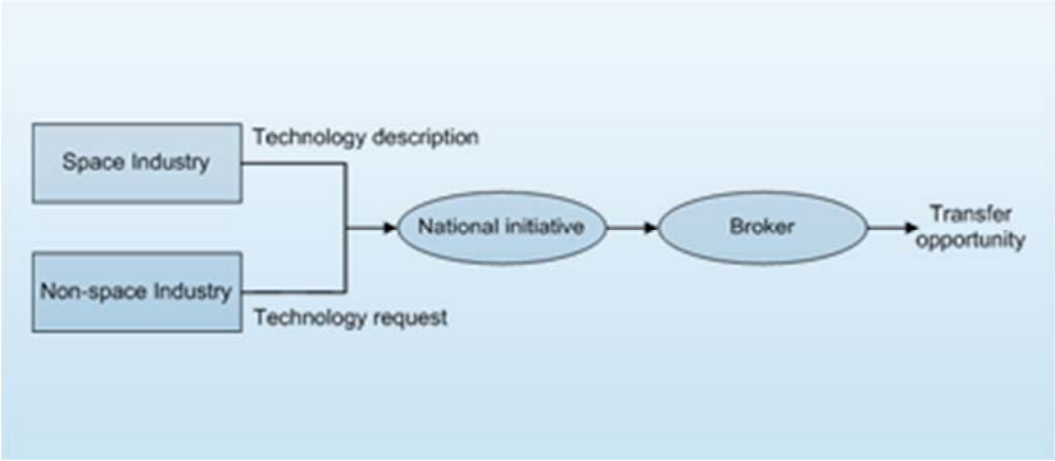


FIGURE 8. TECHNOLOGY TRANSFER PROCESS

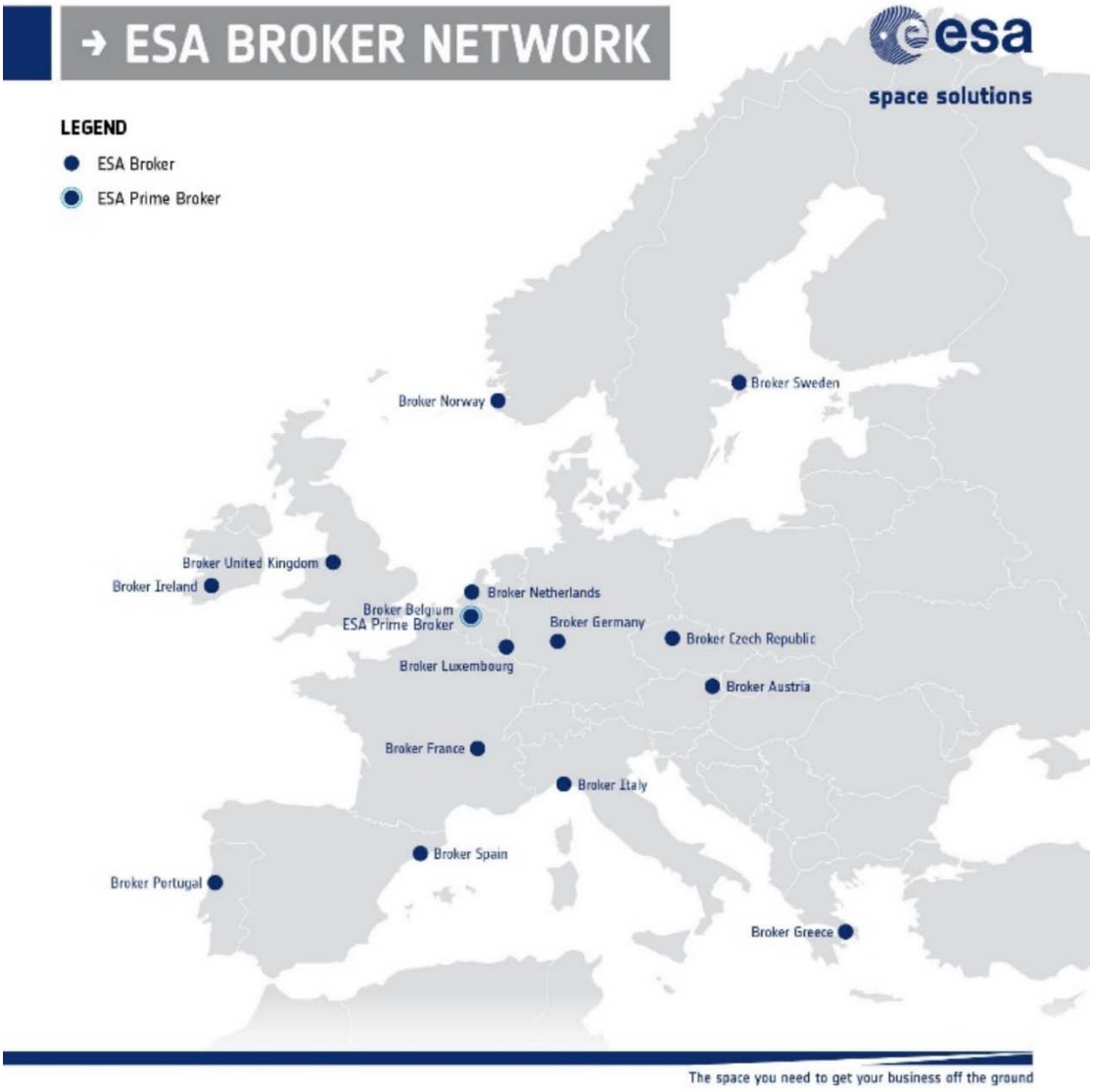


FIGURE 9. ESA BROKER NETWORK

⇒ **Access to European Data Collection Systems.**

Being a full member of ESA gives access to European wide data collection systems that can be used for national purposes (Collaborative Data Hub, Copernicus Sentinel Data and Service Information, etc.). These databases mostly contain information collected through ESA satellites, and which can be used for a variety of purposes – from scientific research to risk mitigation and disaster management.

⇒ **Access to a wider set of contracts for national manufacturers**.

According to the experience of European countries, participation in the ESA gives access not only to final contracts within the framework of the cooperation

