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Latvia PECS end of period report

DRAFT

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Table of contents:

1 INTRODUCTION.....	3
2 RECAP OF OBJECTIVES	3
3 OVERVIEW OF EVOLUTION OF LATVIAN – ESA RELATIONSHIP	4
4 CURRENT LATVIAN INVOLVEMENT IN ESA ACTIVITIES	6
5 ASSESSMENT OF LATVIAN KEY COMPETENCES	17
6 CONCLUSIONS AND RECOMMENDATIONS.....	25
ANNEX 1: REGISTERED ENTITIES	27
ANNEX 2: PECS ACTIVITIES	30
ANNEX 3: ASSESSMENT OF LATVIAN ENTITIES	33
1 ENTITIES VISITED	33
JSC RD Alfa Microelectronics.....	33
Baltic Scientific Instruments	35
Fiber Optical Solution (FOS)	37
2 OTHER ENTITIES.....	38
Eventech	38
Foundation Institute of Environmental Solutions (IES)	39
Latvian State Institute of Wood Chemistry (LSIWC).....	40
ANNEX 4: RESULTS OF THE 4TH AND 5TH PECS CALLS.....	41
Results of the 4 th PECS Call	41
Results of the 5 th PECS Call	43



1 INTRODUCTION

This report has been compiled in order to assess the current status of the Latvian Space landscape after its first period of the Plan for European Cooperating States (PECS). It is compiled in order to provide inputs to decision makers for the next steps for Latvia / ESA relations after this PECS period. It shall be noted that at the point of the issue of this document, only three PECS Calls have been implemented to the point of contract award. The activities approved for the 4th PECS Call in Latvia have received all the necessary approvals by the Latvian Delegation and ESA Delegate bodies, but are still under negotiation and thus have not been committed. The 5th PECS Call has been evaluated and recommendations have been made by ESA and endorsed by the Latvian Delegation, but these are still pending approval of ESA Delegate bodies. The briefing to industry of the 6th PECS Call took place on July 9th 2019 and the invitation to tender is currently open. Therefore, this report does not include all the Calls nor all the funded activities foreseen until the end of PECS in Latvia. The preliminary results of the 4th and 5th Calls are nevertheless included in Annex 4 and throughout the body of this report.

2 RECAP OF OBJECTIVES

a. PECS

The overall objective of the PECS is to prepare the entities in the country in the most efficient manner for possible future accession to the ESA Convention and to associate the Government of the Republic of Latvia with Agency programmes and activities.

To do so, the following specific objectives of PECS are defined:

1. Create and strengthen the respective industrial expertise and capacity of the Republic of Latvia with a view to allowing a fair and equitable industrial participation in future Agency programmes after accession;
2. To align activities with ESA programmes and activities and provide access to joint Agency/EU programmes, in accordance with the terms and conditions of the applicable legal instruments, while ensuring coherence between the space activities of Member States and the Government of the Republic of Latvia e.g. by avoiding unnecessary duplication;
3. Foster the Government of the Republic of Latvia's understanding of the Agency's organisation and functioning of European space products, standards and procedures;
4. Develop cooperation between scientific and applications user communities in the Republic of Latvia and Agency Member States.

b. Latvian government

Latvia's Smart Specialisation Strategy (RIS3) is a joint ministerial strategy of economic transformation towards higher added-value, productivity and more efficient use of resources, of which the Latvian Ministry of Economy is a major stakeholder. Investment in space technologies fits under three of the five smart specialisation areas defined in RIS3,



namely smart materials, technology and engineering; smart energy; and information and communication technologies.

From this perspective, the priorities defined for the RIS3's Smart Specialisation Strategy¹ can be considered as relevant objectives for Latvia's collaboration with ESA. These priorities are summarised below to describe the parts that are considered applicable in the frame of PECS:

1. A more efficient use of primary products and diversification of their application. This includes non-technological innovations leading to the production of goods and services with a higher added value in the economic sectors;
2. Support industrial growth through the creation of new products and technologies within the framework of existing sectors and cross-sectors, as well as in new sectors with high growth potential;
3. An increase in energy efficiency, including the development of new materials, optimization of production processes, introduction of technological innovations, and use of alternative energy;
4. A modern and up-to-date ICT system in both the private and public sector;
5. A modern education system able to respond to future labour market needs, which promotes the transformation of the national economy and the development of competencies, entrepreneurial ability and creativity;
6. Advanced knowledge base (basic science and scientific infrastructure) and human capital in areas of knowledge, in which Latvia has a comparative advantage and which are important in the process of transformation of the national economy. This includes key technologies identified by the European Commission (nanotechnologies, micro- and nano-electronics, photonics, advanced materials and manufacturing systems, biotechnologies);
7. Study of the existing resources of different territories, supporting their economic development.

3 OVERVIEW OF EVOLUTION OF LATVIAN – ESA RELATIONSHIP

After an initial cooperation agreement on 23th July 2009, Latvia signed the ECS (European Cooperating State) agreement with ESA on 15th March 2013. This agreement entered into force with the signature of Latvia's PECS Charter on 30th January 2015, which has a duration of 5 years.

Latvia's interface with ESA is through the Ministry of Education and Science. As of 1st October 2018, Latvia has one Young Graduate Trainees (YGT) in ESA working at ESTEC in the Directorate of Human and Robotic Exploration, within the Research and Utilisation group.

From the signature of Latvia's PECS Charter to May 2019, 3.25 M€ have been returned to Latvia by means of 27 PECS Contracts. Six (6) additional projects have been approved for

¹ http://www.izm.gov.lv/images/zinatne/RIS3_ENG/Appendix_4_RIS3.pdf



implementation under the 4th PECS Call, representing 991 k€ in commitments, and are currently under negotiation. Six (6) more projects have been recommended for implementation under the 5th PECS Call, amounting to a total amount of 839 k€ in commitments, and will be submitted for approval to the relevant ESA Delegate Bodies in the second half of 2019. The complete list of committed and foreseen Latvian ESA activities is including in Annex 2: PECS activities.

The spending rate in Latvia has fluctuated significantly throughout the PECS period. The 1st PECS Call received a very high number of proposals that led to 1.53 M€ being awarded. However, a pronounced decrease was experienced in the 2nd PECS Call, with only 297 k€ awarded. This raised concerns in both ESA and the Latvian delegation, who responded by increasing the communication efforts of available ESA opportunities, which included planning an event to raise awareness of PECS among the Latvian industry. The results of the 3rd PECS Call showed a clear improvement, with 968 k€ awarded in contracts. This led to an average spending rate of 932 k€ per Call (as of 1st October 2018), which would not have been enough to use the budget foreseen before the end of the PECS period.

Consequently, it was decided to increase the frequency of the Calls to approximately one every 6 months. This would allow spending the available budget on schedule while offering the opportunity for entities to resubmit a proposal soon after receiving a debriefing, which is expected to have a positive impact on the success rate of the upcoming PECS Calls.

As described above, the 4th and 5th PECS Calls have resulted in 991 k€ and 839 k€ of industrial commitments approved and recommended for implementation, respectively. These results are expected to correct the spending rate and allow the expenditure of the available funding within the foreseen timeframe. The 6th PECS Call was published on the 12th of July 2019.

Looking ahead, the following key options should be taken into account for the future of Latvia-ESA cooperation:

- **Option 1:** Associate Membership. If this approach is selected, a careful selection of the Optional Programmes should be carried out, mapped to the Latvian industrial capabilities described herein and to the objectives of Latvia in space. In this regard, a Third-Party Programme could be used as an instrument to help to better position Latvian industry to achieve geo-return in ESA Optional Programmes. Third-Party programmes have been recently introduced as an option to the new Associate Member status. It shall be noted, however, that the financial commitment and institutional support needed for an Associate Member are significantly higher than those required for PECS.
- **Option 2:** An additional PECS period, in which the programmatic constraints should be revised to reflect the current status of development of the Latvian space industry. This could include increasing the minimum score for proposal recommendation, as well as additional requirements to target higher Technology Readiness Levels and more industrial involvement.



The ambitions of Latvia in space have also led to the creation of the Latvian Space Technologies Cluster, which was offered the opportunity to deliver a short presentation during the 4th PECS Call Briefing held in Riga in October 2018. Industrial coordination is considered very positive to help maximise the return on ESA investment. This has been observed in countries like Estonia, where the INNOSPACE project has set up an industrial coordination and support team that has led to a significant improvement in the awareness of ESA opportunities and tenders within the Estonian industry.

4 CURRENT LATVIAN INVOLVEMENT IN ESA ACTIVITIES

a. Registered entities

The number of esa-star registrations in Latvia has grown steadily since the signature of the ECS Agreement in 2013. As of 23rd May 2019, the total number of the registered Latvian entities is 54, with 28 having updated their status during the last year. The list of registered entities contains 35 companies from various fields of industrial activity, 18 research organisations and/or university faculties/departments and one (1) international organisation. The list of registered entities is provided in *Annex 1: Registered Entities*.

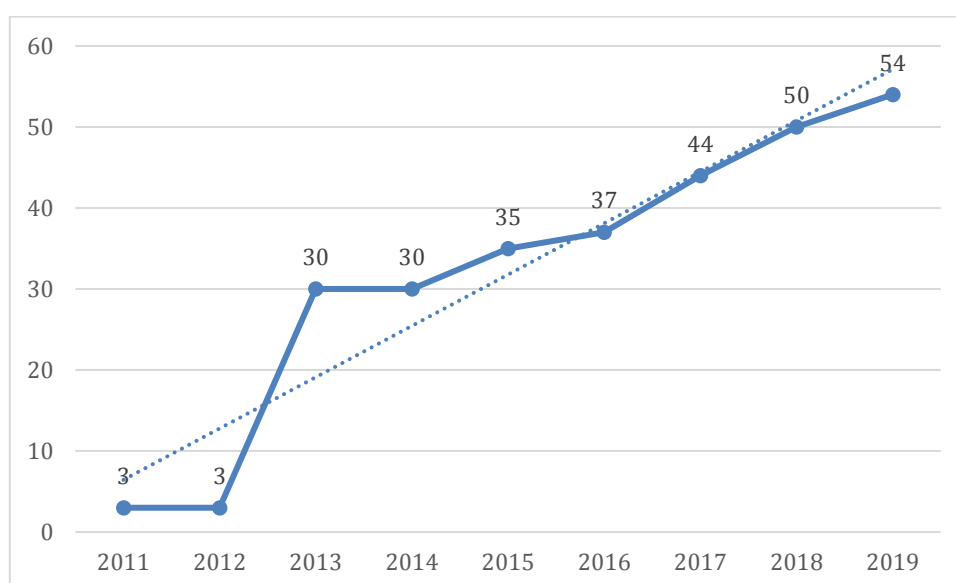


Figure 1: Growth in esa-star registrations since the start of the cooperation with ESA

Table 1 compares these figures with countries of similar economic size at different levels of cooperation with ESA. Hungary and Czech Republic have been added due to their comparable GDP per Capita and history of cooperation with ESA.

