IMPLEMENTATION REPORT

Implementing Bridge Clearance Solutions

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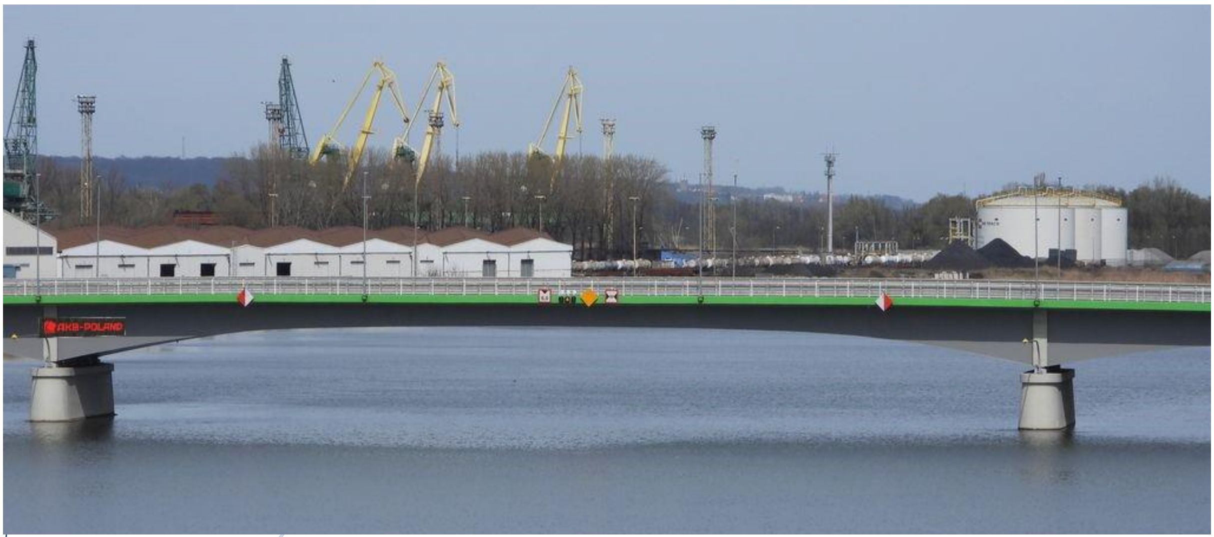

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The Interreg Baltic Sea Region Programme 2014-2020 supports integrated territorial development and cooperation for a more innovative, better accessible and sustainable Baltic Sea region.

The Programme is an agreement between EU member states Denmark, Estonia, Finland, Latvia, Lithuania, Poland, Sweden and the northern parts of Germany as well as partner countries Norway, Belarus and the northwest regions of Russia. The Programme is funded by the European Union and approved by the European Commission.

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More information on aims of the programme, funding possibilities and how to get involved: https://www.interreg-baltic.eu/home.html

Content

1 ABRIVIATION LIST

Abbreviation	
BSR	Baltic Sea Region
BSRP	Baltic Sea Region Programme
IWT	Inland Waterway Transport
MS	Member State
RIS	River Information Services
TEU	Twenty Foot Equivalent Unit
VTS	Vessel Traffic Services

2 BACKGROUND TO THE REPORT

In the BSR draught limitations are a major issue, both water and air draught under bridges. Vessel draught depends on the weight of the loading of the vessel. In general, shippers intend to maximise loading capacity of the vessel and thus maximise water draught and minimise air draught. However, often the ship is fully loaded in one direction and not fully loaded on the return voyage. Thus, one of the most common situations affecting navigation safety is when empty or partially unloaded vessels comes into contact with one of the bridges, caused by misinterpretation of reading non-digitalised water gauges. The most common cause of it is inappropriate assessment of the height of the passage of the vessel, connected with vertical changes in water levels (waves, tides etc.). While a skipper relies solely on manual readings on water gauges, the accuracy fluctuates by +/- 10-20 cm.

Solving this problem would not only help to increase safety, but at the same time allows for more flexible ship loading: Vessel's loading procedures can be adjusted to meet latest waterway conditions and by that allowing ships to pass the bridges the best possible way with maximum or minimum amount of cargo. Thus, using information showing the current value of the clearance under a bridge will have a positive influence on navigation safety and logistics (better route planning). Therefore, Inland Navigation Office in Szczecin as partner of the project has developed and implemented a system of automatic readings of safe clearances under bridges at Odra River in Szczecin, which will be based on a network of radar sensors and electronic information boards showing the clearance values to skippers in real time. The real-time measurement data will be transferred to the RIS centre which will make same public as well. The gained data will be gathered, analysed, and managed by INO also in future.