agreement, but also the perspective of access to a wider set of contracts from ESA and the Member States. An added benefit is the means to develop technologies and products for which there is demand, such as the US, Japan, China and India space technology markets, which are large and growing rapidly.

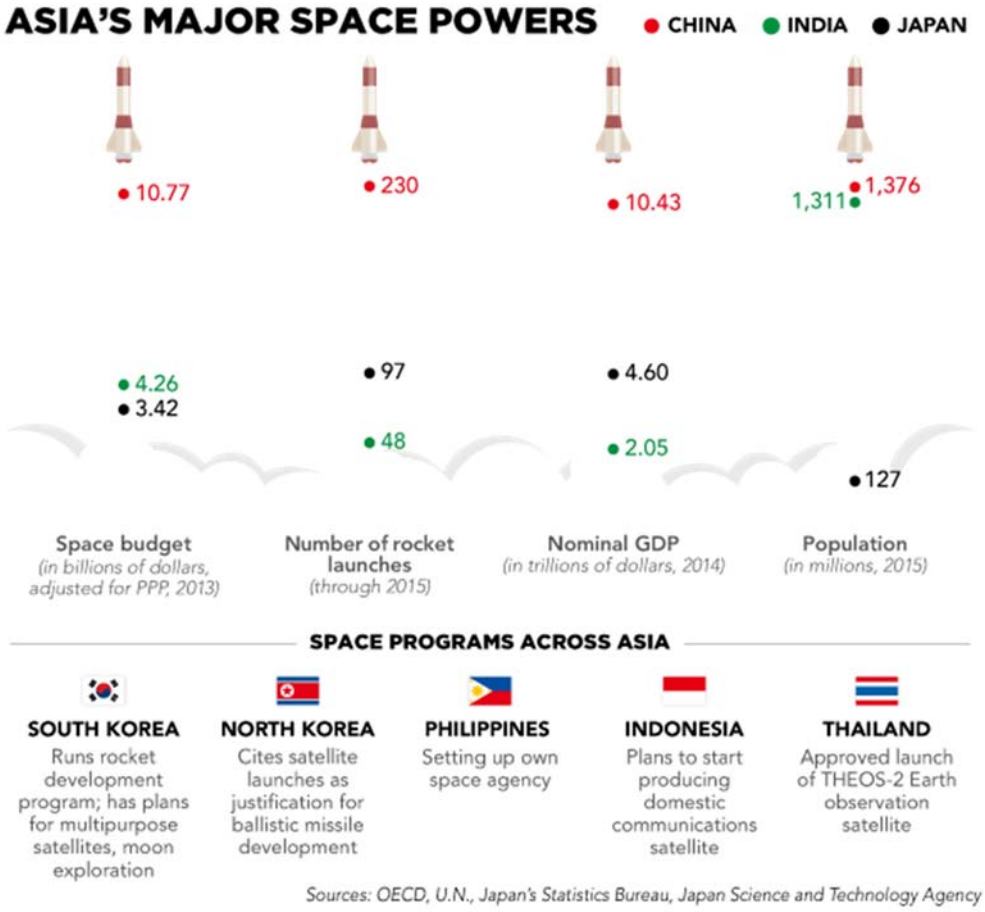


FIGURE 10. ASIA SPACE INDUSTRY (FROM FINANCIAL TIMES, 2018)

⇒ **Better prospects for the future of national economy.**

Space area with its inherent demand prospects is one of the most significant economic and technological growth promoters. In addition to that, development of space technologies in the industry has been documented to produce additional growth and development in related industries, thereby creating a multiplier and spillover effect. This multiplier effect directly translates into GDP growth.