	Cyprus	Latvia	Lithuania	Slovak Republic	Slovenia	Estonia	Hungary	Czech Republic
1. PECS Charter Signature Date	Jul-2016	Jan-2015	Sep-2015	Feb-2016	Jan-2010	Sep-2010	Nov-2003	Nov-2004
2. Current ESA Status	PECS	PECS	PECS	PECS	Associate Member	New Member State	New Member State	Member State
3. GDP, PPP (2017, k\$)²	30,953,320	55,086,061	94,051,970	176,074,592	75,190,619	44,063,633	281,880,134	402,796,089
4. Total Registrations in esa-star	51	54	70	54	52	74	90	211
5. Total Registrations per Billion GDP	1.65	0.98	0.74	0.31	0.69	1.68	0.32	0.52
6. Industry Registrations per Billion GDP ratio	1.42	0.64	0.58	0.22	0.48	1.48	0.18	0.43
7. % Industry / Total Registrations	86% (44/51)	65% (35/54)	79% (55/70)	70% (38/54)	69% (36/52)	88% (65/74)	57% (51/90)	82% (172/211)
8. % SME / Industry Registrations	30% (13/44)	37% (13/35)	35% (19/55)	51% (18/38)	33% (12/36)	68% (44/65)	29% (15/51)	25% (43/172)

Table 1: Comparison of esa-star Registrations with countries of comparable economic size

Among the selected countries, Latvia presents a total number of registrations in esa-star (row 4) and a percentage of industrial entities (row 7) that are on the low side. However, Latvia shows better performance in terms of registrations per unit of GDP (row 5), surpassing countries with a longer history of cooperation with ESA like Czech Republic, Hungary or Slovenia, as well as the neighbouring Lithuania. A similar behaviour can be observed in the number of industrial entities per unit of GDP (row 6), which suggests that the low percentage of industry is strongly influenced by a high number of registrations of non-industrial entities in comparison with other countries.

The percentage of Small and Medium-sized Enterprises (row 8) is in the mid-range, higher than the one observed in Czech Republic, Hungary or Cyprus but lower than in Estonia and Slovakia. However, it shall be emphasised that, as described in the next section, all the Latvian industrial entities that have been awarded an ESA contract up to the 3rd PECS Call are SMEs³. Nevertheless, large corporate groups with presence in Latvia like Axon' Cable, established in the country in 2000 and with numerous contracts with ESA in other countries, are not among the Latvian companies registered in esa-star, nor have participated in PECS Calls. This is also the case of other companies with clear interest in space technologies, such

² World Bank, International Comparison Program database. Accessed 23/05/2019.

³ Aspired Ltd. SME status is not confirmed due to lack of financial information.



as Fiber Optical Solution in the field of optical gyroscopes. Hence, it is concluded that there is still room to improve these statistics.

Overall, it can be concluded that the number of registered Latvian entities in esa-star is following a positive trend. When divided by GDP, both the total number of registrations and the industrial involvement are superior to those of countries with a higher economic size and more advanced status of cooperation with ESA within the range considered. Latvia's low industry ratio is partly consequence of a high number of registrations of non-industrial entities. However, there still seems to be new space players to attract within the Latvian industrial landscape, and additional efforts need to be made in order to raise awareness about the opportunities available for Latvian entities within ESA. In this sense, the recent initiative of the Latvian delegation to establish a database mapping the capabilities of the country in the space domain is considered a good first step.

b. Bidding activity, success rate and supplier assessment

Up to 23rd May 2019, 88 proposals have been submitted by Latvian entities in five (5) PECS open calls, out of which 74 have already been evaluated by ESA and endorsed by the Latvian delegation. So far, this has led to the recommendation for implementation of 30 contracts (with three additional contracts implemented through direct negotiation). These results generate a success rate of 41%, which is higher than the benchmark of 33% considered for PECS. The average proposal marking for the recommended proposals is 55.05. However, both of these figures are influenced by the decision of recommending proposals with a score between 40 and 50 as feasibility studies, resulting in an increase of the success rate and a decrease of the average score.

If only those proposals with a score above 50 had been recommended, the resulting average score would have been 57.5, with a success rate of 32%. In other words, out of the 60 proposals submitted, 24 (32%) have scored over 50, 16 (21%) have scored over 55 and 8 (10%) over 60. The average score of the proposals marked over 50, while not showing a clear trend yet, increased significantly in the 4th Call. This average started by dropping from 56.5 in the 1st Call to 53.75 in the 2nd Call, but increased up to 56.1 in the 3rd Call and 61.9 in the 4th Call. In these last two Calls, some of the lowest scores were obtained in the Management Criterion. This is considered an area where improvement is relatively easy if due attention is paid by the bidder to the briefings, debriefings and tender documentation. The average scores decreased in the 5th Call down to 54.75.

Although these results can be considered satisfactory for a PECS country, especially considering the 4th Call, a general rule of thumb is that proposals scoring above 60 are needed to gain contracts in competitive tenders with other ESA Member States, which would be the most common scenario as an Associate Member subscribing to ESA Optional Programmes. Thus far, only eight (9) Latvian proposals have scored above this threshold, five (5) of them in the 4th and 5th Calls. While the tools available for relevant training are limited within PECS, additional support in terms of proposal writing, space project management, and other training is available for industry under the new Associate Membership. If Associate Membership ends up being the path chosen for the continuation



of Latvia's collaboration with ESA, it would be key to exploit such training opportunities early on.

As of 23rd May 2019, 41 different Latvian entities have submitted proposals to PECS open Calls as prime contractors (39 if the 5th PECS Call, currently under evaluation, is not considered), resulting in 14 Latvian entities being awarded an ESA contract. The awarded entities are composed by six (6) industrial entities (all of which are SMEs²) and eight (8) academic and research organisations. *Table 2* provides a comparison with other PECS and NMS countries.

	Bulgaria	Cyprus	Latvia⁴	Lithuania	Slovakia	Estonia	Hungary
ESA Status	PECS	PECS	PECS	PECS	PECS	NMS	NMS
PECS/ IIS Calls	3	2	4	3	3	3	3
Number of Registered entities	104	51	54	70	54	74	90
Entities having submitted a proposal (Avg per Call)	30 (10)	35 (17.5)	39 (9.8)	32 (10.7)	33 (11)	N/A	N/A
Entities awarded a contract (Avg per Call)	13 (4.3)	9 (4.5)	14 (3.5)	15 (5)	14 (4.7)	11 (3.7)	15 (5)
% Entities awarded a contract	43%	26%	36%	47%	42%	N/A	N/A
Industrial entities awarded (Avg per Call)	5 (1.7)	3 (1.5)	6 (1.5)	7 (2.3)	7 (2.3)	9 (3)	9 (3)
% Industrial / Total entities awarded	38%	33%	43%	47%	50%	82%	60%

Table 2: Comparison of awarded entities with other PECS and NMS countries

Latvia is among the countries with the highest number of different entities with an ESA contract among the countries considered⁵, although the Average per Call shows a lower value

⁴ The Latvian activities from the 4th Call that are currently under negotiation have been considered as awarded contracts. The new submissions of the 5th Call in Latvia has not been considered to enable a better comparison between submissions and contracts awarded. For the rest of the countries, those Calls in which the activities have been committed are considered.

⁵ Only Industrial Incentive Scheme (IIS) Calls have been taken into account for Estonia and Hungary

due to the fact that no new entities were awarded in the 4th Call. The number of different entities submitting proposals per Call is also slightly lower than in other PECS countries, but the number of new entities per Call tends to decrease and thus this value is expected to converge with other PECS countries as they implement new Calls. However, it can be observed that the percentage of entities awarded is in the low side. In addition, the percentage industrial entities awarded is still quite far from the values of ESA New Member States. Out of the Latvian entities awarded a contract only 43% are industrial, while NMS like Estonia or Hungary show a significantly higher ratio.

In terms of financial commitments, the industry ratio for Latvia is 39%, as shown in *Figure 2*, which falls short of the overall target of 75% of commitments allocated to industry. This target is considered as a guideline for a country to successfully achieve return in ESA programmes. Therefore, a higher focus on industry is needed and has been implemented for the last PECS Calls in Latvia.

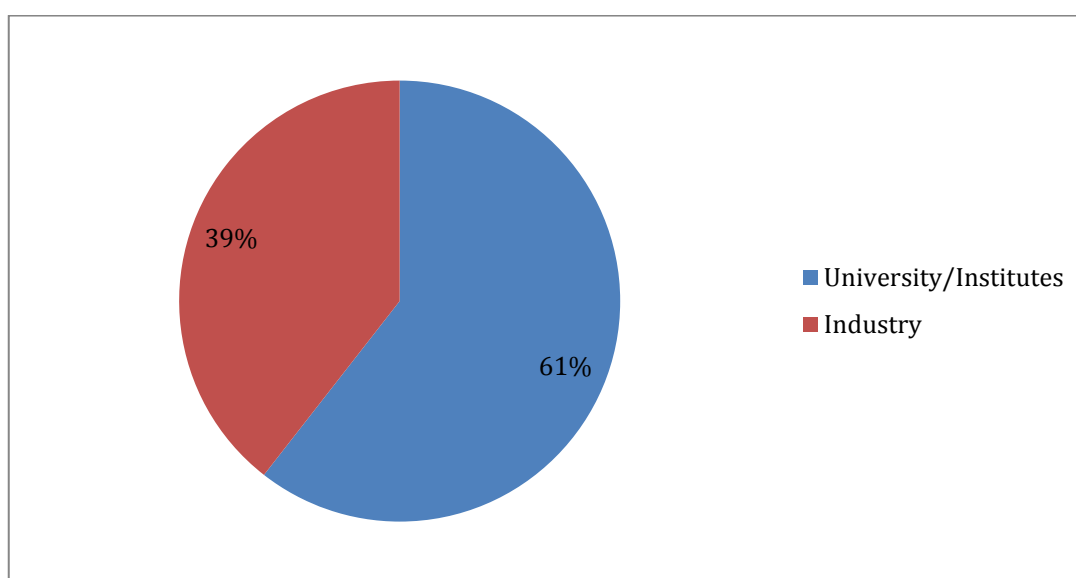


Figure 2: Commitment distribution per type of entity

Digging into the commitments per supplier shown in *Figure 3*, it can be observed that four (4) entities dominate the Latvian landscape, of which two (2) are companies (Eventech and RD Alfa) and two (2) are research organisations (Foundation Institute for Environmental Solutions (IES) and Latvian State Institute of Wood Chemistry (LSIWC)). These entities have received 67% of the total commitments under PECS Latvia as of 1st October 2018.