In EMMA Extensions the main activities refer to testing location of sensors and ways of electronic data exchange as well as integration into RIS and VTS. River Odra is a border crossing river which connects the Polish and German inland waterway system and important seaports in the BSR. The implemented solution will improve navigation on the river for all shippers navigating in theses waterways (mainly border-crossing).

3 INTRODUCTION

There are many existing challenges that must be dealt with in the inland transport, which are commonly called: bottlenecks. One of the main obstacles is insufficient navigability classes, and thus low water levels, preventing free transport, which make it unprofitable for companies to include this type of transport in their transport chains.

Another bottleneck is the low-running bridges, which, in turn, during higher water levels, affects their variability caused by e.g. a passing flood wave, prevent the free passage of transport units or sometimes damage them. Recognizing this problem, the EMMA extension project included the implementation of the activity consisting in the installation of sensors allowing to precisely determine the bridge clearance in real time. Precise parameters displayed on a visible LED board allow the shipowner to make an appropriate decision about the course.
The main purpose of the aforementioned RIS system is to make inland navigation a transparent, reliable, flexible and easily accessible mode of transport that will be able to compete with other types of

cargo transport. strategic benefits There 4 strategic objectives identified for RIS to support inland navigation:

- competitiveness of inland navigation,
- optimization of infrastructure use,
- improving security
- improving environmental protection.

RIS-ODER achieves these goals through the following main activities:

- location of sensors in the RIS area (including CCTV cameras, AIS stations, hydro-meteorological stations) serving as the primary source of information,
- operation of the RIS Center, where information is processed,
- free provision of electronic navigation charts for inland navigation (IENC),
- issuing messages for captains (NtS),
- vessel tracking and tracing (VTT),
- participation in projects enabling the improvement of navigation safety in the area covered by the RIS system, including Full Implementation of RIS Lower Oder and Emma Extension.

Within the implementation of the Emma Extension project, it was planned to install on two selected bridges the information boards indicating the current clearance under the bridge.
This is particularly important information for captains of inland vessels, due to the limited clearance under bridges, which is often the case in the area of operation of the RIS-ODER system.
This information will allow to make the right decision about the possibility of crossing, which in turn will improve safety on inland roads.
The main result is the development and implementation of a system of automatic readings of safe clearances under bridges at Odra River in Szczecin, which will be based on a network of radar sensors and electronic information boards showing the clearance values to skippers in real time. Moreover, the interface will allow to transfer the same information to the RIS operators and will also be integrated with ELIAS - the previously developed in EMMA integrated web application that presents RIS information from the Elbe region. So it gives the system international dimension.

Prior to achieve the above results the technical analysis along with the concept of building a system for indicating safe clearance under the bridge were carried out aiming among others, at:

- selecting bridges to be covered by the system,
- selection of data presentation technology on boards,
- selection of technologies for obtaining data on water level,
- preparation of the description for the interface displaying data in the RIS Center.

The real-time measurement data is transferred to the RIS centre which make same public as well. The gained data is gathered, analysed, and managed by INO also in future.

The implemented solution will improve logistics as more accurate data will allow better route planning for e.g. barge operators. Finally loading procedures of a vessel can be adjusted to meet latest waterway conditions and by that allowing ships to pass the bridges best possible way.
Thus, using information boards showing the current value of the clearance under a bridge will have a positive influence of navigation safety. Another key element is the logistics aspect as it will allow to shorten the passage time of a transport vessel. Thanks to the knowledge of the conditions of passage under a certain bridge, skippers, ship-owners, forwarders, or logisticians will be able to plan the route for the vessel, which will affect the costs and navigation safety. The knowledge of current clearance may also aid the ship loading process by helping to adapt the height of the cargo or ship clearance.