In that respect, participation in ESA ensures a more stable and focused funding for space technology for the development of both research and commercial fields.

⇒ **Better ability to secure big European research grants.**

The exchange of experience and information flows to be expected with the participation in ESA will increase the ability of Latvian researchers to apply competitively and secure large European cooperation projects (Framework projects, Horizon2020), and will also widen their network of professional connections, fostering cooperation with space scientists from other European countries.

⇒ **Access to European level decision making in the space sector.**

With regard to the political aspects of participation in the ESA, it is important to note that the ESA Council (which is the highest governing body of ESA) breakdown of voting rights does not depend on the level of contributions, which means that each Member State, regardless of the scale of its economy and population, has one vote. Smaller countries, like Latvia and Estonia, would have the same political power over the issues of European space development as e.g. France or Germany.

Thus, the **practical benefits to a country for joining ESA** include (but are not limited to):

- Direct financial benefits from procured contracts
- Direct technological and informational benefits from participating in flagship European space projects
- Access to European contracts for national companies
- A long-term possibility to develop technologies and products that would enable Latvian firms to enter larger space technology markets such as US, Japan, China and India
- More innovation in industry
- General technological growth (space sector has proven to be the main industry growth promoter)
- Growth in other sectors, as spin off companies that apply technologies developed in the space sector can benefit medicine, biology, etc.)
- Increased numbers of high- and medium-skill jobs

Recent studies on the multiplier effect (return on investments) in the small member states of ESA showed that, with a few year time lag, all of the analysed countries (Norway, Denmark, Belgium, Ireland) received a return several times higher than their initial investment. In particular, the effect on the national industry and economy was as follows:

- ✓ In Norway, each million euros invested in ESA or national space program has created an **additional EUR 4.4 million turnover**;
- ✓ In Denmark, each million EUR invested in ESA generated **EUR 3.7 million turnover** and in seven years, ESA's projects have **created 192 jobs and related industries - to 350 jobs**;
- ✓ In Belgium, space investment rate of **return amounted to 1.4** in 2010;
- ✓ In Ireland, from **every euro invested in 2012, EUR 3.6** were earned;
- ✓ In Canada, as an associate member of ESA, the rate of **return reached 2.4** in

This is consistent with the consensus of Estonian public officials of the space sector that even a small country can receive a significant return on initial investment and transform cooperation with ESA into stable economic growth. As noted by the head of the Estonian Space Office Madis Võõras, Estonia from the very beginning made it clear that, as a small country, its researchers and developers will not focus on launching spacecraft. This, however, **did not prevent them from creating subsidiary products for space, that could later be used elsewhere, through ESA contracts**.

Apart from direct positive economic effects, a number of indirect effects on the national industry follow from introducing industry support schemes and innovation development contracts from ESA:

TABLE 1. INDIRECT INDUSTRIAL EFFECTS

Technological effects	Commercial effects	Organisation and method effects	Work factors effects
Transfer of technology developed during an R&D programme **Derivatives from ESA products-new products and product improvements**	**Network effects**– new business connections **Reputation effects**- ESA contracts as a marketing tool or a quality badge	Changes to the organizational structure Adoption of novel quality control Experimental procedures, tests and measurement Management methods	Improved qualifications and new skills acquired by involved personnel Spill overs of expertise into the other departments Building up a critical mass of specialists, scientists, engineers and technicians

Source: Cohendet; Evaluating the industrial indirect effects of technology programmes: the case of the European Space Agency (ESA) Programmes. 1997

Regarding the experience of Estonia, a study on the impact of ESA membership on Estonian businesses, conducted by Tõnis Eerme (2013), identified positive impacts in Estonia, which in ratio puts it at the same level with Czech Republic, a full member of ESA since 2008. For example, **four out of six Estonian companies** that have participated in ESA projects which have now ended considered the **technological or financial benefits to be significant**, starting with getting an enhanced reputation. Five companies out of five anticipate benefiting from the collaboration in the future as well, whether by continuing cooperation or in other markets not related to the space industry. Other benefits include increased attention from global investors and support for local business.

Therefore, continuous articulation of importance of membership in ESA in the public debate, as well as collection of evidence to substantiate this claim is an important precondition for a country`s progression on the road to ESA. This can be also achieved through conducting an impact assessment study for Latvian participation in PECS, as compared to full membership in ESA.