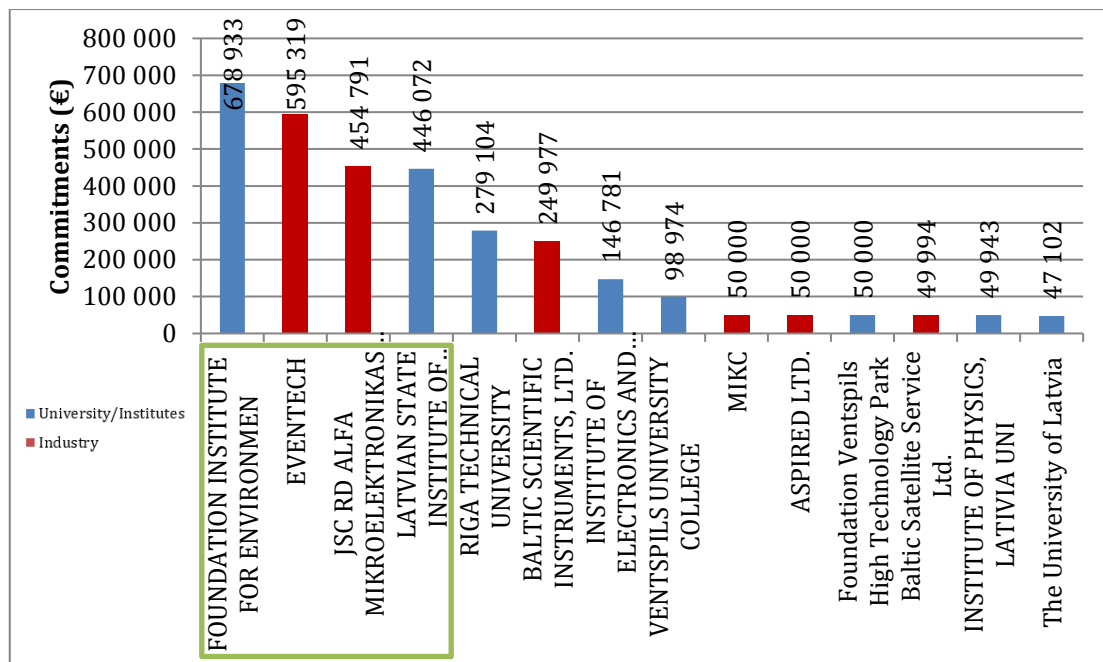


Figure 3: Commitments per supplier

Out of the 14 entities, seven (7) have received more than one ESA contract, as reflected in Figure 4. Achieving higher Technology Readiness Levels (TRLs) often requires a number of consecutive and directly related activities, but this is not always the approach followed by the bidders. Some entities have kept submitting proposals that led to parallel developments at low TRLs. Although these may be interesting from a knowledge expansion perspective, the benefits of this approach for strengthening Latvia's industrial capacity for future participation in ESA programmes are considered limited and more emphasis on higher TRL and follow-on activities is needed. This is expected to improve in the last PECS Calls.

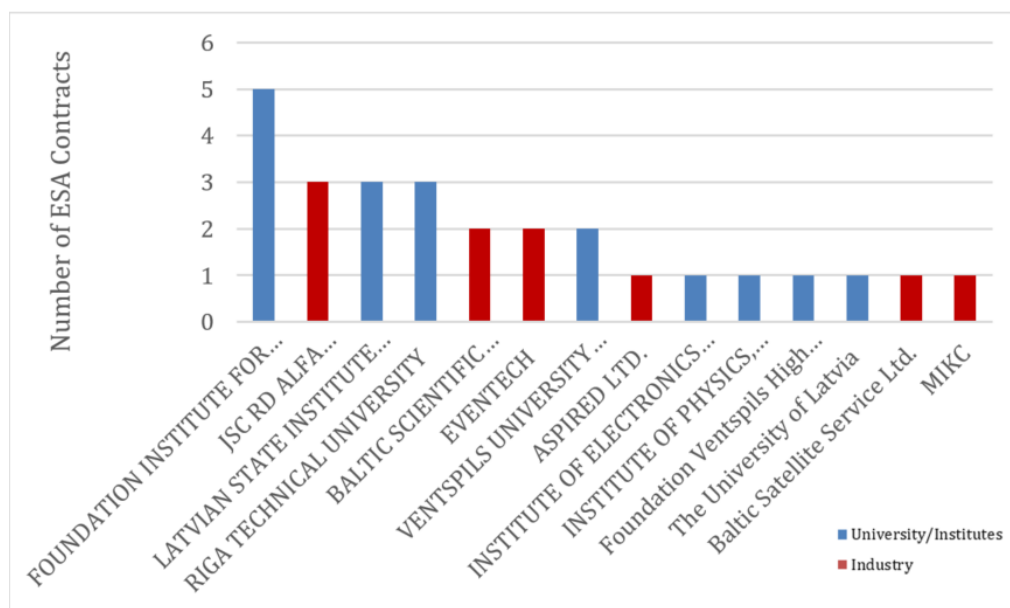


Figure 4: Number of ESA contracts per entity

c. Technology Readiness Level assessment

The number of activities targeting each level of the TRL ladder is shown in *Figure 5*. It can be observed that the bulk of the activities target TRL 3 and TRL 2, representing 61% of the total number of activities with an applicable target TRL. The low TRL activities have played an important role in investigating new technologies and such activities are key to support start-ups and spin-off companies. However, due attention needs to be paid to increasing the target TRL of these technologies such that they are mature enough for potential participation in ESA Optional Programmes and further exploitation. This increase has not yet taken place during this PECS period, in which the average target TRL is 3.6. This number has not shown any improvement since the first Call, in which the average target TRL of the recommended proposals was 3.8.

In general, developments in the range of TRL 5-7 are considered needed to demonstrate sufficient capabilities in a specific area. So far, the two niches in which Latvian entities have more than one activity advancing the TRLs are event timing devices (Eventech) and polyurethane foams for insulation (LSIWC).

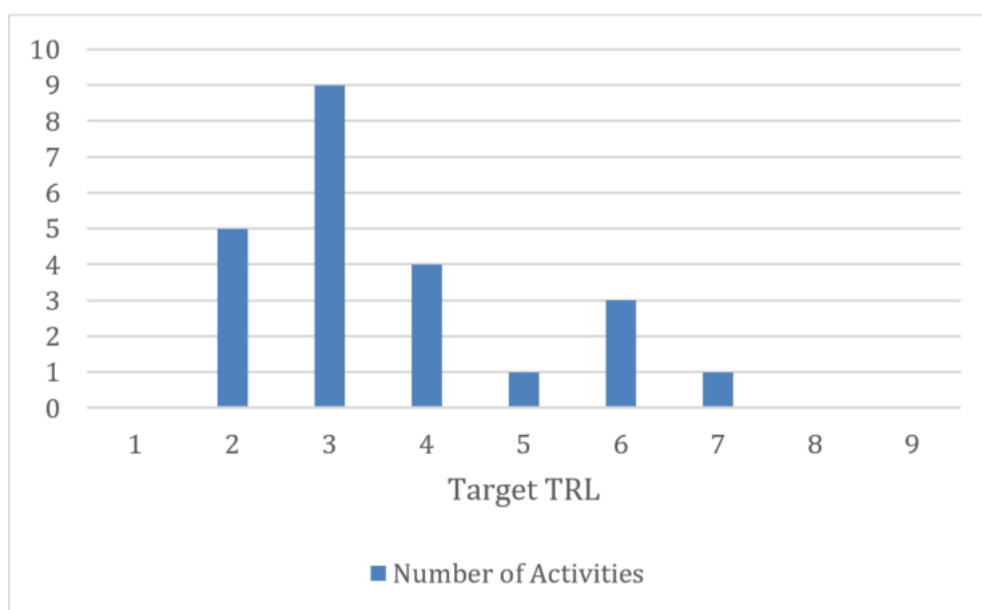


Figure 5: Number of activities per target TRL

This supports the need for additional industrial actors, or the further growth of those already involved, who are able to commit to vertical technology developments. It is expected that the remaining PECS Calls should encourage greater leverage of the R&D activities that have been committed until now, leading to higher TRL products and services that increase the potential to obtain return for Latvia in ESA programmes and commercial markets.

In this sense, fostering cooperation among the awarded research organisations and relevant industrial actors is considered a key factor. In the 3rd PECS Call, IES (the research entity

that gathers the highest number of contracts and commitments) started cooperating with the Forest Owners Consulting Centre (MIKC) with a proposal led by the latter, which is considered a good example of this. Additional such examples are to be encouraged.

The issue has already been addressed through the programmatic requirements of the 4th PECS Call, which establishes higher start and end TRL and requires the involvement of industrial entities for the main activity types, in order to encourage more progression. In this Call, four (4) of the six (6) recommended activities target TRL 5-7, with the other two (2) activities targeting TRL 3. A similar result has been observed in the 5th PECS Call, again with four (4) of the six (6) activities targeting TRL 5-7. This is considered a good TRL distribution for the last stages of PECS.

d. Assessment per service domain

The analysis of ESA commitments per service domain since the start of the PECS charter has been performed and is illustrated in the following figure:

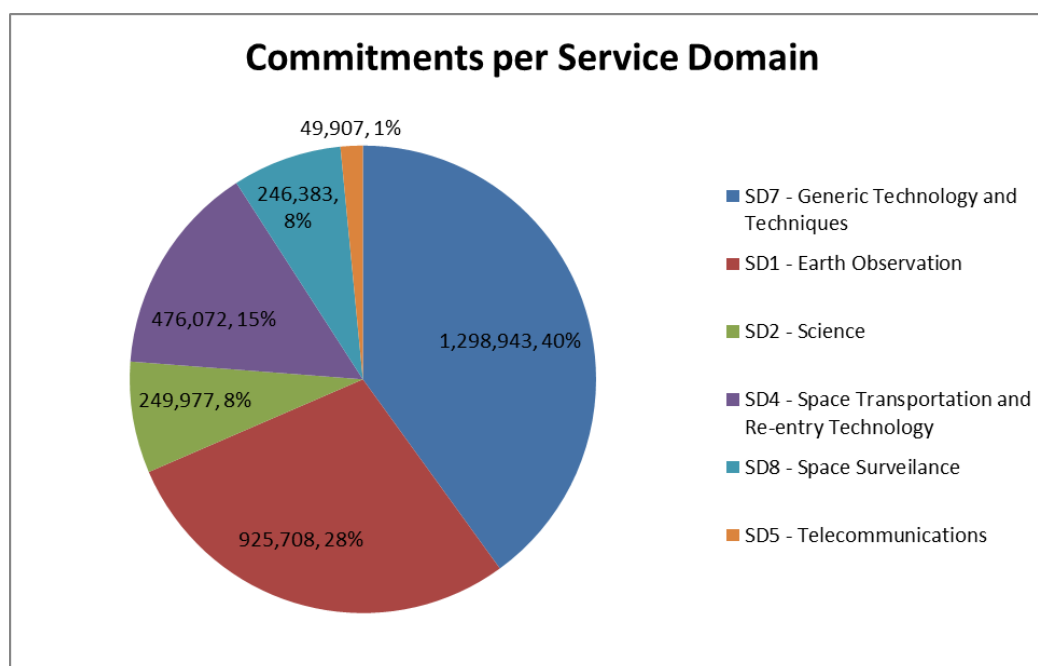


Figure 6: Commitments per Service Domain

From this graphic, and considering the entities in Figure 3, the following key areas have so far emerged as having the most potential future Latvian participation:

- Generic Technology and Techniques:** 40% of the commitments target generic technology and techniques via 10 contracts (including three (3) education/awareness activities). The main competences developed are in microelectronics, event-timing devices and structural damage assessment. The average target TRL of these activities is 3.57, which sits between laboratory experiments and breadboards, with the on-board implementation of a multipurpose event timer reaching TRL 6. These developments would best fit under the General Support Technology Programme



(GSTP), particularly under Element 1 “Develop” considering the current maturity. The microelectronics focus on the development of EEE components that are currently only available from US suppliers and as such could be very interesting to the European space market if they can be successfully qualified and supplied at a competitive price. Such components, while very interesting and useful developments with a potentially good economic return are however likely to fall under the threshold of counting for mandatory GEO-return but would fall well into GSTP. The event timers being developed are considered to be world class and have a promising market both for SSA and in-orbit applications. They could potentially be considered both under GSTP and SSA programmes.

