

# INNOVATIONS IN SURVEYING EDUCATION. GEOSPATIAL DIGITAL ENGINEERING: NEW APPROACH TO THE TRAINING OF QUALIFIED SPECIALISTS AND IMPLEMENTATION OF NEW TECHNOLOGIES IN THE REAL SECTOR OF ECONOMY

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## **Abstract**

*Geospatial digital engineering is a rapidly growing engineering discipline that focuses on spatial information, incorporating aspects of computer engineering, surveying and mapping. Experts in this field combine a number of relevant professions such as surveyor, cartographer and unmanned aerial vehicle ground control operator. As part of the development of the 'Professionals' Championship Movement at the International High Technologies Championship, where the representatives from Ghana, India, Syria and other countries took part, and the Federal Service for State Registration, Cadastre and Cartography (Rosreestr) was the industrial partner, the business community and consumers of geospatial information showed great interest and demand in this competence.*

**Keywords:** *Surveying, Mapping, Computer engineering.*

## **INTRODUCTION**

Geospatial digital engineering is a rapidly growing engineering discipline that focuses on spatial information, incorporating aspects of computer engineering, surveying and mapping. Experts in this field design, develop and operate systems for collecting and analyzing spatial information about land, oceans, natural resources, and anthropogenic objects and combine a number of relevant professions such as surveyor, cartographer, unmanned aerial vehicle ground control operator. Combining the skills and abilities of these professions allows a specialist to solve complex tasks in the field of geodesy and cartography in real production conditions. New specialists use geographic information systems in their work.

## **GEOSPATIAL ENGINEER**

Geospatial engineering includes elements of field engineering and surveying works, as well as modern methods of processing of geospatial data and knowledge in the sphere of geography, geodetic support of construction works, land management and cadastre.

Professional activity of a specialist in the field of geospatial digital engineering implies knowledge and skills to form positioning, navigation and timing support of territories with the help of global navigation satellite systems, to use cartographic works, geoinformation systems, spatial databases, as well as to apply unmanned aerial systems to obtain geospatial data on the Earth's surface.

Modern technologies and tools applied in the professional activity of a specialist in the field of geospatial digital engineering include:

- Earth's remote sensing using unmanned aerial systems and satellite technologies;
- Instrumental geodetic measurements with digital and automated equipment using satellite receivers (GNSS receivers) and electronic total stations to determine distances and coordinates of points;

- Computer analysis of spatial data, 3D aerospace modeling of terrain, objects and structures for engineering and surveying works. The software used is the Geoinformation system Aksioma, and Geoinformation system Sputnik for this purpose. Decoding of Earth remote sensing materials (called orthophotomaps. These are aerial photography materials from an unmanned aerial vehicle) is carried out in geographic information systems. Thematic maps displaying geodata for each element (areas of plots, length of linear objects and their coordinates) are formed based on the results of this decoding. Measurements at mining sites are also carried out in the GIS Sputnik. They are based on digital terrain models, which are compiled from aerial photography from an unmanned aerial vehicle. For example, the areas of excavation polygons and the volumes of earthen embankments are formed in quarries. Moreover, maps with elevation marks are also generated.

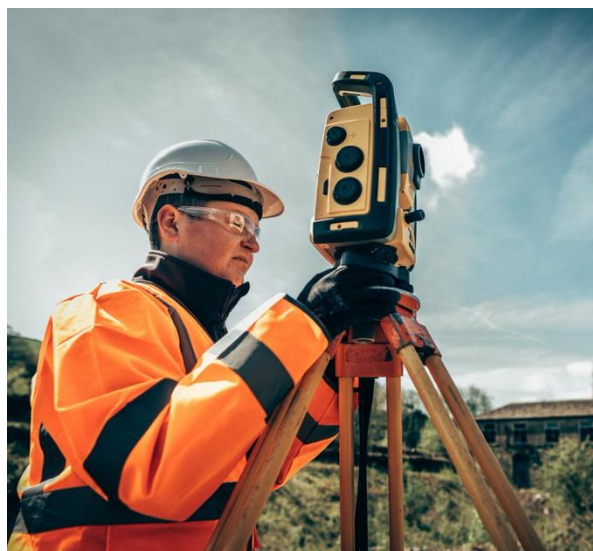


Figure 1. Instrumental geodetic measurements

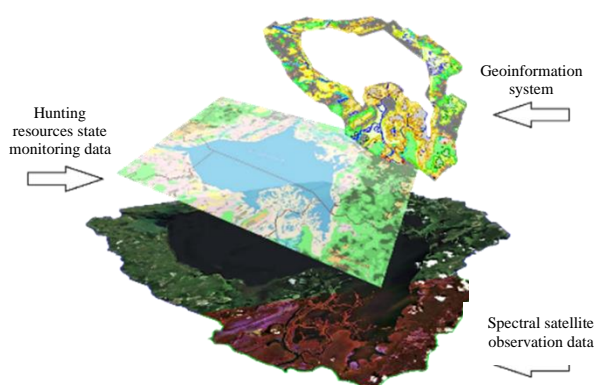


Figure 2. Computer analysis of spatial data

If we talk about the final product resulting from the work of a competence engineer, it is a complex geoinformation system that includes a variety of information about natural and anthropogenic objects obtained by means of traditional geodetic measurements, aerial surveying and unmanned aviation.

This product can be used in design and construction of facilities, engineering development of territories, scientific research and land monitoring.

