

# Semi-Autonomous Hybrid Navigation System in Baltic Sea Region (GEO NAVI)

Interreg Baltic Sea Region Programme 3<sup>rd</sup> call

Gdansk University of Technology, Gdańsk, Poland

Institute of Oceanology of the Polish Academy of Sciences, Sopot, Poland

\*Institute of Geodesy and Cartography, Warsaw, Poland

Lithuanian Transport Safety Administration, Klaipeda, Lithuania

Maritime Administration of Latvia, Riga, Latvia

Riga Technical University, Riga, Latvia

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# Interreg Baltic Sea Region EU Programme

11 countries ...

... strengthen the  
**integrated territorial  
development** and cooperation for  
a more innovative, better  
accessible and sustainable Baltic  
Sea Region...

.. through **transnational  
cooperation projects** in the area



Source: Interreg Baltic Sea Region ([interreg-baltic.eu](http://interreg-baltic.eu))

## Programme funds

- **European Regional Development Fund (ERDF):**

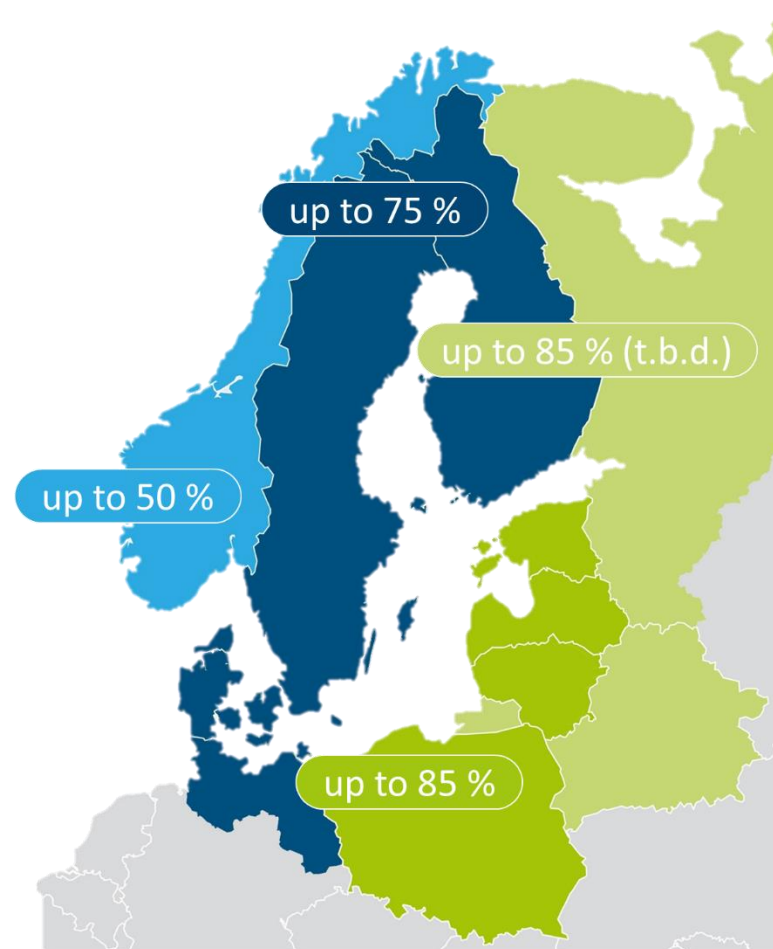
EUR 263.8 milion (for 3<sup>rd</sup> call: 57.5 mln)

- **Norwegian national funding:**

EUR 6 milion (for 3<sup>rd</sup> call: 2.7 mln)

- **European Neighbourhood Instrument (ENI) and Russian funds:**

EUR 8.8 milion (for 3<sup>rd</sup> call: 5.1 mln)



Source: Interreg Baltic Sea Region ([interreg-baltic.eu](http://interreg-baltic.eu))

## Programme Priorities in 3<sup>rd</sup> Call

### Priority 1 „Capacity for innovation”

offers support for e.g. development of innovation infrastructures, implementation of smart specialisation strategies and development of non-technological innovations