In the 4th PECS Call, two (2) additional activities have been approved for implementation and are currently under negotiation. One is a preparatory activity for a time measurement block targeting TRL 3, while the other one aims at the evaluation of an operational amplifier developed in the frame of PECS, targeting TRL 7. Approximately 43% of the foreseen commitments of the Call are allocated to this SD.

Three (3) more activities in this area have been recommended for implementation in the 5th PECS Call. Two are feasibility studies on innovative concepts for photodetectors and spacecraft magnetometers, targeting TRL 4 and 3 respectively, and the other deals with the development of a Xenon refuelling compressor up to TRL 6.

- **Earth Observation:** 28% of the commitments target the EO area via eight (8) contracts (including an education/awareness activity). The leading entity in this field is the research institute IES, which is starting to cooperate with companies (such as MIKC) and leverage the capabilities developed. Other entities in this field include the Institute of Electronics and Computer Science and Baltic Satellite Service. The average target TRL of these activities is 3.43, which is between prototype and alpha version with respect to software maturity and between concept analysis and non-operational service verification from the perspective of applications and services. The only activity aiming higher than TRL 3 was SentiLake, by IES, with a target TRL 6. This suggests that the Earth Observation Envelope Programme (EOEP) would be suitable for Latvia, in particular the Baltic Initiative could be of interest. However, further work is needed in EO to increase the TRL and cooperate with entities in other ECS or ESA member states – particularly in the Baltic region, which has numerous specificities in terms of EO data processing and calibration/ validation needs.

Three (3) additional activities in this service domain have been approved for implementation in the 4th PECS Call. They focus on the development of EO-based downstream services for forest monitoring and automatic identification of mires and peatlands, with target TRLs in the range of 5-7. Approximately 50% of the foreseen commitments of the Call are allocated to this SD.



In the 5th PECS Call, three (3) more activities in the EO area have been recommended for implementation, all of them targeting TRL 5-7. They deal with the development of innovative planning services based on EO-data, a forest soil freezing forecast service and with automated forest wind-fall detection based on Sentinel-1 and Sentinel-2 imagery.

- **Space Transportation and Re-entry Technology:** 15% of the commitments target developments related to space transportation systems via four (4) contracts. Three (3) of them are led by the research institution LSIWC and focus on polyurethane materials for launcher insulation, all of them targeting TRL 4-6. The entity has initiated collaboration with Ariane Group in one of these projects, co-funded by PECS and the Technology Research Programme (TRP), and its research is expected to contribute to a related activity within the Future Launchers Preparatory Programme. The ESA launcher programme could therefore represent a small but fairly secure interest for Latvia. Significant expansion in the launcher area in Latvia is considered to be unlikely.
- **Science:** the commitments related to space science represent 8% of the total and are divided in two (2) contracts led by Baltic Scientific Instruments (BSI), who are considered world class in their area of expertise. The company has had contracts with ESA before PECS and has capabilities to be a valuable industrial partner in the Scientific Experiment Development Programme (PRODEX) for contributing to the development of future science payloads. This area has an average TRL 3, as the company has developed a prototype (TRL 4) and is carrying out a feasibility study (target TRL 2). However, the company already has experience up to TRL 9.
- **Space Surveillance:** the domain of Space Surveillance also represents 8% of the total commitments with two (2) contracts. The largest one is led by Eventech, a leading provider of high-performance timing equipment for satellite laser ranging stations (SLRs), in partnership with the Institute of Astronomy of the University of Latvia, which brings the expertise of running a SLR station as part of the International Laser Ranging Service (ILRS). This contract has a target TRL 7. The second contract is a feasibility study of a ground station for the optical observation of Near-Earth objects with target TRL 2, leading to an average target TRL 4.5 in Space Surveillance. The Space Situational Awareness (SSA) programme would be suitable for the continuation of these developments, especially the Space Surveillance and Tracking (SST) segment considering the Latvian heritage in laser ranging, which has not yet been fully exploited in PECS.

One additional activity related to Space Surveillance has been recommended for implementation in the 4th Call, representing 7% of the foreseen commitments. It is a preparatory activity (target TRL 3) looking at the impact of space weather events on the GNSS Ground Based Augmentation Systems that are in place in Latvia.

- **Telecommunications:** the commitment in this area corresponds to a feasibility study (target TRL 2) that is analysing the potential of VIRAC's radio telescopes to provide telecommunication services. The study focuses on offering commercial services, with the other connection to ESA being the potential collaboration to the European Space Tracking Network (ESTRACK). However the current level of activity in telecommunication related activities in Latvia remains low and is not currently considered to be sufficiently mature to have confidence in being able to obtain sufficient return in a related programme, as such this would not be currently recommended as a priority.

Figure 7 shows the average TRL per service domain, offering a general picture of what has been commented throughout the last two sections.

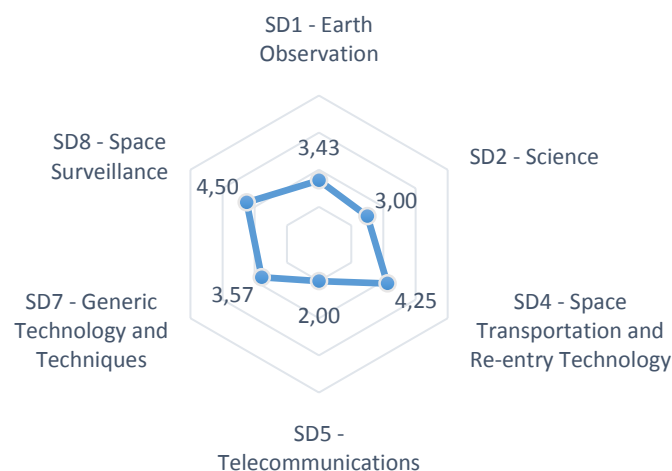


Figure 7: Average Target TRL per Service Domain

e. Commercial/Other space activity

RD Alfa Microelectronics has a long heritage in the supply of integrated circuits for the Soviet and Russian space programmes, with Roscosmos as its main (indirect) end customer. Thanks to the developments carried out in the frame of PECS, the company has established contacts within the European space industry and is now negotiating directly with Large System Integrators (LSIs) for the supply of rad-hard electronic components and is on track towards a formal ECSS qualification effort for these components.

Eventech is another very good example of successful commercial space activity in Latvia, offering event-timing devices for terrestrial satellite laser ranging stations. The company focused on matching the needs of the ground segment of the ILRS, managed by NASA. The ILRS network comprises more than 70 laser-ranging stations worldwide, and the affordable



and high-performance solution provided by Eventech is currently used in more than half of them. The company states to have sold more than 50 devices.

Another commercial entity operating in the space field, but not yet within PECS, is Axon Cable SIA, the Latvian subsidiary of the French group Axon Cable. The company manufactures high-tech cable assemblies for different industries, with aerospace and defence representing 60% of the total turnover. The assembly of cables and connectors is performed in Latvia, from which more than 90% of all the manufactured products are exported. The company boasts a wire-harnessing workshop and tester and sells ESCC qualified wires and connectors. Commercial space contracts include wire harness cabling for Airbus-OneWeb satellite constellation⁶.

Finally, the company Fiber Optical Solution (FOS) has a space grade three-axis fiber-optic gyro among its product portfolio, which represents a very interesting capability in the Latvian commercial space sector. FOS claims extensive flight heritage, with more than 200 units of its TFOS-500 three-axis fiber optic gyros successfully performing in flight missions. FOS is a supplier to NASA in the field of fiber optical navigation⁷ for non-space applications. The company has not submitted any PECS proposal so far, but was visited by ESA experts and attended the 4th PECS Call briefing in March 2019.

5 ASSESSMENT OF LATVIAN KEY COMPETENCES

The key competences in Latvia have been assessed through the analysis of successful ESA bids made by Latvian companies, the implementation of the resulting contracts, interactions with the Latvian delegation, a survey of Latvian entities registered in esa-star and some on-site company visits, discussions and questionnaires.

a. Assessment of key competences not yet fully exploited and mapping to programmes

The following companies were visited in the frame of PECS:

- **JSC RD Alfa Microelectronics**
- **Baltic Scientific Instruments (BSI)**
- Fiber Optical Solution

In addition, the entities listed below were identified and assessed through questionnaires and additional discussions (the entities with at least one ESA contract signed or to be signed are in bold):

- Axon Cable
- **Baltic Satellite Service**
- Cryogenic and Vacuum Systems
- **Eventech**
- **Foundation Institute of Environmental Solutions (IES)**

⁶ Source: Questionnaire filled by the Axon Cable SIA.

⁷ Source: <http://opticalsolution.lv/2018/03/23/fos-and-nasa-cooperation-news/>



- HEE Photonics Labs
- **Institute of Electronics and Computer Science (IECS)**
- **Institute of Materials and Structures, Riga Technical University (IMS, RTU)**
- **Latvian State Institute of Wood Chemistry**
- **University of Latvia**
- **Ventspils International Radioastronomy Centre (VIRAC)**

The assessments of those visited and other entities considered key are included in *Annex 3: Assessment of Latvian Entities*. From these, it is considered that Latvia has capabilities in a number of areas that have yet to be fully exploited in cooperation with ESA.

In the area of electronic components, there is wide expertise in the development and supply of integrated circuits for the Soviet and Russian space programmes that has yet to be fully exploited in cooperation with ESA. In the frame of PECS, certain operational amplifiers with recurrent demand in the European space industry were identified and developed. These components are currently only available from non-European suppliers, which involves more complex procurement processes and potential ITAR issues. A Latvian supplier has the potential to bring important benefits in this regard and to secure recurring business if the component sales prices are competitive. The interest of the Large Scale Integrators (LSI) in these developments has already been noted. However, an evaluation/qualification of the integrated circuits would be needed for potential inclusion in the European Preferred Parts List (EPPL), this could potentially be in the frame of PECS. Demonstrating such capabilities could open the door to further component developments and to being able to offer a component packaging service.

Regarding wires and connectors, there are products already being exported by the Latvian subsidiary of a known French group, but the role of this company within the Latvian space landscape is not yet clear and they have not made any proposals to PECS. A company visit and open discussion could prove beneficial.

Developments in the field of electronic components have been carried out in recent years through the European Components Initiative (ECI, funded through the Mandatory Programme), the General Support Technology Programme (GSTP), ARTES Advanced Technology and the Technology Development programme and therefore both of these companies would have the potential to secure work under these programmes.

The other area in which a Latvian entity has established cooperation with a LSI is the cryogenic insulation of launchers. This cooperation started with a co-funded activity between PECS and the mandatory Technology Research Programme (TRP). It has led to the LSI requesting inputs from the institute LSIWC for an activity under the Future Launchers Preparatory Programme (FLPP). A limited participation of Latvia to FLPP would enable potential future cooperation in this particular topic, but without any additional Latvian entities actively involved in launcher activities, significant activities in the area of Launchers cannot be expected. An industrial partner able to transform LSIWC research into a product at an industrial scale would be beneficial. Certain launcher-related developments have also



been carried out under GSTP, which could be considered as a more flexible alternative to FLPP.

Good capabilities can also be found in the area of Earth Observation (EO). The Latvian PECS activities in this started mainly with research institutes, but the industrial involvement, which is considered essential to ensure a sustainable exploitation of the developments, has increased noticeably in the last Call. This is hoped to lead to applications and services that are closer to the market and can benefit both public authorities and associations of private owners of natural resources. The experience acquired by the Latvian entities by the end of PECS should enable them to participate in competitive tenders under the Earth Observation Envelope Programme (EOEP), as well as in the regional Baltic Initiative. However, increased cooperation with industrial partners, end users and other entities in the Baltic region should be encouraged.

