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The Centre for Scientific Geospatial Analyses and Satellite Computations with Laboratories for Testing and Authorising Geomatic Products (CENAGIS) – project description

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Introduction

In December 2018, the Marshal of the Mazowieckie Voivodeship and the Rector of the Warsaw University of Technology signed an agreement for the implementation of the project entitled "The Centre for Scientific Geospatial Analyses, Satellite Computations with Laboratories for Testing and Authorising Geomatic Products (CENAGIS)". Currently created Centre starts its planned activities. The project received EU funding under the competition no. RPMA.01.01.00-IP.01-14-061/17 from Activity 1.1. Research-and-development activities of research units, project type: "Support for research and development infrastructure of scientific units" of the Regional Operational Programme for the Mazovia Voivodeship for the period 2014–2022. The beneficiary of the project is the Warsaw University of Technology (Faculty of Geodesy and Cartography), which implements the project in Consortium with companies: OPEGIEKA Sp. z o.o., Intergraph Polska Sp. z o.o. and Cloud Ferro Sp. z o.o. The new research and development infrastructure is located in the Main Building of the Warsaw University of Technology and in the Scientific and didactic centre of the Warsaw University of Technology in Józefosław near Piaseczno/Warsaw.

According to the terms of the competition, the main objective of such projects as CENAGIS is to achieve a significant increase in the share of research units' revenues from business sources and to improve the quality of research in Poland in the field of broadly understood geomatics. In accordance with the *Development Strategy for the Mazowieckie Voivodeship until 2030, Innovative Mazovia* (*Strategia Rozwoju Województwa Mazowieckiego do 2030 roku. Innowacyjne Mazowsze – SRWM*) the implementation of the project is located in the Warsaw Metropolitan Area (Obszar Metropolitalny Warszawy – OMW), defined as a growth pole – identified in accordance with the indicated objective 1.1 *Strengthening the metropolitan functions of voivodeship centres and integration functional urban areas* (*KSRR – Krajowa Strategia Rozwoju Regionalnego*). More than half of the research units operating in the region are located in the OMW. Among the directions of activities addressed to the Warsaw Metropolitan Area and specified in the SRWM there is e.g:

– strengthening Warsaw's metropolitan functions,

– development of specialization in the area of innovative economy, e.g. through the expansion of research and development infrastructure and technology transfer, including within the Warsaw Technology Space.

The CENAGIS project is part of the above-mentioned directions of actions. It implements the following development goals and directions of actions adopted in the Territorial Contract for the Mazowieckie Voivodeship:

1. Improvement of research quality and strengthening the cooperation between the science and economy sectors:
   a) development of R&D infrastructure, high technologies and innovations resulting from national and regional specializations,
   b) development of international scientific and research cooperation of the strongest research institutions and teams,
   c) development of regional cooperation networks and flow of modern technologies using the existing potential of the Warsaw Metropolitan Area,
   d) promotion of business investment in scientific research, development of links between enterprises, R&D centres and universities, support of technological and applied research.

Research objectives based on the created research and scientific infrastructure are in line with the following strategic directions of the National Program of Research, among others:

- advanced information, telecommunications and mechatronic technologies,
- environment, agriculture and forestry,
- social and economic development of Poland in the conditions of globalizing markets,
- national security and defense.

The research objectives are in line with:

– Regional Innovation Strategy for Mazovia 2014–2020 (Regionalna Strategia Innowacji – RIS) and are primarily in the areas of the Smart Specialization of Mazovia:
  - intelligent management systems,
  - modern business services.

In particular, the Project implements the priority research directions and research objectives defined in RIS of Mazowieckie Voivodeship (among others, no. 23 "Solutions supporting geoinformation management" – National Smart Specialization no. 10 "Intelligent networks, information and communication technologies and geoinformation" (Krajowa Inteligentna Specjalizacja – KIS) (section: Innovative technologies and industrial processes).

