



**MINISTER OF EDUCATION AND SCIENCE OF THE REPUBLIC OF
LITHUANIA**

ORDER

**REGARDING THE APPROVAL OF THE NATIONAL RESEARCH PROGRAMME
'TOWARDS FUTURE TECHNOLOGIES'**

08 May 2015, No. V-480

Vilnius

Having regard to Sub-Item 25.1 of the Regulations of the National Research Programmes approved by Resolution No. 731 of 16 July 2008 of the Government of the Republic of Lithuania *On the approval of the Regulations of National Research Programmes*, and for the purpose of the implementation of Item 3 on the List of the National Research Programmes approved by Order No. V-949 of 11 October 2013 of the Minister of Education and Science *On the approval of the list of the National Research Programmes*, and having regard to Letter No. 4S-1968 of 29 December 2014 of the Research Council of Lithuania *On the submission of a project under the National Research Programme*,

I hereby approve the National Research Programme *Towards future technologies* (attached).

Minister of Education and Science

Dainius Pavalkis

APPROVED

Order No. V-480 of 8 May 2015
of the Minister of Education and Science
of the Republic of Lithuania

NATIONAL RESEARCH PROGRAMME 'TOWARDS FUTURE TECHNOLOGIES'

CHAPTER I

GENERAL PROVISIONS

1. The National Research Programme 'Towards future technologies' (hereinafter – the Programme) is designed to create the preconditions for the development of future technologies and to enhance the potential of Lithuanian studies and research institutions and prepare them for participation in the research and technologies programmes implemented by the European Space Agency (www.esa.int/ESA) (hereinafter – ESA).

2. For the purpose of attaining the principal objective of the Long-Term Development Strategy of the State approved by Resolution No. IX-1187 of 12 November 2002 of the Seimas of the Republic of Lithuania – to create an environment for the development of the country's material and spiritual well-being which is summarised as a secure knowledge society and competitive economy, it is of the utmost importance for Lithuania to develop future technologies. Space activity in the political and economic context of the modern world is one of the most important driving forces of the knowledge economy. Since 2004, the European Union (hereinafter – EU) has been implementing its space policy in close cooperation with the ESA. Having approved the European space policy guidelines in 2007 and as space activity is designated in the Lisbon Treaty as one of the strategic priorities of the general policy of the EU envisaged to implement the political, economic and social objectives of the EU, the fully-fledged involvement of Lithuania in European space programmes is only possible by joining ESA activities.

3. Lithuania started its integration into ESA activities by adopting the National Programme on the Development of Research, Technologies and Innovations 2010-2015, approved in 2010 by Order No. 4-436 of 7 June 2010 of the Minister of Economy of the Republic of Lithuania 'On the approval of the National Programme on the Development of Research, Technologies and Innovations 2010-2015 and the implementation measure plan in 2010-2011', and by the *Agreement between the Government of the Republic of Lithuania and the European Space Agency Concerning Space Cooperation for Peaceful Purposes* signed on 7 October 2010 in Vilnius and ratified by Law No. XI-1658 of 15 November 2011 of the Republic of Lithuania 'On the ratification of the Agreement between the Government of the Republic of Lithuania and the European Space Agency Concerning Space Cooperation for Peaceful Purposes'. The next step was the development of the Lithuanian Innovation Development Programme for 2014–2020, approved by Resolution No. 1281 of 18 December 2013 of the Government of the Republic of Lithuania 'On the approval of the Lithuanian Innovation Development Programme for 2014–2020' which emphasises the importance of the development of space and related areas for the development of the country.

4. Although Lithuanian scientists have achieved a high international level in a number of areas, only a small share of research results have eventually become new products. The cooperation between science and business in Lithuania to date has been insufficient, meaning that technologies have to be imported extensively. High technology industries account for only a small proportion of Lithuanian industry, or its export. This demonstrates the insufficient coordination of the creation of science knowledge in Lithuania, and means that the knowledge created rarely becomes a commodity. Therefore the research potential of Lithuanian scientists needs to be guided towards areas which are relevant both on the global and on the national scale and in which their potential could be developed and explored to the

maximum possible extent. A consolidation of the efforts of national researchers for addressing specific scientific and technology tasks in the context of the ESA would not only ensure a breakthrough in technological development, but would also create conditions conducive to the development of business based on locally-created technologies.