Latvia also has an important heritage in the field of satellite laser ranging, tracing back to the Soviet space programme under “Interkosmos”⁸. The Institute of Astronomy of the University of Latvia manages the station RIGL 1884, part of the International Laser Ranging Service managed by NASA. This expertise, together the leading Latvian technology in event timing devices, could certainly be exploited within the relevant ESA programmes. The most relevant programme would be the Space Surveillance and Tracking (SST) segment of the Space Situational Awareness Programme (SSA), although certain related developments have been carried out through GSTP and the Mandatory Programme (Technology Development and ESTRACK infrastructure). A number of the proposals received in this area show the need for infrastructure improvements which are out of scope of PECS funding but should be considered for national funding to enable further progress.

The event timing technology also has potential for space platforms. A Time-of-Flight block based on this technology, with a compact design and low power consumption, could meet the requirements of ESA’s future small LIDAR systems such as the planetary altimeter of the HERA mission as well as having other potential applications.

Latvia also has significant expertise in the development of instruments for radiation detection and measurements, with BSI which was established on the basis of the Riga Research and Development Institute for Radio-Isotope Apparatus (RNIIRP). This company would be a valuable industrial partner under the PRODEX programme for developing scientific payloads. Potentially, it could also contribute to the Directed Missions European Space Exploration Envelope Programme’s (E3P) Lunar Mission Campaign.

In the area of thermal engineering solutions, a first contact with the Latvian company Allatherm was established in March 2019. The entity mentioned being working with the Large System Integrator OHB in the breadboard development of a Xenon Refueling Compressor for the “European System Providing Refueling, Infrastructure and Telecommunications” of the Gateway programme. This collaboration and Allatherm

⁸ https://cdidis.nasa.gov/lw19/docs/2014/Posters/3102_Abele_poster.pdf



apparent know-how represents an interesting opportunity that could be exploited through participation in E3P, although the company could also have potential under GSTP.

Fiber Optical Solution (FOS) has been identified as a potential producer of fiber optical gyroscopes despite not having submitted a PECS proposal. The company claims to commercialise a space grade unit⁹, which is provided by very few companies worldwide and would represent an interesting key capability for Latvia. A visit by ESA representatives took place in March 2019, which served to confirm that the company's capabilities and infrastructure are of great interest to ESA. Gyroscope developments are often carried out under GSTP, although some fall under ARTES Competitive and Growth or specific space segment development programmes.

b. Potential ESA Optional Programmes matching Latvia's competences

The key existing competences in Latvia can be summarised as:

- Electrical and electronic space components
- Insulation materials for launchers
- Earth observation applications and services
- Event timing devices
- Satellite laser ranging
- Radiation detection technology
- Fiber optic gyroscopes

Based on the assessment of Latvian competences, the ESA Optional Programmes best matching these have been identified:

General Support Technology Programme (GSTP)

The General Support Technology Programme focuses on developing technology with the following objectives:

- To enable the activities of ESA and the national programmes;
- To support the competitiveness of the European space industry;
- To foster innovation and technology spin-in;
- To enhance the European non-dependence and availability of European resources for critical technologies.

Overall, GSTP is a programme that supports a very wide array of technology developments across the entire TRL ladder, from low-TRL to mature products and flight demonstrations. For the specific case of Latvia, GSTP could enable future developments in space components, which matches the objective of enhancing the European non-dependence, as well as the

⁹ <http://opticalsolution.lv/products/>



miniaturisation of the event timing technology in preparation of specific missions and the further improvement and tailoring of fiber optical gyroscopes. Although developments directly related to launchers are carried out under the space transportation programme, several preparatory activities have been undertaken under GSTP. In this sense, GSTP could offer a more flexible way for Latvia to potentially access launcher-related developments.

Earth Observation Envelop Programme (EOEP)

The Earth Observation Envelope Programme (EOEP) is the backbone of ESA activities in the field of Earth observation. It is made up of two main components:

- The Earth Explorer component involves the development and launch of new types of Earth observing spacecraft, aimed to respond to the requirements of the scientific community through new sensing technology;
- The Development and Exploitation component includes all preparatory activities for future missions, including Earth Observation Preparation Activities (EOPA), Earth Watch Definition (EWD) and Instrument Pre-Development (IPD). They cover end-to-end preparation of missions, from new sensor and spacecraft technologies to overall mission architecture and supporting science studies.

The Latvian entities currently involved in EO activities are more prepared for the Development and Exploitation component. Entities like the Institute for Environmental Solutions (IES) would be prepared to participate in invitations to tender such as the EO Science for Society permanently open Call, which is currently available. However, a potential progression of EOEP away from the exploitation side would involve certain risks for Latvian return in the programme, as the entities are mainly focused in algorithm and service development.

Space Situational Awareness Programme (SSA) – Space Surveillance and Tracking (SST) Segment

As part of the Space Situational Awareness programme, ESA is conducting research and developing technologies for systems that can find and track space debris and issue an alert when evasive action may be necessary. This constitutes the Space Surveillance and Tracking segment, which currently focuses on:

- Further develop SST networking technologies and conduct additional qualifications of national assets, including radars, optical telescopes and laser-ranging systems;
- SST data processing and application development, following a ‘community approach’ to the SST core software, which helps avoid duplication and ensure interoperability;
- SST sensor development, primarily on the ground, but also addressing further conceptualising of a space-based optical;
- Simulate the performance of SST architectures and develop data exchange standards;
- Cooperation with the EU and international partners.



Latvian entities have significant heritage and available infrastructure in laser-ranging and ground optics. Apart from the academic and operational expertise, companies like Eventech are leading providers of satellite laser ranging station elements, while others like HEE Photonics Labs have expressed interest in developing complete satellite laser ranging systems. Moreover, Eventech and the Institute of Astronomy of the University of Latvia are very well positioned, as they are currently involved in the development of an ESA laser ranging station, a project co-funded by PECS and the SSA/SST programme, among others. Therefore, Latvia could be well suited to participate in the SST segment of ESA's SSA programme.

PRODEX

PRODEX is devoted to the development of science experiments. Its activities broadly address space science instrumentation and science ground exploitation, and are implemented through dedicated contracts with scientific institutes and industrial companies in the funding country. The largest set of activities is related to the science programme, but PRODEX also supports scientific experiments in areas such as Earth Observation, Robotic Exploration, and the International Space Station, as well as national contributions to missions led by international partners.

For Latvia to take full advantage of PRODEX, specific national priorities would need to be defined in cooperation with the Latvian scientific community, as the scientific communities of ESA Member States are the ones leading the definition and implementation of the experiments and Science missions. The capabilities of industrial entities like Baltic Scientific Instruments should be taken into account when defining such priorities, as it is the only Latvian entity with experience up to TRL 9.

Future Launchers Preparatory Programme (FLPP)

The Future Launchers Preparatory Programme (FLPP) aims at:

- Preparing competitive technologies for future launchers with low development and production costs;
- Shortening launcher development duration and lowering development risks;
- Promoting industry and new Member States participation in launcher development.

The Latvian State Institute of Wood Chemistry (LSWIC) has established collaboration with Ariane Group in the development of light insulation material technology for application in launchers, a development initiated in TRP that has seen continuation under the Future Launchers Preparatory Programme. This partnership could lead to a small but secure return for Latvia under FLPP. However, there are no prospects of significant expansion in this area, nor additional Latvian entities besides LSWIC that are well positioned to participate in the development of future launchers.



European Space Exploration Envelope Programme (E3P)

The European Space Exploration Envelope Programme (E3P) integrates all ESA's existing space exploration efforts into single programme. Its goal is to secure Europe's central role in global space exploration, deliver new results in both basic and applied science and offer a compelling vision of global endeavour enriching society and inspiring the next generations.

Allatherm has established collaboration with one of the Large System Integrators, OHB, in the early phases of Gateway's ESPRIT, funded through E3P. In addition, Baltic Scientific Instruments could be well suited to participate in the Directed Missions of E3P's Lunar Mission Campaign. The implementation of this campaign, however, is subject to decisions at the ESA Council Meeting at Ministerial level planned for late-2019. The development of Eventech are also interesting for the Luna missions, funded under E3P.

Associate Membership “Incentive Third-party Scheme”

This incentive scheme is based on a targeted open call, the topics of which being jointly decided by a Task Force composed of representatives from the state and from ESA, to ensure fulfilment of the two above key goals. Overall, it forms the basis of a “National Programme” to help position industry to achieve geo-return and prepare for joining new Optional Programmes. For Latvia, it could be used to ensure a smoother transition from PECS, especially useful in those areas in which the current capabilities do not seem to guarantee an immediate return in Optional Programmes, are concentrated in very few entities or at low TRLs.

c. Risks, threats and problem areas

The following main risks have been identified:

Risk 1: Lack of a clear national space plan

The Latvian PECS Charter has represented a first step towards the fulfilment of the Latvian ambitions in space, but its scope is limited to preparing for and strengthening cooperation with ESA. The developments carried out under PECS have so far represented individual initiatives from different Latvian entities with interest in the space field. Although constrained by the programmatic requirements of PECS, the research and development efforts have generally represented a technology-push in very different directions. This has been valuable to identify a number of key capabilities in Latvia, but an evolution towards a more focused approach should be considered. So far, the Latvian objectives in the field are linked to certain areas of RIS3's Smart Specialisation Strategy which, although applicable, is not considered sufficiently tailored to the specificities of the space sector.

A space plan would set out the specific goals for space investment in the country, defining the main objectives to achieve, the funding sources available and the government organisation to oversee its implementation. It also provides partner organisations, such as ESA, with the necessary framework to advice on the best ways to achieve the national



objectives in the field. An evolution towards an Associate Membership would require the definition of priority areas and additional resources, when compared to the current PECS status, in terms of both funding and human capital linked to the Latvian government.

Risk 2: Return in components, materials and parts not reflected in geo-return

Some of the main developments being carried out by Latvian entities under PECS could eventually generate space qualified commercial-of-the-shelf products and materials. This could lead to exports, having a positive impact for the Latvian economy. However, the procurement of components, materials and parts in the frame of ESA projects is generally not reflected in the geo-return statistics. Even if the procurement of these COTS items becomes one of the core contributions of Latvia to the European space industry, leading to important revenues for the suppliers, ESA's geo-return statistics for Latvia (especially in the Science programme) would not reflect it, except for the related development activities that could take place under programmes like GSTP. This could lead to difficulties in justifying further contributions to ESA programmes at a political level, even if these enable the competitiveness of the Latvian suppliers and exports.

Risk 3: Commitments highly concentrated in a few entities

It has been highlighted under *Bidding activity, success rate and supplier assessment* that four (4) entities currently accumulate 67% of the Latvian commitments under PECS. Among them are the only entities that have carried out developments above TRL 4, and they are distributed among different areas (IES in Earth Observation, Eventech mainly in Space Surveillance and LSIWC mainly in Space Transportation). This situation could make potential Latvian geo-return in ESA Optional Programmes related to those areas highly reliant in the capabilities of a single entity.