## COMPETENCE SPECIALIZATIONS

The basic specializations for the competence "Geospatial Digital Engineering" are cartography, land management, aerial photographic geodesy, applied geodesy, operation of unmanned aerial systems, information systems (e.g., in urban planning), construction, environmental management of territories. These basic specializations are represented in more than 180 colleges in 59 cities of Russia.

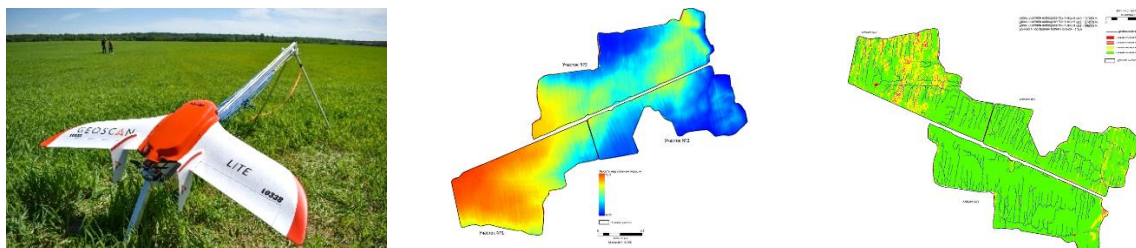
The purpose of the competence is to consolidate knowledge, skills and abilities to train specialists who meet modern demands and requirements of enterprises, as reflected in professional standards:

- Specialist in the field of cartography and geoinformatics;
- Specialist in the operation of unmanned aircraft systems including one or more unmanned aircraft with a maximum take-off weight of 30 kg or less;
- Specialist in the field of geodesy;

The competence "Geospatial Digital Engineering" was elaborated at Yaroslav-the-Wise Novgorod State University and was introduced into the educational process of a number of higher education training areas related to geography, land management and land cadastre, secondary vocational education specialty "**Operation of Unmanned Aerial Systems**", as well as in the programs of additional vocational education "**Specialist in the operation of unmanned aircraft systems comprising one or more unmanned aircraft with a maximum take-off weight of 30 kg or less**" and "**Unmanned aircraft systems and satellite technologies**".

It is obvious that a certain strategy is needed to support the relevance of the knowledge transferred in the training process. This point is realized through research and development works, which are the driver of development. The results obtained during such works (for example, scientific and practical justification of application of the unmanned aerial systems, satellite technologies and GIS in agriculture and nature management) are implemented in educational programs. Students receive in-demand skills, and in some cases this is advanced personnel training. For example, transferring competencies to future specialists in the field of precision agriculture, which is entirely based on sophisticated navigation equipment and geospatial information analysis.

**Cooperation and training, taking into account the standards of competence "Geospatial Digital Engineering" is also possible for foreign organizations interested in the development of this sphere in their country.**



*Figure 3. Geospatial engineer tools*

## **RELEVANCE AND DEMAND FOR COMPETENCIES IN THE REAL SECTOR OF THE ECONOMY**

The global transition to a digital economy is causing a significant increase in the need for spatial data, as well as services and products based on them, in a wide range of applications.

The digital transformation of the spheres of geodesy and cartography is taking place, as well as the transformation of industries that are consumers of spatial data.

Higher, secondary vocational and additional education in the field of geodesy and geoinformation technologies takes this digital transformation into account and approximates its effect.

The greatest demand for spatial data will come from such industries as the electric power industry, housing and utilities sector, financial sector, construction industry, transportation complex, and agriculture. Young professionals are already in demand in these industries.

Nowadays, enterprises of the construction and agro-industrial complex, oil and energy companies, research and other organizations are customers of new specialties and technology partners. These are Public Joint Stock Company "Tatneft" (Republic of Tatarstan), LLC Research, Design and Production Enterprise for Environmental Protection Activities "Nedra" (Perm region), LLC "StartStroy" (Moscow region), LLC "IT-Meridian" (Tambov region), LLC "Geostroyiziskaniya" (Nizhny Novgorod region), Joint Stock Company "Novgorod Aero-geodetic Enterprise" (Novgorod region), Ministry of Natural Resources, Forestry and Ecology of the Novgorod Region (Novgorod region), Public Law Company "Roskadastr".

As part of the development of the 'Professionals' Championship Movement, this competence was presented at the High Technologies Championship in 10 regions of the Russian Federation, as well as in the Republic of Belarus, with the international final in Veliky Novgorod in September 2023, where representatives from such countries as Ghana, India, Syria and others took part. The final of the Championship was attended by the leadership of the Russian Federation. They noted the importance of developing the system of secondary vocational education.

The main industrial partner of the Championship in the "Geospatial Digital Engineering" competence is Public Law Company "Roskadastr" controlled by the federal executive body Rosreestr. Also representatives of Geoscan Group of Companies, Ministry of Natural Resources, Forestry and Ecology of the Novgorod Region and other specialized organizations acted as industrial experts.



*Figure 4. High Technologies Championship Final 2023*

## **BIOGRAPHY**

Oleg BARSUKOV:

Professional activities in the Public Law Company ‘Roskadastr’ branch Information Technology Center ‘Roskadastr-Infotech’

2023: Chief Engineer (TeamLead) of the international project of creation CIS Spatial Data Infrastructure Geoportal

2023: Industrial expert in the field of Geospatial Digital Engineering in the High Technology Championship of the All-Russian ‘Professionals’ Championship Movement

2022: IT infrastructure architect in the project of modernization of the Hardware and Software Complex ‘Federal Geodetic Stations Network’

2022: IT infrastructure architect in the projects of scaling up the State Information Systems ‘Unified Digital Basemap’ and ‘Federal Spatial Data Portal’

Education: Higher

Krasnoyarsk State Technical University, engineer. 2001