5. Space activity is important for both the State and its citizens, as the space sector creates technologies and innovations: it increases the competitiveness in the context of the highest level of science and technologies; when transferred to other industry sectors such innovations increase the overall innovative potential and competitiveness of the country; when used by small or medium business entities it ensures the provision of a wide spectrum of services based on the data received from the space to the public sector and citizens, improves the quality of their life, and reduces social exclusion.

6. Space activities have extensive innovation potential and horizontally encompass all directions and scientific technologies. Space technologies, in the same manner as military technologies, are the most leading-edge technologies, and therefore by enhancing the general culture of innovation, they ensure the competitiveness of the country. Space technologies in different sectors are used as the basis for developing systemic products and services with the highest added value. Space activities help to address the most important problems of political, economic and technological independence and security. Cooperation with the ESA ensures the fast and efficient utilisation of the results of research activities in the innovation cycle, as well as access to edge-cutting technologies and international level expertise. Participation in the ESA activities ensures the implementation of national priorities and the rapid development of competences which meet the needs of both Lithuania and of the EU.

7. One of the major challenges to be addressed in the 21st century which is of special relevance to Lithuania is ensuring the security of information and communication. The development of the technologies required to tackle this problem requires studies in the generation of electromagnetic waves and their detection, new materials, nanoelectronics, information communications and related themes. Lithuania has developed scientific potential which is of an international level in many areas; however, it is not sufficiently concentrated enough to enable the carrying out of high level research relevant to the country in order to essentially enhance Lithuania's competitiveness, its information and communication security and the efficiency of the public sector performance.

8. In view of the rapid development of the services based on space technologies and/or the data acquired from space, an increasing number of States are engaging in space research, including smaller States. Being an EU Member State means Lithuania has the only efficient way to engage in space activities – joining the ESA.

9. ESA membership is only possible only when a State is capable, by participating in competitive procedures, of recovering its contribution to the ESA budget through orders for national research and business entities. ESA member states must participate in the ESA research programmes and may choose ESA technology development programmes as prioritised.

10. Having performed an audit of the possibilities for Lithuanian research and business entities to participate in ESA programmes in 2013, ESA experts concluded that while the potential of the Lithuanian research and development (social and cultural) activities (hereinafter – R&D) was sufficient for starting cooperation with the ESA, it was not sufficiently coordinated enough to address the highest level scientific and technological tasks and compete on an equal basis in the context of the other ESA member states. Therefore a recommendation was submitted to implement a programme which would help Lithuanian scientists to prepare for successful participation in ESA activities.

CHAPTER II

ANALYSIS OF THE CURRENT STATUS OF THE RESEARCH

11. The development of high technologies and the re-industrialisation of Europe, i.e. the return of manufacturing, has been a widely discussed topic in the EU. Initiatives were highlighted in the Framework Programme for Research and Innovation Horizon 2020 (2014-2020) approved by Regulation (EU) No. 1291/2013 of the European Parliament and of the Council of 11 December 2013 (establishing the Framework Programme for Research and Innovations Horizon 2020 (2014-2020) and repealing Decision No. 1982/2006/EC (hereinafter – Horizon 2020 Programme), the Programme for the implementation of priority directions in research and development (social and cultural) and innovations (smart specialisation) approved by Resolution No. 411 of 30 April 2014 of the Government of the Republic of Lithuania *On the approval of the Programme for the implementation of priority directions in research and development (social and cultural) and innovations (smart specialisation)*, the European Space Programmes Galileo (global navigation satellite system) (www.esa.int/Our_Activities/Navigation/The_future_-_Galileo/What_is_Galileo) and Copernicus (global monitoring for environment and security) (www.esa.int/Our_Activities/Observing_the_Earth/Copernicus), as well as in other strategic programmes of European importance.

12. ESA experts concluded that Lithuania has a high level of scientific potential capable of developing and applying space, defence, strategic independence and other key enabling technologies. The largest R&D potential lies in areas related to the generation, conversion, transmission and registration of microwave and infra-red electromagnetic radiation and the creation of the new materials required for this processes. This potential is capable of building the scientific base required both for meeting national needs for new strategic technologies, their integration into European and international high technology development networks and for successfully competing within ESA programmes.