The system of automatic readings of safe clearances under bridges, which will be based on a network of radar sensors and electronic information boards showing the clearance values. This feature will be operating under the developed RIS system and ready to be fed into the GIS map piloted by the ISL the German partner of EMMA project. That will be the next step contributing digitalisation, greatly improving traffic and transport management through more accurate information on traffic conditions. Exchanging data that will be available for both countries will greatly benefit the business, making the route safer, predictable, efficient opening a wide range of new business opportunities. The monitoring system that is becoming more and more advanced and reliable for the businesses can trigger in the long run further investments in the infrastructure of both private and public sector.

3.1 State-of-the-Art in Polish Fairways

Inland water transport is the most ecological mean of transport, which is particularly important in the era of reducing the emission of harmful compounds to the atmosphere.
In the EU countries, the share of inland waterway transport ranges from 4 to 6% of the total transport work. In Poland, the network of waterways largely coincides with the main directions of cargo flows, Currently, inland waterway transport accounts for only about 0.4% of the domestic transport, counted in tonnes of transported cargo. This is mainly due to the unsatisfactory condition of the infrastructure. Even though after the second Word War the transportation of goods using waterways were gradually increasing and at its peak time reached about 20 million tons/year. However, due to neglect of maintenance activities and a significant deterioration of navigation conditions, a drastic decrease in inland waterway transport has been observed since the 1980s. Poland has a dense network of waterways, but with low technical parameters, hence they are of a regional and seasonal character. The length of the inland waterways in Poland is 3,347 km. In the years 1990–2014, as a result of neglecting their maintenance and modernization, the length of inland waterways recognized for navigable decreased by 650 km, with the biggest changes taking place since 2000, when their length decreased by 466 km. Apart from the relatively large length and density of the inland waterway network in Poland,

their advantages are evidenced by the favourable arrangement in terms of the course cargo lines, especially towards sea ports, and connection with the waterways of Western Europe.

Possibility of increasing cargo transport by inland transport in Poland depends on the improvement of the parameters of waterways. The most important goal is the development of inland waterways is the modernization or construction of waterways with the parameters of class IV waterway, as well as meeting the conditions for water transport infrastructure for the trans-European transport network.

In 2016, the Council of Ministers adopted a resolution on the assumptions to the development plans of inland waterways in Poland for 2016–2020 with a perspective until 2030, the Ministry of Maritime Economy and Inland Navigation has created four priorities, which consist of eleven tasks to achieve the intended goal of developing inland navigation through reducing the environmental impact of transport. The first priority of the Ministry of Maritime Economy and Inland Navigation is to achieve an international navigability class and include in the European waterway network Odra Waterway E-30. Intended tasks for the implementation of the investment include:

- removing existing bottlenecks;
- adaptation of the Odra Waterway to the parameters of the Va waterway;
- construction of the missing section of the Danube-Odra-Laba connection in Poland;
- construction of the Silesian Canal.

The second priority is to achieve a significant improvement in the navigation conditions on the waterway of the Vistula River. The tasks for this priority are:

- construction of the Vistula cascade on the section from Warsaw to Gdańsk;
- construction of a barrage in Niepołomice, modernization of the upper canalised Vistula.
- nother priority is the connection of the Odra-Vistula-Vistula Lagoon and Warsaw-Brest, i.e. expansion of E-70 and E-40 waterways. The following tasks have been planned for this priority:
- preparation for the modernization of the international waterway Odra- Vistula – Vistula Lagun, waterway E-70;
- preparation for the construction of a section of the international waterway WisłaDniepr from Warsaw to Brest in Poland, waterway E-40.
- The last priority planned is the development of partnership and cooperation for inland waterways. Planned tasks for the last priority are as follows:
- implementation of the River Information Service System (RIS);
- development of cooperation between rail partnerships for inland waterways;
- development of international cooperation for inland waterways

The problems of the development of inland waterway transport in Poland are increasing as a result of negligence related to the modernization and maintenance. At the same time expansion of roads is increasing as well due to the uncertainty of shipping transport. Assumptions for the development plans of inland roads adopted in Poland for the years 2016-2020 with the perspective until 2030 create a perspective development of inland navigation in line with European trends in the field of sustainable development of transport, constituting an opportunity to increase efficiency socio-economic transport system in Poland. Planned investments may become an impulse to increase competitiveness river ports and sea ports at the mouth of the Odra and Vistula rivers, and activation riverside regions. Plans for the development of inland waterways in Poland.