LATVIAN SMART SPECIALISATION STRATEGY AND ESA

The development of Latvian economy, especially in growing and emerging fields, is guided by the Latvian Smart Specialization Strategy (RIS3 Final document 2013). The Smart specialization strategy (S3) defines five sectors/directions as most promising for Latvian economic growth:

- ⇒ Knowledge intensive bio-economy
- ⇒ Biomedicine, medical technologies and biotechnology
- ⇒ Smart materials, technology and engineering
- ⇒ Advanced ICT
- ⇒ Smart Energy

These sectors also receive additional financial support through various national frameworks, as well as a priority status in European level competition schemes.

However, the potential of ESA in advancing Latvian S3 areas has so far escaped public attention. An initial study conducted in 2018[24] shows that **ESA ACTIVITIES AND SPECIFICALLY COLLABORATIVE PROJECT OPPORTUNITIES DIRECTLY SUPPORT AT LEAST 3 OUT OF 5 LATVIAN S3 AREAS (see Table 2)**:

- ⇒ Knowledge intensive bio-economy
- ⇒ Advanced ICT
- ⇒ Smart Energy

[24] Conducted by the authors of the report based on the public information available on the ESA platform

TABLE 2. EXISTING ESA PROJECTS IN LATVIAN SMART SPECIALISATION AREAS

*Blue for completed, green for ongoing projects

Knowledge intensive bio-economy	Advanced ICT	Smart Energy
CYMONS FS - CYANOBACTERIA MONITORING SERVICES	HUMANAV-NEXT	TELERETAIL DELIVERY ROBOT
SFEDONA - SATELLITE-BASED FIRE DETECTION AUTOMATED SYSTEM	MAPP-DEMO MARITIME PREVENTION PROJECT (MAPP) DEMONSTRATOR	ORCA (Optical and RF Constellation on Aircraft)
BIRDSTRIKE RISK REDUCTION FOR CIVIL AVIATION	ASTROCAST	UTRAQ - URBAN TRAFFIC MANAGEMENT AND AIR QUALITY
DSE IOT PROJECT - DRYGRO SATELLITE-ENABLED IOT PROJECT GREENSPIN AGRI PLANET	SATAPPS - SPACE TECHNOLOGIES FOR MACHINE-2-MACHINE APPLICATIONS	PIMS
MYFOODS - MICRO YIELDS FOR ASSESSING FOOD SECURITY AND MALNUTRITION (MYFOODS)	UAM® - NICHE MANAGED COMMUNICATION SERVICES USING INNOVATIVE DELIVERY PLATFORMS	WIAP
CERBERUS - FOREST FALCON	MULDIARCOS - MULTI-MISSION DATA AND INFORMATION SERVICE FOR ARCTIC OPERATIONS	INTOGENER
SIITAG - SATELLITE-ENABLED INTELLIGENT INTERNET OF THINGS FOR AGRICULTURE	EFFORS - ENHANCED FLOOD FORECASTING SYSTEM FOR CRITICAL INFRASTRUCTURE PROTECTION IN MEDIUM SIZE ALPINE CATCHMENTS	transparentforests
AGRILOC - ARTES 20 DEMONSTRATION PROJECT – SUSTAINABLE MISSION PLANNING AND SUPERIOR ROUTING OF FARM MACHINERY	DESIRE II - DEMONSTRATION OF THE USE OF SATELLITES COMPLEMENTING REMOTELY PILOTED AIRCRAFT SYSTEMS INTEGRATED IN NON-SEGREGATED AIRSPACE – SECOND ELEMENT	SHARPERSAT
AG|KNOWLEDGE 4.0 - GLOBAL TRANSPARENCY OF AGRICULTURAL CROP PRODUCTION	EMUSER - ENHANCED MULTI-SENSOR DATA HANDLER FOR RAILWAYS	GRIDWATCH FS - MAINTENANCE AND RECOVERY OF HIGH VOLTAGE ELECTRICITY TRANSPORT SYSTEM
SISMA - SPACE INNOVATIVE SYSTEM TO MONITOR ANIMALS	ELECTRONIC MONITORING	THERMCERT - THERMCERT FUTURE CITIES IN RESPONSE TO COMPETITIVE TENDER AO 7974 SPACE APPLICATIONS IN SUPPORT OF FUTURE CITIES