13. Lithuania is participating in the formation and the implementation of EU space policy and contributes to the funding of EU space programmes by paying its EU membership fee. However, national research and business entities participate in the implementation of EU space programmes only indirectly – by executing sub-contracted orders from the entities of ESA member states.

14. Outcome expected to be achieved by implementing the provisions of the Lithuanian space policy: the Lithuanian space sector would successfully join ESA activities and European space programmes and would become competitive on a global scale; space technologies would be transferred faster and applied in other sectors, thus creating conditions conducive to the development of the potential of space technology researchers and increasing the attractiveness of a career as a researcher, reducing the 'brain drain'; the knowledge about space and the products and services created on the basis of space technologies would be useful both in terms of gaining and accumulating knowledge for the State and the well-being of its citizens.

15. Most Lithuanian research and studies institutions – Vilnius University, the Kaunas University of Technology, the Lithuanian University of Health Science, Vilnius Gediminas Technical University, the Centre for Physical Sciences and Technology, the Nature Research Centre, and the Lithuanian Energy Institute have demonstrable scientific potential equal to that of the groups of researchers currently participating in ESA programmes.

16. The wide number of space science and technologies programmes creates a platform for the participation of practically all high level Lithuanian scientists to relate their research work to the subject matters of the ESA programmes. Such developments would stimulate competition among the Programme's projects and would develop a wide-spectrum of scientific competence creating the preconditions for the successful implementation of the Programme.

17. The Lithuanian R&D potential is adequate for carrying out high level international level research. The concentration and efficient coordination of the efforts of implementers of projects under the Programme would facilitate the preparation of a sufficient number of groups of researchers capable of competing within ESA programmes with researchers in other countries, and would mean that Lithuania would acquire the right to become a member of the ESA.

CHAPTER III

OBJECTIVE AND TASKS OF THE PROGRAMME, IMPLEMENTATING MEASURES

18. The purpose of the Programme is to create a favourable international context and the conditions for research to build up a basis for developing future technologies, promoting innovations and enhancing Lithuania's competitiveness and security.

19. The objective of the Programme is planned to be achieved by developing the fundamental and applied research necessary for the integration of Lithuanian economic entities into the research and technology development programmes of the ESA which will materially contribute to the enhancement of the Lithuanian science and the expedient implementation of its results.

20. The most important condition for Lithuania's joining the ESA is the potential of national science to compete with other implementers of ESA programmes. Therefore, priority shall be given within the competitions of projects under the Programme to research which is directly related to programmes implemented by the ESA.

21. The projects implemented under the Programme may encompass no more than five stages of research and development as defined in the description of the recommended classification of the stages of research and development activities, approved by Resolution No. 650 of 6 June 2012 of the Government of the Republic of Lithuania 'On the approval of the description of the recommended classification of stages of research and development activities'.

22. The Programme addresses two tasks:

22.1. the acquiring of special competences and experience in carrying out research according to the themes provided for in ESA programmes;

22.2. the development of research activities focusing on the studies of methods of the generation, transmission and registration of electromagnetic radiation.

23. Two measures have been envisaged with respect to the first task under the Programme:

23.1. Fundamental research

23.1.1. participation in preparing and implementing ESA research programmes (Euclid, PLATO, Solar Orbiter, James Webb Space Telescope, JUICE, ATHENA (<http://sci.esa.int/euclid>; <http://sci.esa.int/plato>; <http://sci.esa.int/solar-orbiter>; <http://sci.esa.int/jwst>; <http://sci.esa.int/juice>; <http://sci.esa.int/cosmic-vision/54517-athena>));

23.1.2. carrying out research according to the themes relevant for the Programme: land-based observations complementing the data of space observatories; the development of methods for the processing and analysis of intellectual large scale heterogeneous spectrophotometry data; the development of advanced image recognition and classification methods; the development of new

data archiving and knowledge search methods, and analysing the archive data accumulated according to ESA programmes.

23.1.3. After Lithuania joins the ESA, participation in research under the measure referred to in Item 23.1 will be mandatory. For Lithuanian researchers to acquire sufficient special competences it is intended that 8-10 projects be implemented under the measure provided under the Programme.