They assume the implementation of investments important for flood protection, the production of electricity from renewable sources and the development of passenger and tourist navigation.

The EMMA Extension investment, therefore, goes in line with the tendencies of major improvement that will be implemented in Poland it paths the way for continuation of similar actions in the near future largely benefiting the development and the profitability of this type of transport.

3.2 Problem description

The main obstacles to inland navigation are constraints mainly due to the state of the water level. In the summer season, frequently recurring droughts result in very low water levels and effectively hinder navigation. On the other hand, excessively high-water levels, which often appear in the spring season, intensify bottlenecks, such as low bridge clearance structures. Rising water, a sudden flooding wave reduces the bridge clearance to a level that prevents free, safe passage.

Thus, one of the most common situations affecting navigation safety is when empty or partially unloaded vessels comes into contact with one of the bridges, caused by misinterpretation of reading non-digitalised water gauges. The most common cause of it is inappropriate assessment of the height of the passage of the vessel, connected with vertical changes in water levels (waves, tides etc.). While a skipper relies solely on manual readings on water gauges, the accuracy fluctuates by +/- 10-20 cm.

The planned investment involves the installation of a microwave (radar) sensor where the measurement will be carried out. It is a method that gives a measurement result at a distance of up to 25-30 m with an accuracy of 0.1 cm. The non-contact method increases the reliability of the installation and enables the sensor to be installed outside the navigation window. Fully digitalised solution will allow to monitor and coordinate its operation on the regular basis.

3.3 Requirements

As a result of the technical analyses two locations have been selected in Szczecin for the system installation:

1. “Most Długi”, with a clearance of 3.4m at high navigable water,

2. “Most Cłowy” (despite the lack of an existing 230VAC power supply), with a clearance of 6.0m at the navigable window.

These locations are accessible to inland traffic, both bridges in the ownership of the Roads and Public Transport Department, and most importantly, in constant navigable traffic.

A number of general requirements have been set out, including:

- All components of the system to be supplied must be brand new, free of any defects and not subject to third party rights.
- The software supplied must be free of all licence and subscription fees for an unlimited period.
- The applicable time for the whole system must be UTC time.
- All elements of the system where there is a time reference must include information on the applicable time.
- Active SIM cards must be provided by the Contractor during installation, testing and training.
- The border of the LED display must be permanently marked with the basic, visible information about the Employer, i.e. the logo and name of the Employer.
- Access to all elements of the system should be available at the Employer's premises via a dedicated application or via the device's web interface.
- The selection of the appropriate size of the display results from the visibility at the appropriate distance, while maintaining normal air transparency.
- The size of the selected display will allow the message to be easily seen from a distance of about 150-200m in normal visibility and air clarity.

4 IMPLEMENTATION DETAILS AND EVALUATION

Upon defining the existing bridge clearance problem and the need to minimize it, it was decided to include the task of installing a safe bridge clearance sensor system as part of the EMMA Extension project. In the first place, in order to define the task specification and select the appropriate bridges, a technical analysis was carried out along with the concept of building an automatic system for indicating safe clearance under the bridge.

In this pilot program, it was planned to start up and install two measurement sites, along with an LED display that monitors the current state of the clearance under bridges, meeting the low clearance criterion (safe navigation height for inland water transport units). The following criteria were taken into account when selecting the bridges:

- proximity to the RIS Center for service, technical and calibration purposes,
- low clearance under the bridge for inland navigation,
- availability of the network node for direct data transfer via the existing links to the RIS Center,
- existing 230VAC power supply,
- monitored zone (each bridge has an installation installed so that it is visible from the next bridge); you can observe the status and operation of the display system using RIS monitoring cameras,
- the site which is an actual waterway with current inland traffic.

As part of the technical analysis, the scope of the technology used was determined, including functional and non-functional requirements, service and location requirements, and technical requirements.

In addition, the selection of the type of transmission, description of the construction and assembly method, description of the measurement sensor, analog signal converter and logger, transmission system, power block, description of the interface displaying data in the RIS Center.

Taking into account the above parameters, the total cost of this project was also estimated.

The next stage was the selection of an appropriate entity, which, based on the recommended specification, carried out the task.

The system operator (RIS in the case of this investment) must poses extensive and advance IT infrastructure in order to build, monitor and maintain. Experienced Staff with fluent English (when the system is linked with other systems for instance in Germany) is a must!