GRAZINGSPACE - SPACE APPLICATIONS USING ANIMAL TRACKING DATA	SMART - SPACE FOR SMART RESOURCE MANAGEMENT FOR DISASTER EARLY WARNING	
KORE - KNOWLEDGE, OBSERVATION, RESPONSE, EVALUATION	INTELLIGENT SENSOR AND SATELLITE NETWORK (ISSN)	
SOLUMSCIRE - SATELLITE AND IN SITU SOIL SENSING FOR AREAL SOIL DATA TO BOOST PRECISION FARMING	3INSAT - TRAIN INTEGRATED SAFETY SATELLITE SYSTEM	
FERTISAT - SATELLITE-BASED SERVICE FOR VARIABLE RATE NITROGEN APPLICATION IN CEREAL PRODUCTION	INSUREAPP SERVICE INSUREAPP SERVICE - THE HAZARD CONTROL ROOM FOR THE INSURANCE INDUSTRY	
DATEGIS DEMO - AN INTEGRATED GEO-INFORMATION SYSTEM (GIS) FOR PRECISION AGRICULTURE OF DATE PALM FARMING	MIMIR 2.0	
HIVACROM - HIGH VALUE CROP MONITORING		
BIOSCOPE		
TALKINGFIELDS - DEMONSTRATION PROJECT ON SERVICES FOR PRECISION FARMING		

The funding available through ESA membership frameworks would be complementary to the already existing national support for the S3 areas. It is estimated that **ESA would bring in millions of EUR to Latvia via projects in the S3 sectors,** further supporting the movement of production in the direction of higher skills and technology.

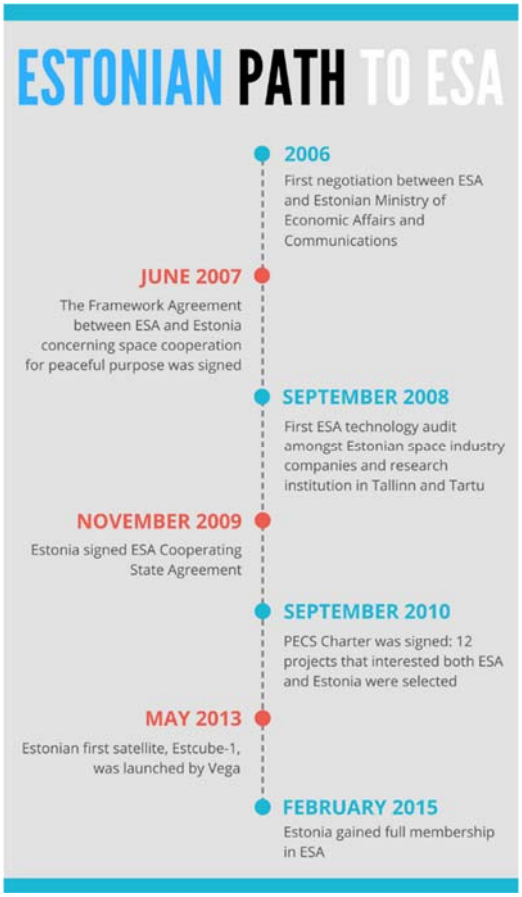
ESA activities are closely aligned with Latvian smart specialization, as the space sector provides challenges and opportunities to develop solutions in areas of advanced ICT, biomedicine, smart materials and smart energy. As was mentioned before, the spillover effects of space activities are significant. Strengthening Latvia`s smart specialization profile through ESA membership is a useful opportunity to engage outside funding and add new cooperation networks for the benefit of actors and sectors engaged in Latvian S3 areas.

ESTONIAN CASE STUDY

To assess approximate benefits of ESA membership on an example of a small European country, an outline of the case of Estonia is presented below.

Box 1. Estonian case study.

THE ESTONIAN SPACE GOVERNANCE CASE: A SMALL STATE WITH BIG AMBITIONS



Estonia began to approach ESA in 2006 in the framework of negotiations between the European Space Agency and Estonian Ministry of Economic Affairs and Communications. In the same year, Estonia started its cooperation with the European Organisation for the Exploitation of Metereological Satellites (EUMETSAT). **In 2010 the Estonian Space Office (EstSO) was created by Enterprise Estonia** to reflect the consensus between the long Estonian tradition in space studies (e.g. Tartu Observatory) with its industrial capabilities and economic interests.

The Framework Agreement with ESA was reached in June 2007 and in September 2008 the first ESA technology audit took place. Estonia signed the Cooperating State Charter (PECS) in 2009, and, as planned, **gained full membership upon its completion, in 2015.**

For the first PECS call in 2010, 36 different projects were presented and 12 of them were selected and funded, while for the second PECS call in 2013, 18 projects were presented and 10 of them selected.