23.2. Applied research

23.2.1. participation in the ESA physical and life sciences programme ELIPS (www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/Taking_the_ISS_to_the_next_level_ISS_exploitation_and_ELIPS), carrying out research in the area of satellite navigation (the Galileo programme), satellite communications, Earth observation (the Copernicus programme), integrated services and related areas;

23.2.2. carrying out research on subjects relevant to the Programme: the development of functional and smart materials and their study under micro-gravitation conditions; the development of signal and data flows formation and compression algorithms; the development of autonomous robots and mechatronics systems designed to operate in a changing gravitation environment; the study of human movement, orientation, speech and recognition abilities under micro-gravitation conditions; the development of non-contact methods for the identification and monitoring of the human psycho-physiological condition; the study of plants and animals under micro-gravitation conditions; the development of information and communication security and remote observation systems on the basis of satellite data; the development of innovative (high capacity, energy efficient and safe) computation methods for space programmes;

23.2.3. After Lithuania joins the ESA, there will be the possibility to choose the research themes under the measure referred to in Item 23.2. 6-8 projects under this measure of the Programme are intended to be implemented in order to identify the most promising areas for research and to enable Lithuanian researchers to acquire a sufficiently wide spectrum of special competences.

24. Two measures have been envisaged with respect to the second task under the Programme:

24.1. The development and study of sources of electromagnetic radiation, generation systems and the related materials:

24.1.1. anticipated themes for the projects under the measure: new generation electromagnetic radiation sources and their components created by nanotechnology methods; optoelectronic systems using electromagnetic radiation sources; ultra-short impulses (picosecond and femtosecond) solid state and fibre lasers, related coatings and optical components; micrometric and nanometric material processing; new generation functional and smart, nanostructural materials by design for sources and generation systems;

24.1.2. It is intended that 4-6 projects be implemented under this measure of the Programme.

24.2. The development and study of electromagnetic radiation sensors, generation systems and related materials:

24.2.1. anticipated themes for projects under this measure: broadband and selective sensors and their components developed according to nanotechnology methods; photonic, plasmonic, ionic and other sensors developed according to carbon electronics principles; new generation spectroscopic, imaging, telecommunication, detection systems and their components (lenses, filters, modulators,

waveguides, etc.); new generation functional, smart, nano-structural substances which have the qualities required for sensors and registration systems;

24.2.2. It is intended that 6-8 projects be implemented under this measure of the Programme.

CHAPTER IV

PROJECTED RESULTS, THEIR ASSESSMENT CRITERIA AND THE USAGE

POSSIBILITIES

25. The key expected outcome of the Programme is the preparedness of Lithuanian researchers to compete on equal basis with entities in other countries in relation to the implementation of projects under ESA research and technologies programmes which will facilitate and ensure the conditions for Lithuania to join the ESA.

26. The implementation of the Programme will enable Lithuanian researchers to concentrate their efforts and enable Lithuanian research institutions to cooperate on an equal basis with entities in other countries while implementing programmes according to the subjects covered by the ESA, to participate in the networks of the European Research Area, the 'Horizon 2020' Programme, and the programme for the implementation of priority directions in research and development (social and cultural) and innovations, as well as the relevant priority activities.

27. Addressing the first task under the Programme will facilitate the acquisition of the special competences and experience related to the subjects under ESA programmes, which will ensure the successful integration of Lithuanian researchers into the research, technologies and innovations programmes of the EU.

28. The results obtained in relation to the implementation of the projects under the first task will constitute the basis for drawing up the recommendations for the identification of the most relevant areas of Lithuania's scientific and technological cooperation with the ESA.

29. Addressing the second task is expected to bring about a breakthrough in the area of microwave and infra-red radiation sources and sensors, and the development of their systems. The implementation of the projects under the task will create a basis for Lithuanian researchers to successfully and efficiently participate in ESA technology and innovation programmes for cooperation with business entities in Lithuania and other Member States of the EU for the purpose of developing future technologies.

30. The results obtained in relation to the implementation of the projects under the second task will constitute the basis for drawing up the recommendations for the identification of the most prospective areas of the development of future technologies for Lithuania.