Specific project objectives

The above-mentioned general objectives are implemented by the creation of the first geospatial scientific analysis centre in Poland, with a profile that fits into the above-mentioned RIS and KIS, using the latest technologies, especially geoinformatics and information technology that allows remote access to newly created unique research laboratories

for a wide group of scientists and cooperating innovative technology companies. The aim of the project is to create a unique, comprehensive research centre in the field of geomatics. Geomatics is a scientific and technical field that deals with the acquisition, analysis, interpretation, dissemination and practical use of geoinformation (source: "Internet Geomatics Lexicon", Polish Association for Spatial Information, 2010). It includes both technologies and methods of spatial data acquisition using various sensors and instruments, as well as geoinformatics technologies and methods, allowing for the management of spatial data and creation of various geoinformation applications.

So far, the scientific community in Poland dealing with geospatial analyses has not had any computing centre of this type.

The demand for the results of geospatial analyses and intelligent geo-information applications is growing exponentially, and a noticeable manifestation of the widespread access to geo-information systems are car navigation systems, geoportals, spatial information systems (GIS – Geographical Information Systems), or systems for monitoring vehicles and people, including those using remote sensing technologies. The market for obtaining spatial data from unmanned aerial platforms (drones, UAVs) is developing extremely dynamically. One of the foundations for the development of the so-called smart cities and smart villages becomes access to and analysis of geoinformation. Autonomous vehicles, which rely on the collection and analysis of highly accurate geospatial models, are becoming an extraordinary driving force for the industry of the future. In all these cases, both data-collecting sensors (measuring devices) and data processing and analysis systems (big data type) are important. Spatial data is also playing an increasingly important role in the trade sector. The so-called e-commerce developes, in particular based on geomarketing, profiling of user preferences and advertising messages, depending on the spatial location of customers, including precise location inside buildings.

Research in this field needs to be intensified in order to be included in European and global research programmes. It is necessary to integrate research in the field of geomatics in national scientific units and enterprises and to create conditions for the development of new innovative technology companies. The planned centre can play a key role in this process, consolidating and strengthening the position of the Mazowieckie Voivodeship as a leader in innovation and scientific research. In the field of geoinformation technologies and broadly understood geomatics, it is necessary to carry out research on the development of navigation systems and applications, the development of remote sensing and photogrammetric methods and technologies, 3D modeling and geovisualization methods, laser scanning data processing methods, modern spatial management, spatial planning and monitoring, and measurements of the whole Earth (satellite, gravimetric, rotational motion, etc. measurements). The basis for their implementation is access to geospatial information.

Over the past several years, revolutionary changes have been made in the field of collecting geospatial data in Poland. This process has intensified especially in the last

few years as a result of great efforts of the Geodetic and Cartographic Service, in particular the Chief Geodesist of the Country, the implementation of the EU INSPIRE Directive (Spatial Information Infrastructure Act) and the acquisition of significant EU funds for the creation of digital geoinformation resources. Precise digital terrain models of Poland were created, including topographic data, address data and information on administrative units, laser scanning data supporting creation of 3D city models and flood protection systems, aerial and satellite photos and LPIS data (for Land Parcel Identification System). Thematic databases such as sozological, hydrographic, geological and statistical ones are also created and modernized. Large amounts of data acquired by commercial companies and social data have been created.

An additional development factor has become the so-called "release" of spatial data, which occurred as a result of the amendment of the Geodetic and Cartographic Law (Act of April 16, 2020 amending the Act – Geodetic and Cartographic Law and some other acts). Under this law, from July 31, 2020, "released" spatial data can be downloaded for free from, among others, the website www.geoportal.gov.pl. For the first time in history, Poland has such up-to-date and accurate digital spatial data for the entire territory of the country. Although the data is available for both viewing and downloading, analysing it still faces limitations. The main obstacle to the access to the above-mentioned geospatial data resources by the scientific community is their huge volumes, which require the installation of expensive IT solutions, both in terms of hardware and software, in individual research units. This limits so far the possibilities of conducting research on a large scale.

The infrastructure created by the Geodetic and Cartographic Service, as well as other institutions that create spatial data, exists and is being developed. By assumption, this type of infrastructure is not and cannot be prepared for the needs of scientific research. It is primarily used to gather resources and share data and geoinformation services available to public institutions.

Providing data available for scientific purposes requires a different methodological and technological approach (in contrast to the purposes of public offices), e.g. the creation of virtual research laboratories that allow conducting efficient scientific simulations.