Risk 4: Difficulties in leveraging the funding allocated to research/academia

Connected to the previous risk, two out of the four entities that accumulate the largest share of PECS commitments are research institutions. Although these entities certainly have an important role in the Latvian space sector, collaboration with industrial entities interested in taking their developments to the market is considered key to generate return on the investments that have been carried out. So far, the cases of collaboration between industrial and research institutions have been limited and should be further encouraged.

Risk 5: Limited number of activities targeting high TRL

As outlined in the *Technology Readiness Level assessment*, most of the activities carried out under PECS have target TRL 2-3. Capabilities at TRL 5-7 are considered needed to compete in ESA Optional Programmes, but only a limited number of Latvian developments are currently in this range, and they are carried out by just three entities across different



domains. Higher target TRL developments would be needed in the last PECS Calls in Latvia to reduce the risk of not having mature-enough capabilities to obtain geo-return in ESA Optional Programmes.

6 CONCLUSIONS AND RECOMMENDATIONS

a) Conclusion

Latvia has taken important steps towards defining its role in ESA and the European space industry. Through the Plan for European Cooperating States, several key capabilities have been identified and initial collaboration with ESA programmes and space large system integrators has been established. Entities like RD Alfa, Eventech and Fiber Optical Solution have shown capabilities in specific niches that are of interest for ESA and other players within the European space sector. However, the industrial involvement, while growing, still has room for improvement and, consequently, the overall maturity of the developments has not yet reached the higher levels of the TRL ladder. The key technology areas that have so far emerged in Latvia map primarily to the GSTP and EOEP programmes of ESA with further interesting developments falling into SSA and PRODEX and a very limited potential participation in Launchers, E3P and ARTES.

The primary options for Latvia in going forward with ESA are to apply to become an Associate Member (AM) or to perform a second period of PECS. The financial commitment needed to be an AM is significantly higher than that of PECS and it also requires increased support from a Latvian 'space office'. These aspects should be taken into account in any decision made. Irrespective of the route taken, the next years would benefit from focussing on getting products qualified, increasing the industrial participation and establishing connections into the LSI supply chains. Several initiatives in these directions have been undertaken during the last year, contributing to the good results obtained in the 4th and 5th PECS Calls.

Should it be decided to progress to an Associate Membership status, the optional programmes of GSTP and EOEP are deemed to be the most suitable first subscriptions. A significant contribution to the "Incentive Third-party Scheme" should be considered. Should it be decided to repeat a second round of PECS instead, the emphasis should be on progressing towards higher industrial participation and technology readiness levels.

b) Recommendations

Considering the analysis reported in this document, the following recommendations can be made:

- **Recommendation 1:** Latvia is recommended to develop a National Space Plan with clear goals and priorities and identifying the key mechanisms (e.g. funding sources) envisaged to support them.
- **Recommendation 2:** Encourage industry-academia collaboration and broaden the industrial base working in space.



- **Recommendation 3:** Additional publicity to industry of ESA and the available opportunities for participation, potentially in collaboration with industry associations.
- **Recommendation 4:** Ensure support to rapidly raise the TRL of the first mature technologies (e.g. components, event timers and EO applications) sufficiently to enter the supply chain and act as examples for other entities.
- **Recommendation 5:** Should Latvia become an AM, consider to set up an industrial coordination and support team along the lines of the Estonian INNOSPACE project to help industry maximise the return on any ESA investments.

ANNEX 1: REGISTERED ENTITIES

Name	Entity Type	Year of registration
Allatherm SIA	Company	2018
ASPIRED LTD.	Company	2013
Baltic CG	Company	2018
BALTIC OPEN SOLUTIONS CENTER, LTD.	Company	2013
Baltic Satellite Service	Company	2017
BALTIC SCIENTIFIC INSTRUMENTS, LTD.	Company	2011
CRYOGENIC AND VACUUM SYSTEMS	Company	2015
DATORKARTE LTD	Company	2015
DIVERS LV	Company	2016
EMT. ELECTRICAL MECHANICAL TECHNOLOGIES	Company	2019
Envirotech	Company	2018
EVENTECH	Company	2013
First International Technological Platform	Research organization	2017
FOUNDATION INSTITUTE FOR ENVIRONMENTAL SOLUTIONS	Research organization	2013
GPS PARTNERS LTD	Company	2015
HEE PHOTONIC LABS	Company	2013
HELIOCENTRIC TECHNOLOGIES LATVIA	Company	2015
HORUS LABORATORY, LTD	Research organization	2011
INDUCONT, Sabiedriba ar ierobežotu atbildību	Company	2019
INSTITUTE OF ELECTRONICS AND COMPUTER SCIENCE	Research organization	2013
INSTITUTE OF PHYSICS, LATVIA UNI (LATVIA	Research organization	2013

Institute of Solid State Physics, University of Latvia	Research organization	2017
ISMA	Research organization	2019
JSC RD ALFA MIKROELEKTRONIKAS DEPARTAMENTS	Company	2013
LATSPACE	Company	2013
Latvian Association of Science Centers	Company	2013
Latvian Environment, Geology and Meteorology Centre	Company	2016
LATVIAN GEOSPATIAL INFORMATION AGEN	International organization	2013
Latvian Institute of Aquatic Ecology, Agency of Daugavpils University	Research organization	2017
LATVIAN STATE FOREST RESEARCH INSTI	Research organization	2013
LATVIAN STATE INSTITUTE OF WOOD CHEMISTRY	Research organization	2013
Meza ipasnieku konsultatīvais centrs, SIA	Company	2017
MINISTRY OF EDUCATION AND SCIENCE	Research organization	2013
MOBILE SYSTEMS	Company	2011
PASSIVE HOUSE LATVIJA	Company	2013
PLASMA & CERAMIC TECHNOLOGIES	Company	2013
Rezekne Academy of Technologies	Research organization	2015
RIGA TECHNICAL UNIVERSITY	Research organization	2013
SIA "YUNASKO Latvia"	Company	2017
SIA ASTROSAT R&D	Company	2013
SIA BALTIC EMBEDDED	Company	2013
SPH Engineering	Company	2018



SWH SETS	Company	2018
TECHNOLOGY DEVELOPMENT FORUM	Company	2013
the Fund of Support Technologies Development SENTAVID	Research organization	2017
THE INSTITUTE OF MATHEMATICS AND CO	Research organization	2013
THERMCERT LV	Company	2013
Transport and Telecommunication Institute	Research organization	2018
UNIVERSITY OF LATVIA	Research organization	2013
VALSTS AKCIJU SABIEDRĪBA LATVI	Company	2013
VENTSPILS FREEPORT AUTHORITY	Company	2013
VENTSPILS HIGH TECHNOLOGY PARK	Company	2013
VENTSPILS UNIVERSITY COLLEGE	Research organization	2013
VIZULO	Company	2019

ANNEX 2: PECS ACTIVITIES

Prime Contractor	Activity Title	Total (€)	Target TRL
ASPIRED LTD.	RAISING THE MOTIVATION AND AWARENESS OF CHILDREN AND YOUNGSTERS ABOUT SPACE AND SPACE TECHNOLOGIES	50,000	N/A
VENTSPILS UNIVERSITY COLLEGE	VENTSPILS UNIVERSITY COLLEGE SATELLITE TECHNOLOGY EDUCATION PROGRAMME	49,067	N/A
FOUNDATION INSTITUTE FOR ENVIRONMENTAL SOLUTIONS	SIMULATING PERFORMANCE OF ESA FUTURE SATELLITES FOR WATER QUALITY MONITORING OF THE BALTIC SEA	159,979	3
FOUNDATION INSTITUTE FOR ENVIRONMENTAL SOLUTIONS	SIMULATION OF SENTINEL-2 IMAGES FOR LAND COVER / LAND USE MONITORING USING HYPERSPECTRAL AIRBORNE REMOTE SENSING	150,019	3
BALTIC SCIENTIFIC INSTRUMENTS, LTD.	DEVELOPMENT PERFORMANCE OF A MINIATURE GAMMA SPECTROMETER FOR REMOTE SENSING PLANETARY APPLICATIONS	199,995	4
INSTITUTE OF PHYSICS, LATVIA UNI	EVALUATION AND DEVELOPMENT OF LINEAR ELECTRICITY CONVERTERS WITH HYDRAULIC OR ACOUSTIC COUPLING	49,943	2
RIGA TECHNICAL UNIVERSITY	METHODOLOGY FOR ASSESSMENT OF DAMAGE RESISTANCE PROPERTIES OF SANDWICH STRUCTURES FOR EUROPEAN SPACE SECTOR	200,000	4
LATVIAN STATE INSTITUTE OF WOODCHEMISTRY	RIGID POLYURETHANE FOAMS FOR INTERNAL TANK INSULATION FOR LAUNCHER UPPER STAGES (CRYOFOAMS)	201,977	5
RIGA TECHNICAL UNIVERSITY	DEVELOPMENT OF THE PROTOTYPE OF AUTONOMOUS AEROSPACE VEHICLE FOR COMPREHENSIVE MONITORING (DREAM) -INITIAL STUDY	30,000	2
EVENTECH	ONBOARD IMPLEMENTATION OF THE MULTI-PURPOSE EVENT TIMER	396,038	6
JSC RD ALFA MIKROELEKTRONIKAS DEPAR	DEVELOPMENT OF MICROCIRCUIT RD117 (ANALOGUE OF LM117) FOR APPLICATIONS IN ESA MISSIONS -INITIAL STUDY	54,792	4
FOUNDATION INSTITUTE FOR ENVIRONMENTAL SOLUTIONS	ASSESSMENT OF GRASSLAND QUALITY QUANTITY PARAMETERS MANAGEMENT ACTIVITIES USING SENTINEL 12 DATA (SENTIGRASS)	149,509	3
INSTITUTE OF ELECTRONICS AND COMPUTSCIENCE	DYNAMIC LAND USE MONITORING BY FUSION OF SATELLITE DATA (DYNLAND)	146,781	3
JSC RD ALFA MIKROELEKTRONIKAS DEPAR	FEASIBILITY STUDY: RESEARCH AND IDENTIFICATION OF IC FOR APPLICATION IN ESA MISSION: RESEARCH AND DEVELOPMENT OF MICROCHIP ARD124 -EXPRO	199,999	3