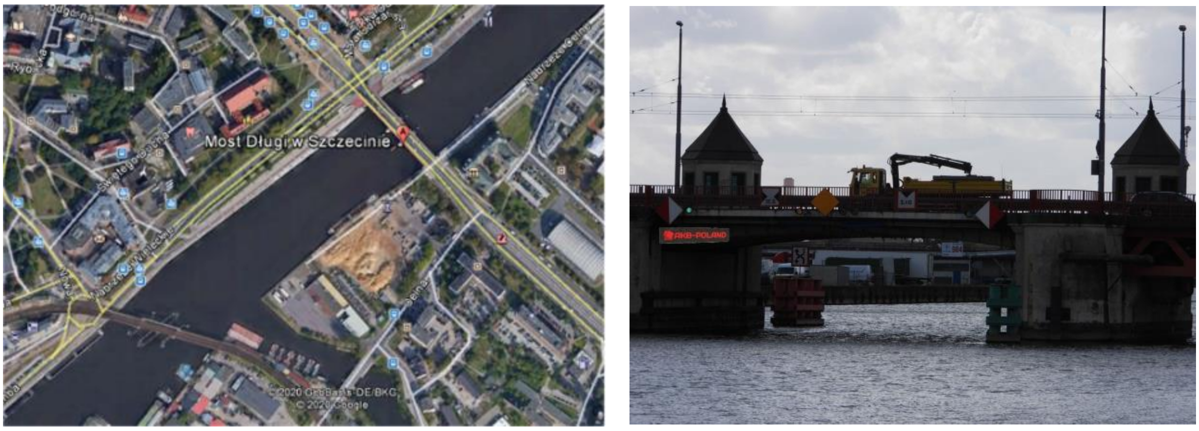
During the investment there were number of obstacles that have been encountered, these are as follows:

- selection of bridge locations in order to be most useful
- selection of the size and brightness of the display so that it is visible to users of the waterway
- availability of the power supply
- supervision of the operating system was difficult due to the distance from the bridges
- the distance from which the board is visible does not always allow to change the decision about the sailing route
- the time needed to obtain the consent of the administrator of the facility and, in the case of historic bridges, the consent of the municipal conservator of monuments should be taken into account

Further steps have been taken to reduce and overcome occurring difficulties:

- before starting the project implementation, hiring the external contractor for the commissioning a technical analysis in order to define the structure and location for the system proved to be essential and beneficial for the whole investment
- the display panel ordered was equipped with the automatic brightness adjustment to be visible from the long distance despite the weather conditions
- creating an emergency power supply in the form of photovoltaic panels
- adding to the control application the information system about the reports from the devices, as well as the possibility of generating them with the date and description to an external file
- building a web application with information about the clearance under the bridges, available to all users

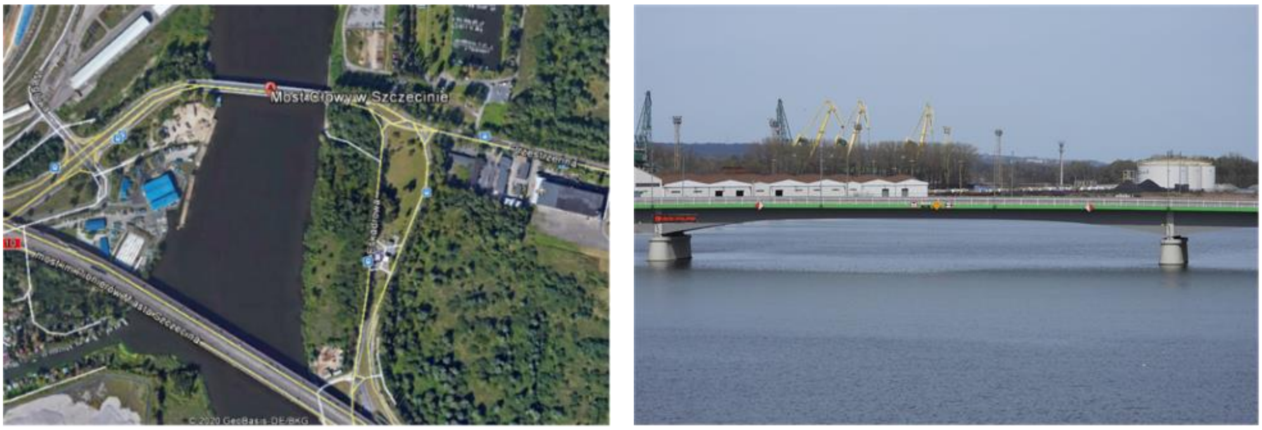
The system is in two areas within Szczecin: “Most Długi” and “Most Cłowy”. The first of the selected locations is "Most Długi" in Szczecin. This is a city centre location with good access to the measuring equipment. From the turret structure there is access to the bridge joist level. Access to this location is lockable, no access for unauthorised persons. Location very close to the RIS Centre. Here there is navigable traffic in the form of river transport - barges. Clearance 3.4m, at high navigable water.