31. The Programme encompasses the areas of research in which Lithuania has accumulated an exceptionally high level scientific potential with a huge number of knowledge-intensive companies. Therefore it is reasonable to expect that the results of the Programme will be expediently applied in practice, as partners of some of the projects implemented under the Programme will be Lithuanian business entities.

32. Key quantitative criteria for the evaluation of the Programme's results will be the relevance of the research results in the international context, their innovativeness, reliability and the significance of their dissemination.

33. The results of the Programme will be evaluated according to the following indicators:

33.1. scientific articles in journals which are included in Thomson Reuters Web of Science Journal Citation Reports (<http://thomsonreuters.com/journal-citation-reports>) and which have no lower than a Q1 citation index in the group of the respective themes (no less than 50);

33.2. obtained patents (patent applications filed) registered in the European Patent Office (EPO), United States Patent and Trademark Office (USPTO), or the Japan Patent Office (no less than 5);

33.3. developed and implemented new technologies (no less than 5);

33.4. developed and studied new materials (no less than 10);

33.5. developed and tested models of new equipment and software (no less than 10);

33.6. developed and tested methods of measurement and data analysis (no less than 10);

34. The results of the Programme will be made available to all entities of interest in Lithuania and be accessible for the purpose of research in other research, technology and innovation programmes.

CHAPTER V

IMPLEMENTATION OF THE PROGRAMME, MONITORING AND REPORTING

35. The Programme shall be administered by the Research Council of Lithuania (hereinafter – the Council), in accordance with the Regulations of the National Research Programmes approved by the Government of the Republic of Lithuania, and the *Description of the procedure for the preparation and implementation of National Research Programmes* approved by the Council and agreed with the Ministry of Education and Science.

36. The Council will carry out the monitoring of the implementation of the Programme; while performing this function the Council shall review the results of Programme on an annual basis and draw up the interim and the final reports for the Programme, publish the reports on the website of the Programme, and organise the evaluation and public discussion of the reports.

37. For the purpose of the interim evaluation of the Programme the Council shall evaluate an interim report submitted by the Programme Implementation Group; such interim report shall be submitted after three years of the Programme's implementation. Having evaluated the report on the Programme, the Council may propose to specify the Programme, or in the case that the Programme has been implemented unsatisfactorily or insufficient funding has been allocated for the implementation of the Programme, it may propose the implementation of the Programme be terminated earlier than initially anticipated.

38. The reports of the Programme specifying the results of the projects implemented under the Programme, as well as the conclusions obtained and its recommendations are submitted to the ministries concerned and other institutions which will be published at events in relation to the publishing of the results in the media and by other means of information.

CHAPTER VI

FINAL PROVISIONS

39. The Programme shall be funded subject to the financial capacities of the State by appropriations from the budget of the Republic of Lithuania committed for the Council and from other legitimate funding sources. The projected period for addressing the tasks and the implementation of the measures is 2015-2020. A preliminary funding demand for the tasks and the measures in 2015-2017

is specified in the Annex to the Programme. Having examined and evaluated the results of the interim report of the Programme, the Minister of Education and Science provides for the funding requirement for the implementation of the Programme in 2018-2020.

40. The implementation of the Programme is completed after the Research Council approves the final report of the Programme.

NATIONAL RESEARCH PROGRAMME 'TOWARDS FUTURE TECHNOLOGIES'

ANNEX

IMPLEMENTATING MEASURE PLAN OF THE NATIONAL RESEARCH PROGRAMME 'TOWARDS FUTURE TECHNOLOGIES' FOR 2015-2017

Task of the Programme	Measures implemented with respect to the task of the Programme	Preliminary funding requirement, EUR'000			
		2015	2016	2017	Total:
1. Acquire special competences and experience in carrying out research according to the themes of the research programmes of the European Space Agency.	1.1. Fundamental research 1.2. Applied research	580	735	735	2,050
2. Develop research activities focusing on the studies of methods of generation, transmission and registration of electromagnetic radiation.	2.1. Develop and study sources of electromagnetic radiation, generation systems and related materials 2.2. Develop and study sensors of electromagnetic radiation, generation systems and the related materials:	580	735	735	2,050

Task of the Programme	Measures implemented with respect to the task of the Programme	Preliminary funding requirement, EUR'000			
		2015	2016	2017	Total:
Total for the Programme:		1,160	1,470	1,470	4,100