LATVIAN STATE INSTITUTE OF WOODCHEMISTRY	DEVELOPMENT OF GREEN POLYURETHANE MATERIALS FOR USE IN SPACECRAFT AND LAUNCHER APPLICATIONS (PTRP) -EXPRO PLUS -T724-502QT	44,879	4
EVENTECH	LASER RANGING STATION (LRS) FOR COOPERATIVE TARGETS -G618-050GS	199,281	7
LATVIAN STATE INSTITUTE OF WOODCHEMISTRY	LV3_06 LIGHT WEIGHT POLYURETHANE INSULATION FOR THE BULKHEAD OF ARIANE ROCKET, PRODUCED WITH THE NEXT GENERATION BLOWING AGENTS AND ENVIRONMENTALLY FRIENDLY CATALYSTS (CRYOFOAMS-LW)	199,216	5
JSC RD ALFA MIKROELEKTRONIKAS DEPAR	LV3_04 DEVELOPMENT OF THE MICROCIRCUIT ARD139A FOR APPLICATIONS IN ESA MISSIONS	200,000	3
VENTSPILS UNIVERSITY COLLEGE	LV3-01 ESTABLISHING NANOSATELLITE GROUND STATION BY ADAPTING RT-16 RADIO TELESCOPE INFRASTRUCTURE - FEASIBILITY STUDY	49,907	2
FOUNDATION INSTITUTE FOR ENVIRONMENTAL SOLUTIONS	LV3-10 EXPANDING EARTH OBSERVATION AWARENESS AMONG KEY DECISION-MAKERS (EXPANDEO)	72,155	N/A
FOUNDATION VENTSPILS HIGH TECHNOLOGY PARK	SPACE CHALLENGE: INTERACTIVE TEACHING TOOL	50,000	N/A
THE UNIVERSITY OF LATVIA	GROUND STATION FOR OPTICAL OBSERVATIONS OF NEAR-EARTH OBJECTS –PREPARATORY STUDY	47,102	2
BALTIC SCIENTIFIC INSTRUMENTS, LTD.	LV3_11 HIGH RESOLUTION X-AND GAMMA–RAY SPECTROSCOPY SYSTEMS FOR SPACE APPLICATIONS	49,982	2
RIGA TECHNICAL UNIVERSITY	LV3_16 DEVELOPMENT AND VALIDATION OF METHODOLOGY FOR ASSESSMENT OF DAMAGE RESISTANCE PROPERTIES OF SANDWICH STRUCTURES FOR EUROPEAN SPACE SECTOR –FEASIBILITY STUDY	49,104	3
FOUNDATION INSTITUTE FOR ENVIRONMENTAL SOLUTIONS	SENTINEL-2 SERVICE FOR REGULAR WATER QUALITY MONITORING IN LAKES (SENTILAKE)	147,271	6
BALTIC SATELLITE SERVICE LTD.	FULLY-AUTOMATED SOFTWARE SYSTEM FOR MONITORING GAS PIPELINE PROTECTION AREAS USING MULTI-SPECTRAL SATELLITE IMAGERY –FEASIBILITY STUDY	49,994	3
MIKC	[LV3_08] -HUMAN SETTLEMENT PATTERN MODELLING - SUPPORT TOOL FOR RURAL DEVELOPMENT PLANNING (HUMAN HABITAT)	50,000	3
EVENTECH LTD.	COMPACT UNIVERSAL TIME MEASUREMENT BLOCK (CUTMB)	99,913	3
RD ALFA MICROELECTRONICS	QUALIFICATION OF IC ARD124A FOR APPLICATION IN ESA MISSIONS	321,904	7
MEIA IPASNIEKU KONSULTATVAIS CENTRS, SIA	DEVELOPMENT OF SERVICE FOR FOREST MONITORING AND RAPID ALERT (FORMAL)	149,550	6



INSTITUTE OF ELECTRONICS AND COMPUTER SCIENCE (IECS)	AUTOMATED IDENTIFICATION OF MIRES AND PEATLANDS USING MULTI-TEMPORAL SATELLITE DATA (MIRECLASS)	200,000	5
UNIVERSITY OF LATVIA, INSTITUTE OF GEODESY AND GEOINFORMATICS	IONOSPHERIC CHARACTERIZATION BY STATISTICS ANALYSIS OF LATVIAN GBAS 11 YEAR SELECTIVE DAILY OBSERVATIONS	70,092	3
BALTIC SATELLITE SERVICE, LTD.	FULLY AUTOMATED FOREST CLEAR-CUT MONITORING SYSTEM BASED ON SENTINEL-1 DATA	149,414	7
ALLATHERM SIA	XENON REFUELLING COMPRESSOR DEVELOPMENT AND ENGINEERING MODEL	386,000	6
LASER CENTRE OF THE UNIVERSITY OF LATVIA	FEASIBILITY STUDY OF SPACECRAFT MAGNETOMETERS BASED ON NITROGEN-VACANCY CENTRES IN DIAMOND	74,079	3
RD ALFA MICROELECTRONICS	FEASIBILITY STUDY ON INNOVATIVE PHOTODETECTOR FOR APPLICATIONS IN ESA MISSIONS	30,000	4
MEZA IPASNIEKU KONSULTATĪVAIS CENTRS, SIA	INNOVATIVE SPATIAL PLANNING SERVICE FOR RURAL DEVELOPMENT	149,335	7
MEZA IPASNIEKU KONSULTATĪVAIS CENTRS, SIA	DEVELOPMENT OF FOREST SOIL FREEZING FORECAST SERVICE FOR NORTHERN REGIONS (FROST)	149,800	6
BALTIC SATELLITE SERVICE, LTD.	AUTOMATED FOREST WIND-FALL DETECTION SYSTEM BASED ON SENTINEL-1 AND SENTINEL-2 IMAGERY	50,000	5

ANNEX 3: ASSESSMENT OF LATVIAN ENTITIES

1 ENTITIES VISITED

JSC RD Alfa Microelectronics

Company Overview

RD ALFA Microelectronics (<http://www.rdalfa.eu>) was established in 1962 and accumulates over 50 years of experience in the design and production of HiRel, RadHard & ITAR free analogue integrated circuits (ICs) for aerospace, defence and other high-performance applications. The company has significant expertise in the field of Analog and Analog to Digital technology (Bi-polar (Bi), Bi-FET, complementary Bi, CMOS, and Bi-CMOS), and the design and testing of microcircuits.

Key figures:

- Annual turnover: **€1.11 million** in 2017
- Number of employees: **63 people** in 2017

Core competences

The company's main offering to customers, who range from video systems and consumer electronics companies to aerospace and defence programmes, are:

- Development, design and manufacturing of ICs and other HiRel semiconductors.
 - o Operational amplifiers;
 - o Comparators;
 - o Amplifiers;
 - o Analog switches;
 - o Sample and hold circuits;
 - o Circuits for general application in electronics.
- Devices for the processing and transmission of video signals over long distances.

Work with ESA

RD Alfa was among the first companies that obtained an ESA contract after the first PECS Call in Latvia in 2013. This first activity has led to two (2) related contracts, making RD Alfa one of the most successful Latvian companies in terms of number of contracts with ESA:

- **Research and Identification of Integrated Circuits (ICs) for application in ESA missions.** The project led to the identification of three (3) ICs of interest for the European Industry Market: αRD124A, αRD108 and αRD139A. An additional Work Package was included through a Contract Change Notice (CCN) to design, manufacture and test industrial prototypes of αRD108, leading to cooperation with Thales Alenia Space France and potential sales of the IC.
- **Development of the microcircuit αRD124 for application in ESA missions.** This IC was identified as the most demanded by the European space industry in the

first study. The project is currently in its last phase, with industrial prototypes of the IC being sent to ESA for testing.

- **Development of the microcircuit aRD139A for application in ESA missions.** The project aims to develop prototype models of the IC α RD139A, the last IC identified in the company's first ESA contract. The IC will be free of any export restrictions and target applications needing enhanced reliability and more than 15 years of lifetime in space.

Recommendation for the next steps

So far, RD Alfa has demonstrated its capabilities to develop working prototypes of IC circuits demanded by the European space industry. During the visit, it was possible to see the modernised encapsulation facilities installed in April-May 2017. However, it is considered key that the company engages in an evaluation/qualification of its processes for at least one of the ICs developed in accordance with the specifications of the European Space Components Coordination (ESCC). The demonstration of the repeatability of all major processes by verification of different wafers and assembly lots is imperative for potential future inclusion into the European Preferred Parts List (EPPL).





Baltic Scientific Instruments

Company Overview

Baltic Scientific Instruments (BSI, <http://bsi.lv/en/>) was established in 1994 on the basis of Riga Research and Development Institute for Radio-Isotope Apparatus (RNIIRP, est.1966), which belonged to the Ministry for Atomic Energy of the former Soviet Union. In 2003, the company entered the German group of Bruker companies, changing its name to Bruker Baltic in 2007. In June 2010, the company bought its share from Bruker AXS and returned to its original name.

The company specializes in the development and serial production of the spectrometric devices based on silicon, high-pure germanium and CdZnTe detectors, as well as in the development and serial production of the spectrometric devices based on silicon, high-pure germanium and cadmium-zinc-tellurium detectors.

Key figures:

- Annual turnover: **€3.66 million** in 2017
- Number of employees: **68 people** in 2017

Core competences

The company's products are applied in nuclear energy, ecology, geology and mineral resource industries, medicine and research activities, customs control, environmental monitoring, space applications and other spheres. BSI's portfolio includes:

- HPGe and Si-based detectors & spectrometers
- CdZnTe/CdTe detectors and associated electronics
- Scintillation detectors, spectrometers & radiometers
- Gas filled detectors
- XRF analysers
- Nuclear electronics
- Related analysis and calibration software

In the space domain, the company has the following heritage:

- Development and fabrication of CdZnTe pixel and strip detectors for space applications (ESA, NASA, SEA Saclay, Danish SRI, Russian SRI, Inst. di Astrofisica e Fisica Cosmica, Italy);
- Development of HPGe gamma-spectrometer for space applications (ESA);
- Development of miniature XRF analyzer for space application (Russian SRI);
- Development of new types of detectors based on TlBr crystals (ESA);
- Development of beta detectors for space applications (Space Science And Applied Research Institute, China).

Work with ESA

BSI was among the first companies that obtained an ESA contract after the first PECS Call in Latvia in 2013, but the company had previous experience with ESA's Science Programme. Only one of the projects before PECS is listed here, but there were additional activities (e.g. testing of TlBr crystals):

- **Technical Assistance in the Development of TlBr Gamma-ray Detection Systems for Planetary and Astrophysics Missions (2005-2010).** This 643.9 k€ project was carried out during the time BSI was a subsidiary of the German company Bruker AXS.
- **Development Performance of a Miniature Gamma Spectrometer for Remote Sensing Planetary Applications.** The total weight of the designed spectrometer, based on 35% registration efficiency HPGe detector, was 3.1 kg with very low power consumption.
- **High resolution X and Gamma-Ray Spectroscopy Systems for Space Applications.** The purpose of this activity is to identify areas and missions that would benefit from new disruptive technologies in X and Gamma-Ray Spectroscopy map them to specific technology developments.

Recommendation for the next steps

Baltic Scientific Instruments has a long history of cooperation with ESA under the Scientific Programme. They have the required expertise to contribute to the development of payloads for scientific missions requiring X and Gamma Ray detectors. It is expected that the outcome of their current ongoing project will help to define a roadmap for future technology developments in the frame of PECS. In the longer term, they might benefit from Latvian participation to the PRODEX programme by participating as an industrial partner. However, a strong research institute would likely be needed to lead the project from a scientific perspective.



Fiber Optical Solution (FOS)

Company Overview

Fiber Optical Solution (FOS) (<http://opticalsolution.lv/>) is a vertically-integrated company specializing in the production Fiber Optic Gyroscopes (FOG). It was established in Riga in 2013 as a sister company of Optolinks, a Russian entities that is owned and managed by the same team. FOS is currently working on a new site for the manufacturing of optical components, including ISO4 clean rooms. Upon completion, the new facilities would allow the manufacturing of gyroscopes and Inertial Measurement Units (IMU) on-site in Latvia.

FOS has supplied high precision FOGs and other Inertial Navigation Systems to more than 20 companies worldwide, including NASA, Applanix Corporation and Lockheed Martin. This involves, however, only non-space applications thus far. Its sister company, Optolinks, has supplied several flight units for the control systems of EgyptSat-1 (Egypt), DubaiSat-2 (UAE), TeleOS-1 (Singapore), KhalifaSat-1 (UAE) and Soyuz.