Picture 1. View of the installation on the" Most Długi"

Second selected localization is "Most Cłowy" in Szczecin. This is a location close to the city centre, with potentially good access to the measuring equipment. Access via a newly built platform structure, no possibility of access by the public.

The location is close to the RIS Centre office. In this location there is a large shipping area - barges, ships. Clearance of 6.0 m in the navigation window, with high navigable water.



Picture 2. View of the installation on „Most Cłowy"

Both locations are open to inland waterway traffic, both bridges in the ownership of the Roads and Public Transport Department, and most importantly, in constant navigation.

Both locations are covered by RIS monitoring.

To install the system it was necessary to:

- obtain the Facility Manager's consent for the installation of the equipment,
- receive the Monuments Conservator's consent

- obtain power supply (it concerns building a new connection at the location of the "Most Cłowy" and increasing power consumption an additional circuit in the existing power supply node on the "Most Długi),
- prepare the technical project.

The system of measuring and collecting data is essential for increasing the safety of inland navigation as well as collecting data in order to prevent threats.

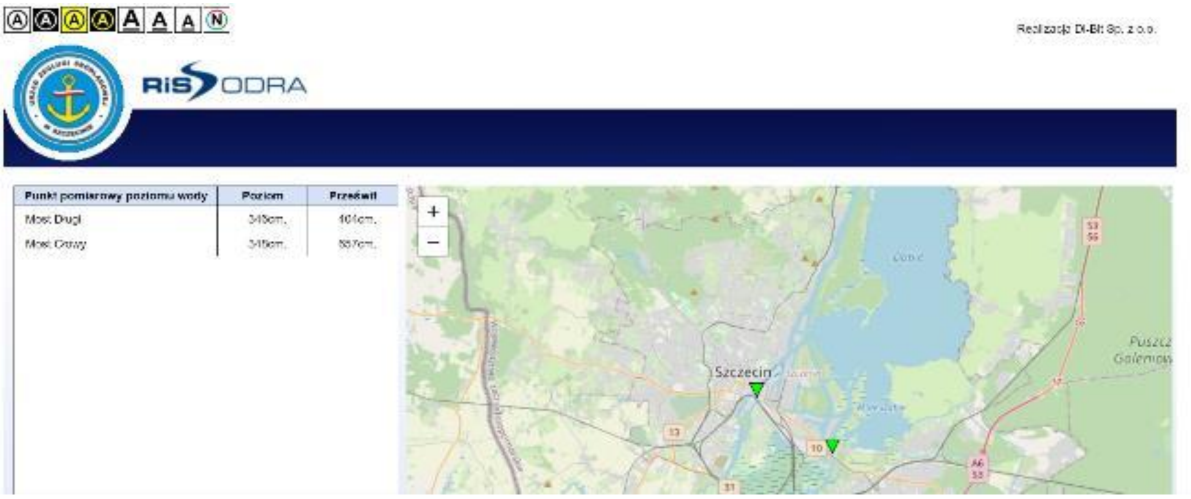
The collection of measurement data enables long-term testing in the field of monitoring and status of inland waters. Measuring devices combined with a display, located at the measuring site allows for a quick presentation of the hazard at each of the measuring places.

The data collection system in the RIS Center is to be the culmination of the purpose of data collection - for Operators and all subsidiaries using the collected measurement data.