In November 2017 the Estonian ESA Business Incubation Centre (BIC) was opened with offices in Tartu and Tallinn. The BIC will help to transfer technology from space to non-space applications and will support 20 Estonian start-ups over a 5-year period to develop products for terrestrial use. The ESA BIC Estonia Consortium consists of eight governmental and private partners, including:

- Tartu Science Park
- Tallinn Science Park Tehnopol

- Tartu Observatory
- University of Tartu
- Tallinn University of Technology
- City of Tartu
- City of Tallinn
- Fund KredEx

Several factors allowed Estonia to move quickly to full membership:

⇒ The State Space Policy and Strategy were defined already in 2011; **specific areas of economy and production were designated** as those, that would benefit from space technologies (emergency prevention, forestry and agriculture, transport and logistics).

⇒ Consequently, according to these areas, **specific activities in the framework of PECS** and, in the future, ESA, were defined: to participate in European strategic projects GEMS and Galileo, and also encourage companies` participation in all open schemes for funding.

⇒ A study of positive effects of ESA membership was conducted in 2013 and helped to forge internal consensus.

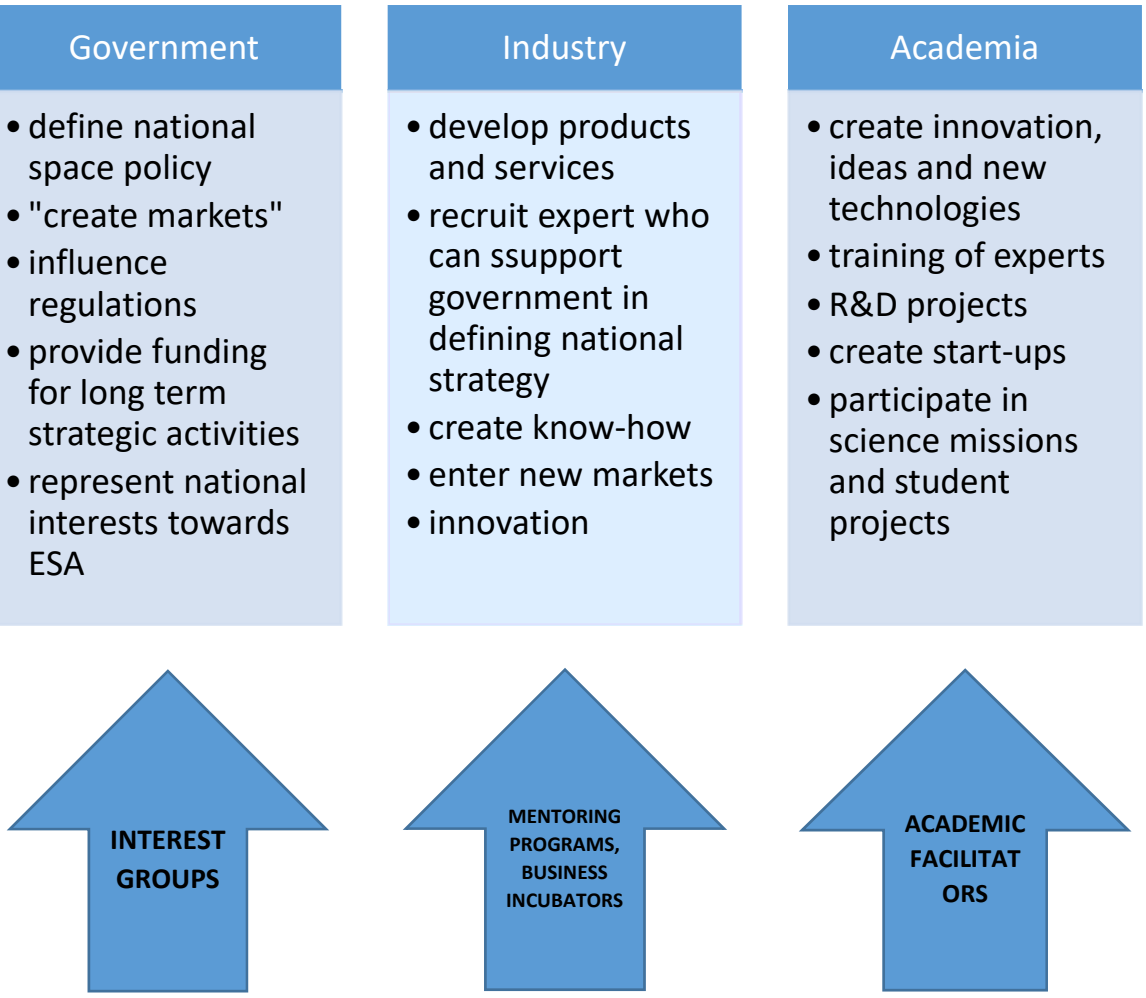
BY 2019 ESTONIAN RETURN-ON-INVESTMENT COEFFICIENT IN ESA WILL REACH **0,85** AND THE SPIN OFF MULTIPLIER EFFECT OF ESA INVESTMENTS WILL REACH **1,5**

The biggest success of Estonian ESA activities has no doubt been the development of the EST-Cube nanosatellite. Its successful launch was an important part of the technological and educational contribution of the Estonian Student Satellite Program. One of its most significant elements was that in 2013 it carried out the first experiment of the electric solar wind sail and plasma brake technology during EST-Cube-1.