Core competences

FOS core competences include:

- Fabrication of LiNbO₃ based integrated optic elements
- Fabrication of polarization maintaining fibers (PANDA) and fiber optical components
- Assembly and calibration of fiber optical gyroscopes, inertial measurement units and other inertial navigation systems



Recommendation for the next steps

The capabilities of FOS are very scarce in Europe and represent a very interesting asset for the Latvian space sector, of great interest to ESA and other key players in the European space supply chain. However, there are certain concerns regarding potential quality assurance, IPR and import/export issues on the current version of space-grade FOGs, built mainly using Russian parts. Possible first steps for the company to access the European market would be to undergo a product and quality assurance audit to generate a list of potential improvements, followed by a redesign of the system/s using European parts and complying with the European Cooperation for Space Standardization (ECSS) standards. A potential way to carry out these steps would be through the new Associate Membership's "Incentive Third-party Scheme".

2 OTHER ENTITIES

Eventech

Company Overview

Established in 2011, Eventech is a Latvian technology leader in extremely high-accuracy event timing equipment providing single-shot measurements of extreme accuracy. This has gained them a market share of over 50% in the Satellite Laser Ranging area, but their technology also has potential applications in space LiDAR and 3D altimetry, and could be tailored for data transfer and synchronization for satellite constellations.

Key figures:

- Annual turnover: **€92,400** in 2017
- Number of employees: **4 people (7-8 considering outsourcing)** in 2017

Core competences

- Extremely accurate digital signal processing
- Time-tagging
- Single shot 5-7 ps accuracy of space HW
- Environment and Rad-Hard tolerant devices

Work with ESA

- On-board Implementation of the MultiPurpose Event Timer (MPET)
- Laser Ranging Station (LRS) for Cooperative Targets

Recommendation for the next steps

Eventech has established a valuable cooperation with ESA in the area of Satellite Laser Ranging, being involved through PECS in the development of the first prototype of an ESA SLR station. Thus, the company is very well positioned to get involved in the future developments of an area that is of raising interest to ESA.

In addition, Eventech shall continue to explore the applications of its unique technology in space (flight) systems. For instance, rad-hard compact and low power consumptions Time of Flight blocks are currently not available in Europe. A development in that direction would open new options for miniaturised LiDAR systems among other applications.



Foundation Institute of Environmental Solutions (IES)

Company Overview

IES is a privately-established research and development institution. It is formed by a team of specialists in ecology, limnology, forestry, agriculture, chemistry, physics, technologies, and innovation management who develop Earth Observation and Remote Sensing data-based solutions in their particular fields of expertise.

Key figures:

- Annual turnover: **€ 392,636** in 2017
- Number of employees: **30 people** in 2017

Core competences

- Automated workflows for the classification and change monitoring in different land cover classes
- Wide network or potential end-users and an approach for their need analysis
- ARSENAL, an airborne laboratory consisting of multiple sensors (hyperspectral, thermal and a laser scanner)

Work with ESA

- Simulating Performance of ESA Future Satellites for Water Quality Monitoring of the Baltic Sea
- Simulation of Sentinel-2 Images for Land Cover / Land Use Monitoring using Hyperspectral Airborne Remote Sensing
- Assessment of Grassland Quality Quantity Parameters Management Activities using Sentinel-1/2 Data (SentiGrass)
- Expanding Earth Observation Awareness among Key Decision-Makers (ExpandEO)
- Sentinel-2 Service for Regular Water Quality Monitoring in Lakes (SentiLake)
- Human Settlement Pattern Modelling-Support Tool For Rural Development Planning (Human Habitat): subcontractor to MIKC

Recommendation for the next steps

IES has established itself as a key player in the Latvian EO landscape, which provides an excellent position to get involved in the Baltic Initiative. Within this initiative, collaboration with Estonian and Lithuanian entities would help IES to establish a network in the region that would also be valuable for potential future involvement in the ESA Earth Observation Envelope Programme.

Latvian State Institute of Wood Chemistry (LSIWC)

Company Overview

The Latvian State Institute of Wood Chemistry (LSIWC), founded in 1946, is a State R&D Institute. Its Polymer Department focuses on the specification of raw materials for polyurethane (PUR) and polyisocyanurate (PIR), including biodegradable and recyclable foams, coatings and elastomers, PUR foam synthesis, calculation of thermal economy and environmental impact and consultation of end user of foams.

Key figures:

- Annual turnover: **€ 3.4 million** in 2017
- Number of employees: **112 people** in 2017

Core competences

- Polyurethane materials from renewable resources
- Rigid PU foams as cryogenic insulation material

Work with ESA

- Rigid Polyurethane Foams for Internal Tank Insulation for Launcher Upper Stages (CRYOFOAMS)
- Development of Green Polyurethane Materials for use in Spacecraft and Launcher Applications: under TRP
- Light Weight Polyurethane Insulation for the Bulkhead of Ariane Rocket, produced with the Next Generation Blowing Agents and Environmentally Friendly Catalysts (CRYOFOAMS-LW)

Recommendation for the next steps

LSIWC research has proven to be of interest for the European space sector, allowing the entity to work with Ariane Group under ESA's TRP programme (co-financed through PECS) and to provide inputs to a project under the Future Launchers Preparatory programme. In order to maximise the return that these collaborations can offer to Latvia and the entity, it is recommended to look into ways to commercialise the IPR developed and evolve towards the delivery of related products or services, ideally in collaboration with a Latvian industrial partner.

ANNEX 4: RESULTS OF THE 4TH AND 5TH PECS CALLS

Results of the 4th PECS Call

The Tender Evaluation Board of the 4th PECS Call for Outline Proposals in Latvia was held in the 1st Quarter of 2019, followed by the debriefing to the Latvian Delegation. Fourteen (14) proposals were received and evaluated, resulting in six (6) activities being recommended for implementation and endorsed by the Latvian Delegation. This leads to a success rate of 43%, which represents the highest percentage of proposals scoring over 50 in a PECS Call in Latvia.

The average score of the recommended proposals was 61.9, with a maximum score of 70, a minimum of 57.5, and four (4) out of the six (6) proposals scoring above the benchmark of 60 that is considered needed to compete in ESA Optional Programmes. These results denote a significant improvement in the quality of the proposals with respect to previous Calls.

The recommended activities have received approval by the relevant ESA Delegate Bodies and, if the negotiations are successful, will represent new commitments amounting to 991k€. The following facts can be highlighted with respect to the distribution of the potential commitments:

- Four (4) activities are led by industrial entities, with an additional activity led by a research organisation that includes an industrial subcontractor. This leads to 811k€ of commitments allocated to industry, 82% of the total commitments foreseen for this Call.
- One (1) of the recommended activity falls within activity type a) Flight segment related activities; one (1) activity addresses activity type b) Research and Development Activities; two (2) activities target activity type c) Space (Downstream) Applications; and two activities address activity type d) Preparatory Activities.
- Four (4) activities target TRL 5-7, with the other two (2) activities targeting TRL 3.
- The recommended activities can be divided in the following Service Domains (SD):
 - SD1-Earth Observation: three (3) activities focus on the development of EO-based downstream services for forest monitoring and automatic identification of mires and peatlands, with target TRLs in the range of 5-7. Approximately 50% of the foreseen commitments of the Call are allocated to this SD.
 - SD7-Generic Technology and Techniques: two (2) activities fall within this SD, both in the area of flight hardware. One is a preparatory activity for a time measurement block targeting TRL 3, while the other one aims at the evaluation of an operational amplifier developed in the frame of PECS, targeting TRL 7. Approximately 43% of the foreseen commitments of the Call are allocated to this SD.
 - SD8-Space Surveillance: one (1) activity, representing 7% of the foreseen commitments, falls within SD8. It is a preparatory activity (target TRL 3)



looking at the impact of space weather events on the GNSS Ground Based Augmentation Systems that are in place in Latvia.

Overall, these results denote a significant improvement with respect to previous PECS Calls in several areas. The average score of the recommended proposals is above 60, which is considered the minimum needed to be able to compete with entities from other ESA Member States in competitive tenders. The industry ratio for the Call is higher than the benchmark of 75% percent, defined as a guideline to successfully achieve return in ESA programmes. In addition, most of the activities target the TRL 5-7 range, including a case of collaboration between research and industrial organisations to do so. Developments in this range tend to demonstrate sufficient capabilities in a specific area.

The programmatic changes performed by ESA and the Latvian Delegation in preparation of the 4th PECS Call in Latvia have so far contributed to raising the industry ratio and target TRL. At the same time, the briefings to industry and the cumulative experience of Latvian entities working with ESA have allowed for a significant increase in the quality of the proposals. The option of collaborating with Lithuanian entities has not been exploited so far, but the Baltic Space Industry Event held in Riga is expected to encourage collaboration of Latvian entities with actors from Lithuania, Estonia and potentially LSIs in future Calls.

Results of the 5th PECS Call

The Tender Evaluation Board of the 5th PECS Call for Outline Proposals in Latvia was held on the 12th of June 2019, followed by the debriefing to the Latvian Delegation. Fourteen (14) proposals were received and evaluated, resulting in six (6) activities being recommended for implementation and endorsed by the Latvian Delegation. This leads to a success rate of 43%, which matches the overall result of the 4th PECS Call.

The average score of the recommended proposals was 54.75, with a maximum score of 61.5 and a minimum score of 50.5. Only one of the proposals scored above the benchmark of 60 that is considered needed to compete in ESA Optional Programmes, which represents a decline with respect to the previous Call.

The recommended activities will be submitted for approval to the relevant ESA Delegate Bodies on the second half of 2019. Assuming the activities receive the necessary approvals and that the negotiations are successful, these activities will represent new commitments amounting to 839k€. The following facts can be highlighted with respect to the distribution of the potential commitments:

- Five (5) activities are led by industrial entities, with only one (1) activity led by a research organisation. This leads to 765k€ of commitments allocated to industry, 91% of the total commitments foreseen for this Call.
- One (1) of the recommended activity falls within activity type a) Flight segment related activities; one (1) activity addresses activity type b) Research and Development Activities; two (2) activities target activity type c) Space (Downstream) Applications; and two (2) activities address activity type d) Preparatory Activities.
- Four (4) activities target TRL 5-7, with the other two (2) activities targeting TRL 3-4.
- The recommended activities can be divided in the following Service Domains (SD):
 - SD1-Earth Observation: three (3) activities focus on the development of EO-based downstream services, with target TRLs in the range of 5-7. Approximately 42% of the foreseen commitments of the Call are allocated to this SD.
 - SD7-Generic Technology and Techniques: three (3) activities fall within this SD. Two are feasibility studies on innovative concepts for photodetectors and spacecraft magnetometers, targeting TRL 4 and 3 respectively, and the other deals with the development of a Xenon refuelling compressor up to TRL 6. Approximately 58% of the foreseen commitments of the Call are allocated to this SD.

Although the average score achieved is lower than the one of the previous Call, the positive trends in industrial participation and high TRL levels have been maintained. In addition, the distribution of activity types and service domains of the recommended activities are well aligned with previous Calls, which suggests a consolidation of the Latvian industry's competences and interests in the space field. Besides, some of the non-successful proposals represent promising developments and are likely to be recommended in the 6th PECS Call, assuming the feedback provided to the bidders is well addressed in the resubmissions.