

## **Building Polish space sector – from small islands of excellence to a national innovation ecosystem**

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A leading motto for UE space R&D strategy has been “Prepare for the increasing role of space in the future and reap the benefits of space now”. Implementation of the latter involves two European space flagships. One has been Galileo, the European global satellite-based navigation system, providing a highly accurate, guaranteed global positioning service under civilian control, and another Copernicus, the European Program for the establishment of the European capacity for Earth Observation based on a constellation of periodically launched Sentinel satellites. Both, high precision of Galileo positioning services staying under civilian control, and a free, public access model to Sentinel data, have created limitless opportunities to European business, administration and researchers for uptake of space data for the development of innovative applications and contribute to the steady growth of the European digital market. Examples include the emerging 5G mobile wireless standard for better implementation of the Internet of Things and ubiquitous and everywhere access to the Internet, intelligent transport including unmanned, autonomous vehicles, precision agriculture using farming robots, and homeland security. These innovations would come at a cost, however, as related technological challenges would include, among others, a need to develop more efficient electrical power generation and energy storage technologies than the ones used today (lithium batteries or fuel cells), to ensure navigation service integrity despite of signal degradation in urban areas, fusion of data from incompatible sources, and space debris mitigation, due to the excessive amount of human made objects on low orbits around the Earth.

Poland has a long way to go to benefit from the rapidly growing market of space-based data and services, even with some of its research entities being already able to catch up with their leading European counterparts, and to actively participate in the global technological race, in several specific domains. In the paper, major findings on the state of space research and exploitation in Poland will be presented, based on analytical reports published annually by the Polish Space Agency (POLSA). Their methodology has been based on the European Space Agency (ESA) technology tree, providing a three-level classification system for all space-related technical knowhow, including technology domains, subdomains and groups. The analyzed data involved top level publications records of all Polish research institutions, reports of projects funded by the National Science Center and the National Research and Development Center, data on successful Polish participants in ESA procurements, as well as on Polish partners of all international consortia implementing projects funded by Horizon 2020 Space EU program. Based on that, the national potential could have been assessed in a comprehensive way, in particular, existing islands of excellence identified as strengths to exploit, and shortages as weaknesses to challenge. This activity of POLSA fits to the Polish Space Strategy, published by the Polish Government in 2017 to set up the list of specific objectives to be reached by 2030, in particular increasing competitiveness of the Polish space sector, developing satellite applications contributing to the process of building the digital economy in Poland, and strengthening the national capability in the area of security and defense. The National Space Program being developed by POLSA, soon after publication of the PSA strategy document, specifies the planned activities and undertakings intended to pave the way for its implementation.

In the conclusion of the paper perspectives of implementing the National Space Strategy will be discussed in short based on such a model of innovation ecosystems: exploiting opportunities offered by unique (niche) technological specializations identified above, setting up their key enterprises on the path of growth to manufacturing excellence, development of innovation capabilities of their compatible ecosystem research participants, as well as building staff expertise, competences and skills.