EVALUATION OF LATVIAN PROGRESS BASED ON ESA RECOMMENDATIONS

A 2014 report of the European Space Policy Institute on the ESA enlargement in Central and Eastern Europe outlined the instruments main roles that different actors should play in countries seeking to join ESA and advance the space sector in Europe. These suggestions are presented in the figure below:

Figure 11. Pillars for space sector development.



Source: ESA Enlargement in the CEE. 2014

Based on this logic, a set of necessary preconditions for further development of the space sector was suggested to aspiring countries. Latvia`s progress in that regard can be assessed along the lines suggested by ESA, by looking at how well these pre-conditions were implemented by the respective actors from government, industry and academia.

Recommendation	Measure taken
Organization and coordination of space activities – creation of a defined framework for space activities	The government established a framework for space activities in Latvia (under the Ministry of Education), however, the logic of the framework has come under legitimate criticism. Positioning of the space policy development under the Ministry of Education reflects the government`s vision of space as a "black hole" for investment which is not capable of producing profit. Moreover, it makes competition for funding hard, as it forces space businesses to compete with teachers and educators.
National space policy – clear long-term vision	Development of the National space policy of Latvia (2013) can be seen as a major landmark in relations between ESA and Latvia. The strategy gives a comprehensive overview of Latvian capabilities in the space domain and provides a clear set of actions to be taken (conclusion of the PECS charter, conducting an ESA membership impact study for Latvia, surveying needs of young professionals, etc.) and indicators to measure their success. However, there are two main objections to the essence of the strategy: 1) **Its unambitious character**. The ESA membership impact study is scheduled only for 2018, and it would take even more time to disseminate its results to the public and political representatives. 2) **Its lack of defined space sector niche**, as opposed to e.g. Estonian Space Strategy (2011) that clearly defines Earth Observation as one of the focus areas.
Cooperation and interplay between the government, academia and industries	A strong initiative to force cooperation between industry, academia and government in Latvia was established in the form of the Latvian Cluster for Space technologies and services leaded by Ventspils High technology Park. Since 2016 the clustering role is taken over the Latvian Green and Smart Technology Cluster. The main focus of the Cluster`s activities is to assist companies in internationalization and increase competitiveness. In 2018, the Latvian Space Industry Association (Latvijas Kosmosa Industrijas Asociācija) was established. It is planned that the Association will encourage strong cooperation between industry and the government.
Budgetary consolidation	Latvia had an opportunity to join ESA in 2014 and 2015, before signing the PECS Charter. However, these opportunities were missed due to the government`s lack of

	desire to allocate funds for the full membership fees. Coupled by the fact that there is no specific funding for the space sector support schemes, this signifies the lack of budgetary consolidation in Latvia.
Raising public awareness – creation of a "case for space"	Despite a clear action plan laid out in the Space Strategy, arguably the public support and understanding of the space sector potential remain very low. Public bodies like agencies and/or Ministries need to develop and implement a clear action plan to raise awareness of priority business sectors in Latvia. There is a lack of such kind of plan and/or activities.
Following a niche strategy (Latvia as a small economy)	Space sector is still small but is demonstrating high potential in the near future. Funding for R&D and market research activities is critically necessary. Some national level programs need to be defined and opened for industry.
Intensifying educational activities	There is a significant brain drain of graduate students from Latvia to Estonia and other countries members of ESA, as it gives young scientists an opportunity to apply for ESA Innovation support schemes and engage in product development. At the same time, there are well developed opportunities for education and/or research in Latvia – University College of Ventspils, Riga Technical University, University of Latvia, Institute of Transport and Communication.
Establishing Cluster and technology Platforms	As was mentioned above, the Latvian Cluster for Space Technologies and the Space Association have been established. To establish further technology platforms, a responsible Ministry needs to be pro-active in using some existing platforms (Enterprise Europe Network or similar).
Communicating with ESA (getting acquainted with its mechanisms – making Latvia known to ESA)	Arguably, the communication between the Latvian contact point and ESA is not active enough. There is a need to take political decision about Latvia's targets in cooperation with ESA and define clear action plan (middle and long term). The responsible Ministry and responsible persons need to be enthusiastic and interested in the space sector.
Cooperation with international partners – also through Institutional Interest Groups	One of the suggested ways for Latvia to encourage the cooperation with international partners was through the European Inter-parliamentary Space Conference - a permanent forum for inter-parliamentary co-operation in space between the European national parliaments interested in space policy. Participation in the Conference`s activities is free, and gives a great opportunity to communicate with other European parliamentarians, as well as experience in discussing space policy issues. Unfortunately, Latvia did not join the EISC and