Scope of work:

- Delivery, installation and configuration of PPPW devices.
- Delivery, installation, and configuration of WLED devices.
- Installation of the supplied PPPW in locations indicated by the purchaser, in accordance with the conditions issued by the administrators of the facilities.
- Installation of the supplied WLEDs at locations indicated by the purchaser, in accordance with the conditions issued by Facility Administrators and the Historic Preservation Officer.
- Configuration of PPPW devices.
- Configuration of the website with measurement data.
- The data obtained through the system is available in real time to all users of a given section of the waterway and can be seen thanks to the following website: https://przeswit.ris-odra.pl Waterway users do not have access to historical data.

The MeasurementSensors application is also created, to which only RIS Center employees and persons authorized by the administrator have access.



Picture 3. View of the bridge clearance website

Installed microwave sensor has the following capabilities:

- measuring accuracy of +/- 2mm minimum,
- maximum measuring range is at least 10m,
- minimum water resistance class IP67,
- temperature range minimum -30°C +50°C
- measurement output compatible with the recorder.

The sensors are connected via data loggers dedicated to each site, ensuring uninterrupted data recording in the event of interruption of communication with the server. Two sensors are mounted at each measuring point, providing measurement redundancy and eliminating erroneous results. Sensor calibration based on geodetic height measurement.

The system also includes a recorder which, in cooperation with the sensor, collects data at the measurement site. The recorder is equipped, among others, with Modbus RTU interfaces, supporting RS-485 serial transmission and network interface (Ethernet) for IP transmission.3.1.10. The recorder is equipped with a GSM/GPRS modem. The result of the measurement of the vertical clearance under the bridge is shown on an LED display mounted on both sides of the bridge. The brightness of the LED display is over 6000cd/1m2 with the size of the figures min. 40cm high. LED displays are mounted on galvanised steel frames.

The operation of the system assumes the use of the network interface for data transmission to the data collection server. It is required to collect data on the prepared for this purpose server of the Inland

Navigation Office in Szczecin and to make and run the interface for information exchange with the central system ELIAS developed in the first EMMA project.

Functional requirements:

- The application allow access to real-time data
- The application allow access to historical data
- Archiving time is 2 years
- The application allow the operator to remotely turn off the LED display
- The application displays data from all locations simultaneously

The power supply of the system should be implemented in the form of a buffer power supply with >95% efficiency, which, in combination with the power supply by means of a solar panel, redundant module and back-up batteries, will provide a 100% guarantee of power supply, even in the event of prolonged lack of source power.

The success of the implementation could be done by monitoring of user experience through conducting surveys among the users, publishing surveys on the Inland Navigation Offices' social media. Another way is to send the request to the Polish Shipowners Association for the recommendation. The investor (INO) will also be monitoring the functioning of the system via RIS and periodically upon request could generate relevant reports.

From the point of view of the implementation of transport tasks of the inland navigation, the technical subsystem is the most important. Adequate port infrastructure and waterways as well technical and operational parameters of the fleet of inland vessels determine the correctness of the implementation of transport tasks.

Searching for solutions that contribute to improvement and transport safety and efficiency is achieved through the introduction of new ones and/or improved solutions or innovations.

Increase of the efficiency of inland waterway transport is possible while at the same time investing in the fleet and infrastructure, which will enable regular implementation transportation, independence from water levels and full use of the watercraft's capacity.

Implementing bridge clearance solution is in line with the technological development of inland navigation and increases its profitability, safety, predictability, provides data needed for long run planning preventing floods and droughts, encourages entrepreneurs to include this type of transport in their transport chains.

It is not easy to make a financial evaluation of such an undertaking in the short term. Investments of this type modernizing the infrastructure build the credibility and profitability of inland shipping. The installation of bridge clearance sensors can warn of insufficient ground clearance and thus is able to prevent potential incidents, damage, and collisions. In the long term, it will undoubtedly bring significant economic benefits, and modern and safe infrastructure is the popularity of this type of transport and tangible benefits for companies.

This investment fits perfectly into the RIS system operation schedule, which is the main operator of the functionality of this task, as well as of many others improving the efficient navigation. The overall basic benefits of RIS include:

• more efficient use of units - the use of accurate and up-to-date information on the waterway available on the Internet allows for better fleet management (optimized work of personnel and fleet management based on current information), as well as more careful planning of the trip.