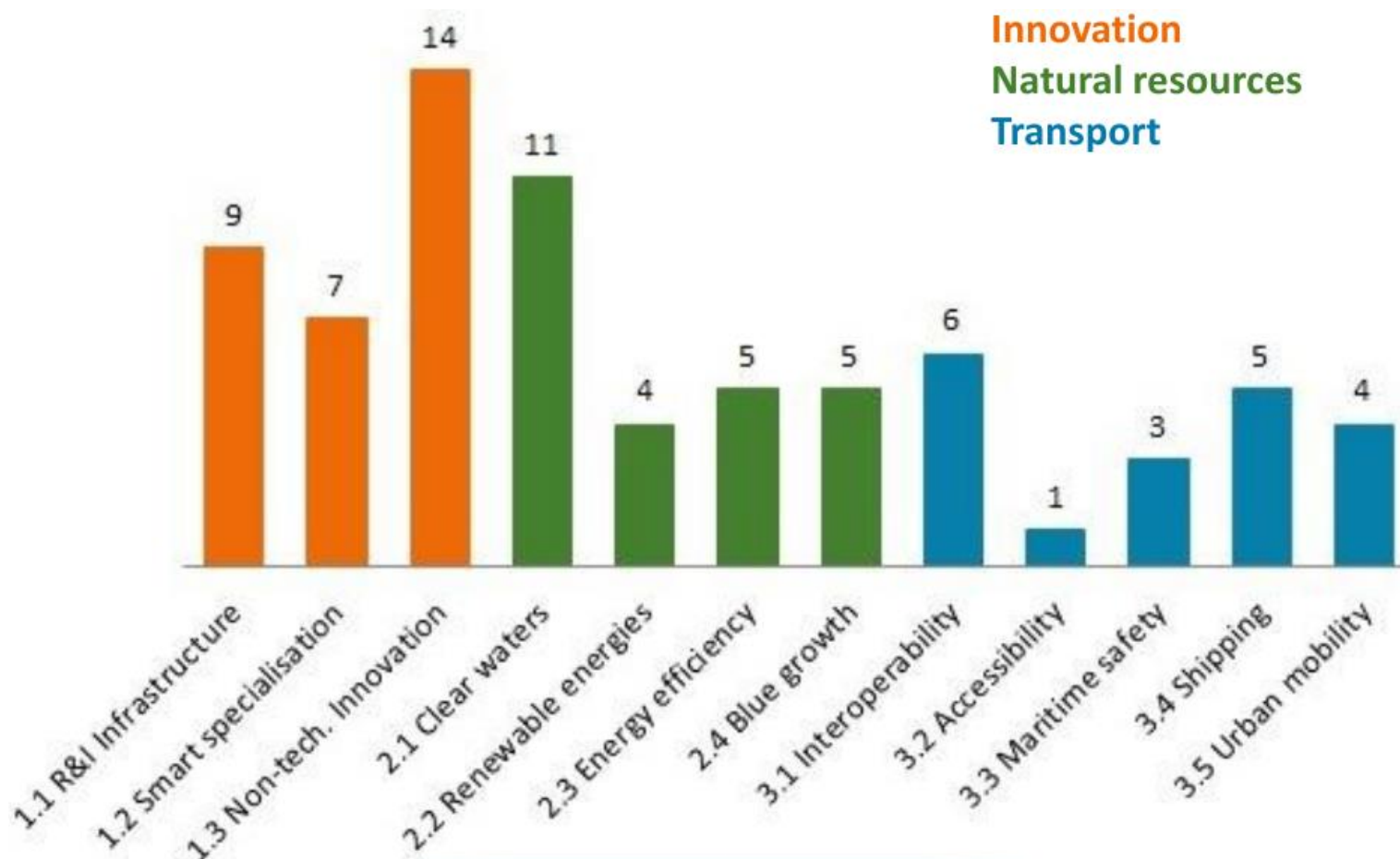
### Priority 2 „Efficient management of natural resource”

offers support for more efficient managing natural resources e.g. clear water, renewable energy, Energy efficiency and blue growth

### Priority 3 „Sustainable transport”

offers support for themes such as accessibility of remote areas, maritime safety, environmentally friendly shipping and urban mobility

## Approved project after two calls



## **What is expected from the projects?**

Solution for common challenges relevant for the whole or major part of the region

**To increase institutional capacities of public authorities and agencies, Non-governmental organisation, enterprises and research organisations, also including public authorities with relevant roles in the partnership**

## **Project partners**

At least 3 partners from 3 different countries

## Programme timeline

- Submission of Project Idea Form: Lead Applicant, 15 January 2018 (passed)
- Submission of applications: Lead Applicant, 09 April 2018 16:00 CEST (UTC+2)
- Admissibility check: Managing Authority/Joint Secretariat, Lead Applicant
- Assessment: Managing Authority/Joint Secretariat
- Selection: Monitoring Committee, September 2018
- Contracting: Managing Authority/Joint Secretariat, Lead Applicant, October 2018—December 2018
- End of programme: June 2021

Project name: **Semi-Autonomous Hybrid Navigation System  
in Baltic Sea Region**