Active participation in development of European Space Policy	There were 2 discussions in the parliament on the topic of European Space Policy, however, engagement is arguably rather small.
Creation of Incubator Programs	No space related incubator is created in Latvia. Existing incubators and/or accelerators in Latvia are ready to support space sector businesses if demand and a clear business model is available. Latvian Investment and Development Agencies (LIDA) Business incubators in various regions of Latvia are available. Additionally, acceleration funds created by ALTUM are available. There is a lack of a well-defined space related business cases to be supported. Motivation, awareness raising and clear understanding of space sector possibilities are missing.
Offering Mentoring programs for businesses	Mentoring programs are mainly organized by LIDA in Latvia. There is no space sector specific mentoring program. Once in two years there is a space hackathon “Act in Space” initiated by ESA. Clear action plan of activities in space sector need to be defined.

ROADMAP

Based on the state of space policy development in Latvia described above and its cross-comparison with recommendations from the European Space Policy Institute and ESA, the following roadmap for Latvia can be suggested. It addresses various actors (the government, industry, academia) and includes both first-order and second-order activities.

Space governance
⇒ Move the space policy and governance away from the Ministry of Education and place it under the jurisdiction of the Ministry of Economics This point is supported by direct experience of Estonia (Estonian Space Office is located under the Enterprise Estonia) and other European countries. ⇒ Establish a link between the space sector and Latvia`s smart specialization strategy (not necessarily by including it into the S3, but by mentioning in the updated Strategy documents)
Space policy
⇒ Establishing a clear timeframe for joining ESA ⇒ Defining the niche potential of the Latvian space sector ⇒ Defining overall objectives for the space sector ⇒ Engage with discussions on European Space Policy
Engagement with interest groups
⇒ Joining the European Interparliamentary Space Conference and participating in its activities
Engagement with ESA
⇒ Establish and enforce one concrete contact point for communication with ESA ⇒ Appoint one ambassador to the government and one to the parliament to advocate space affairs on both levels
Cooperation with industry and academia
⇒ Order an assessment of the impact of PECS on the Latvian economy ⇒ Order an impact study of ESA membership vs. PECS for Latvia

Support for businesses
⇒ Motivation/Mentoring program for space industry (campaigns, hackatons, space weeks etc) ⇒ Support programs for companies (R&D and market access) ⇒ Active and motivated space sector representative from Latvia (Ministry, Agency) ⇒ Close cooperation with ESA

CONCLUSIONS

To reiterate, the report suggests to:

1. Establish a clear timeframe for joining ESA
2. Update Latvian Space Strategy, establish realistic goals and niche for LV space sector
3. Formalize a link between the space sector and Latvia`s Smart Specialization Strategy
4. Move space governance to the Ministry of economics
5. Order an assessment of the impact of PECS on the Latvian economy (also vs. prospective ESA membership)
6. Establish and enforce one concrete contact point for communication with ESA

Latvian space capabilities and expertise are competitive on the European level and there is a considerable underused potential for stream-lining space research and businesses with the needs of society and the national economy. The research and cadres produced

by the Latvian academia, as well as the projects executed by the space-related SMEs and businesses, do not lose in comparison with other representatives of the CEE (Central and Eastern Europe) region. **However, the state framework for conducting space activities is rather unfavourable.**

There is a lack of political will to establish such conditions for Latvian entrepreneurs and research that would enable them to compete with other European countries on an equal ground. Latvia does not participate in ESA fully, which impedes implementation of many joint projects and lock the country out of the potential profits.

The space industry in general is still considered to be "unable to produce profit", which explains its positioning under the Ministry of Education, and not the Ministry of Economy.

Additionally, specific areas of space expertise and focused space activities have not yet been defined for Latvia. This would help by pooling together the national space capabilities, streamlining the already existing activities and clearly defining the role, support and responsibility of the state in this area. **For that, a comprehensive evaluation of Latvia`s success in PECS vs. the economic benefits of joining ESA is needed.**

The current point in the development of global space capabilities still provides a window of opportunity for Latvia. Moreover, in the context of the development of the CEE region, the need for Latvia to re-focus its economic activities in a more sustainable, innovation-based way cannot be overstressed. The space sector is a high-technology high-skilled industry which tends to produce a significantly large number of commercial products (that are often used for public sector activities) and whose effects often spill over to neighbouring industries, creating additional jobs and driving the innovation further. It is in the interest of Latvia to reap the potential benefits of maximizing its space industry potential, for the benefit and the well-being of its population.