Spatial analyses of large territories, including the entire territory of the country, will open up completely new opportunities in the field of new types of research. The main idea of conducted geospatial scientific analyses will be to develop new models and algorithms of data analysis for the use in industry, services and activities of public offices.

The created research and scientific environment, equipped with modern geospatial data information systems, may become, inter alia, a good platform for supporting spatial management monitoring at the regional and national level.

Prospects for the centre's operation

The created Centre has a chance to have a significant impact on the way of conducting geomatics research in Poland, especially in the field of geospatial analyses.

Current applications for research and projects in this area are characterised by:

1. Each individual download of geospatial data by various research units and companies. This approach results in duplication of some data processing work.
2. Creation of many small IT solutions that prevent advanced processing on a large scale.
3. Lack of wide cooperation of research units, dispersion and incoherence of infrastructure.
4. Lack of access to research results and the possibility to conduct research remotely from various locations, especially effective i involvement of international partners.
5. Lack of broad, systemic cooperation with enterprises.

The CENAGIS Centre can help to overcome all the barriers mentioned above. The implementation of geospatial analysis projects by different entities in accordance with the idea of the Centre's operation in Poland may support other projects of this type and develop the Centre's potential available to all partners. This will be a mechanism analogous to the development of open source software. The partners will not have to apply for the costs of processing the same data, but for the development of common resources. They will also not have to develop small, individual IT infrastructures to the same extent as before, but to "add" to the existing solution new "geospatial services", implementing further advanced data analysis algorithms and using previously developed services by other teams of scientists, as part of previous research. Together, this will create the potential to conduct research on a much larger scale in the field of geomatics.

The purpose of the Centre's activity is, inter alia, to facilitate analysis of extremely rich and valuable data resources not only for surveyors and cartographers, but also for scientists from many other branches, who so far have used such resources to a very limited extent. This applies, for example, to specialists in the field of architecture, spatial planning, archaeology, meteorology, geography, demography, aviation, forestry, agriculture, environmental protection, security and defense.

In 2020, the Scientific Network of Analysis and Presentation of Geospatial Data was established, with 24 research units from across the country joining. The goals of establishing the Network included, inter alia, the effective use of the research infrastructure possessed by the contracting parties, including the infrastructure of the CENAGIS Centre created by the Faculty of Geodesy and Cartography of the Warsaw University of Technology.

Together, the members of the Network constitute a significant, integrated group of the best experts in the field of geoinformation in Poland.

The attractiveness of the project should encourage young scientists to conduct world-class research in Poland, as well as encourage European scientists to conduct research at the CENAGIS Centre, e.g. within competition projects under Horizon Europe. In addition, the created infrastructure, due to its uniqueness on a national scale, will enable to provide specialist scientific expertise and will allow to increase the scientific and practical competences of employees.

One of the interesting projects in which the new research infrastructure is already used is the project "Implementation of the Smart Villages concept in the Mazowieckie Voivodeship". The project is implemented in a consortium of seven research institutions. The initiative aims to support the community and rural development of Mazovia, as well as to strengthen traditional and create new networks of connections between stakeholders through modern means of communication, and above all to raise public awareness of rural development. The basis for achieving the objectives will be carrying out research and scientific analysis consisting in identification of elements slowing down the development of agriculture, assessment of farming conditions and identification of factors influencing the slowdown in the development of agriculture. The implementation of the project is planned for the years 2021–2023.

Possibilities of cooperation in spatial development monitoring

The Centre's technical and human potential, as well as the cooperating research units and companies from all over the country, enable taking up great challenges, not only of scientific nature, but also of an expert and economic nature. The created research and scientific environment equipped with modern analytical systems may become a good platform for supporting spatial development monitoring at the regional and national level.

The Faculty of Geodesy and Cartography of the Warsaw University of Technology is already cooperating in the implementation of the space monitoring idea initiated in the Lubuskie Voivodeship by the University of Zielona Góra.

It seems natural to support similar monitoring in the Mazowieckie Voivodeship, and then on the scale of the entire country.

Translated by Anna Kwil

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