Project acronym: **GEO NAVI**

Programme priority: **3. Sustainable Transport**

Programme specific objectives: **To increase maritime safety and security  
based on advanced capacity of maritime actors**

Project duration of the implementation phase: **30 months**

Project region: **Southern and Eastern Baltic Sea Region (selected areas)**

Lead applicant: **Gdansk University of Technology, Poland**



## Specific challenge to be addressed

- Developing and testing a prototype of semi-autonomous hybrid navigation system based on a combination of the inertial navigation system (INS) with a high-resolution gravimetric measurements and gravity anomaly maps to support the Global Navigation Satellites Systems when they fail to operate;
- A transfer of knowledge and skills between project partners;
- A transfer of knowledge and data exchange with ongoing flagship project of EU Strategy for the Baltic Sea Region – FAMOS.

## Main project activities

- Onshore land and shipborne gravity surveys performed in collaboration of project partners in the selected areas of the Southern and Eastern Baltic Sea Region;
- Unification of existing onshore and shipborne gravity data (old) with high-resolution data obtained in the course of the project (new);
- Modelling the vertical reference surface (geoid);
- Development of the semi-autonomous hybrid navigation system based on the inertial navigation system (INS) with a high-resolution gravimetric measurements and geoid modelling;
- Tests of the prototype of the navigation system on selected vessels;
- An iterative approach will be applied.

## Partnership [1]

### Gdansk University of Technology (Gdansk, Poland)

- role: shipborne gravity measurements at the selected areas of the Southern and Eastern Baltic Sea, a development of the innovative semi-autonomous hybrid navigation system;
- equipment: MGS-6 Gravity Meter (Micro-g LaCoste).

### Institute of Oceanology of the Polish Academy of Sciences (Sopot, Poland)

- role: shipborne hydrographic measurements during the gravity campaign, forecasting and monitoring of sea dynamics for the selected areas of the Southern and Eastern Baltic Sea during the shipborne gravity measurements;
- equipment: research vessel s/y *OCEANIA*, multibeam echosounder (purchase in the project).

## Partnership [2]

### Institute of Geodesy and Cartography (Warsaw, Poland)

- role: onshore absolute gravity measurements, unification of existing sea and land gravity data of Poland, unification of onshore and shipborne gravity data (old) with data (new) obtained during the project, gravity anomaly maps creation and geoid modelling for the selected areas of the Southern and Eastern Baltic Sea Region;
- equipment: A10 Portable Absolute Gravity Meter (Micro-g LaCoste).

### Riga Technical University (Riga, Latvia)

- role: relative gravity measurements, unification of existing sea and land gravity data of Latvia, gravity anomaly maps creation and geoid modelling for the selected areas of the Southern and Eastern Baltic Sea Region, precise GPS/GNSS positioning of ship gravity measurements;
- equipment: GPS/GNSS temporary stations, 2 ZLS Gravimeter (Burris; purchase in the project).

## Partnership [3]

### Maritime Administration of Latvia (Riga, Latvia)

- role: testing of the prototype of semi-hybrid navigation system;
- equipment: hydrographic vessel *Kristians Dals*.

### Vilnius Gediminas Technical University (Vilnius, Lithuania)

- role: unification of existing sea and land gravity data for Lithuania;
- equipment:

### Lithuanian Transport Safety Administration (Klaipeda, Lithuania)

*[final decision on participation has not been made yet]*

- role: testing of the prototype of semi-hybrid navigation system;
- equipment:

## MEMS Gravimeter (laboratory version)

- **MEMS Gravimeter — microscopic mechanical device made from semiconductor materials to measure the Earth tides**
- **Sensitivity :  $40 \mu\text{Gal Hz}^{1/2}$  down to  $10^{-6} \text{ Hz}$**

Please, see Fig. 3 in Middlemiss et al., 2016, *Nature*

Please, see Fig. 1 in Middlemiss et al., 2017, *Sensors*

The measurements of the Earth tides obtained from the MEMS device [Middlemiss et al., 2016, *Nature*]

The initial MEMS gravimeter [Middlemiss et al., 2017, *Sensors*]

## MEMS Gravimeter (portable version)

- MEMS Gravimeter — microscopic mechanical device made from semiconductor materials to measure the Earth tides
- Sensitivity of device:  $2.9 \text{ mGal Hz}^{-1/2}$  (up—down hill measurements)

Please, see Fig. 7 in Middlemiss et al., 2017, *Sensors*

The field-portable MEMS gravimeter [Middlemiss et al., 2017, *Sensors*]

Please, see Fig. 8 in Middlemiss et al., 2017, *Sensors*

The measurements of MEMS gravimeter on the field test up the Campsie hills [Middlemiss et al., 2017, *Sensors*]