• Reduce Fuel Consumption - RIS provides information that can be used to plan a trip. The operators of the locks / bridges / terminals on the basis of the data collected by the system can calculate the required time of arrival for a specific vessel and provide this information to its helmsman. When approaching a terminal / airlock, the helmsman may choose to adjust the speed and thus achieve a more uniform travel speed. This leads to lower fuel consumption and, consequently, to lower operating costs for the owner of the unit.

• Reduction of delays and waiting times - calculating and providing information on Required Time of Arrival for specific units enables better planning of transport. The timely (at a predetermined time) arrival of units to the terminals and locks improves the organization of work and enables the schedule to be adjusted to the needs. Ultimately, it leads to reduced waiting times at terminals and locks.

• Better safety - RIS services offer skippers a holistic view of the current waterway situation. Well-informed shipmasters can make navigational decisions adapted to the current situation. Consequently, knowledge-based navigation decisions lead to fewer incidents, accidents and casualties. In addition,

RIS enables detailed monitoring of the transport of dangerous goods and thus for immediate action in the event of an accident and the occurrence of environmental threats.

• Improved Logistics Planning - Harmonized River Information Services can help to improve the integration of inland navigation with other links of intermodal transport in Europe. RIS enables real-time monitoring of the river fleet as well as the conditions (e.g. weather) on the waterway. Based on the data received via RIS, IWT customers have the option of implementing their own or improving existing tracking and tracing systems. The information generated by these systems can be effectively used to significantly reduce logistics costs.

One of the most important aspects of RIS implementation is increasing the safety of river navigation. The socio-economic benefit of the project is the benefit of avoiding accidents on inland waterways.

SWAT analysis

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Strengths

- collected data for increasing the safety of inland navigation
- Reduction of delays and waiting times
- the data collection system in the RIS Center is available for Operators and all subsidiaries
- Measurement with a microwave (radar) sensor giving the measurement result at a distance of 25-30 m with an accuracy of 0.1 cm
- size of the selected display will allow the message to be easily seen from a distance of about 150-200m in normal visibility and air clarity
- interface for information exchange and integration with other systems abroad such as ELIAS.

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Weaknesses

- low level of use of the website with data on clearance by waterway users, which will make it impossible to change the selected route at an appropriate time interval;
- the need to maintain equipment on bridges;
- high cost of maintenance

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Opportunities

- measurement data enables long-term research in the field of monitoring and the status of inland waters
- data on the occurrence of high and low water levels to plan preventive actions
- measurable economic benefits for shipowners
- Improved logistics planning
- better fleet management

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Threats

- in the case of a greater number of system operators, difficulties might occur to communicate with each other about system failures.

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4.1 Technical specifications

Construction of a system on the “Most Długi: in Szczecin:

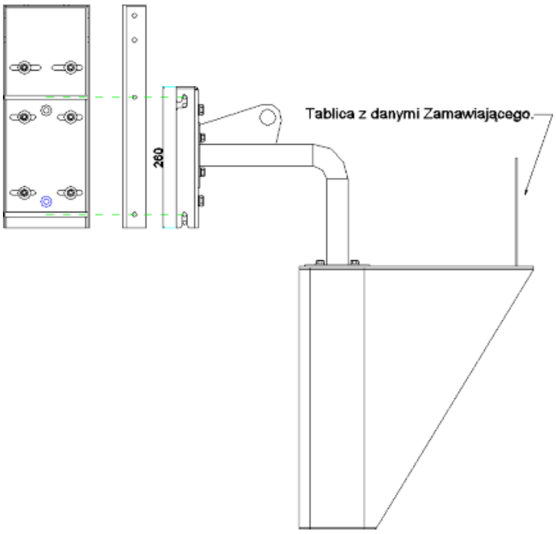
Elements:

- Two LED displays with bracket.
- Two PPPW devices placed in a teletechnical cabinet with radar measurement sensors brought outside. Due to the placement of PPPW components in the teletechnical cabinet, the systems will be powered by one 12V/42Ah battery.
- Teletechnical cabinet 800x600x250
- Radar sensor holder made of stainless steel.

- Photovoltaic panel.

LED DISPLAY WITH HANDLE

- Technical data:
- P8 resolution.
- Brightness 6000cd/1m2.
- Power supply 230V.
- GPRS communication.
- Display dimensions width 96cm, height 48cm.



Picture 4. Construction of the WLED including the mounting.

Picture 5. LED monitor showing the current bridge clearance

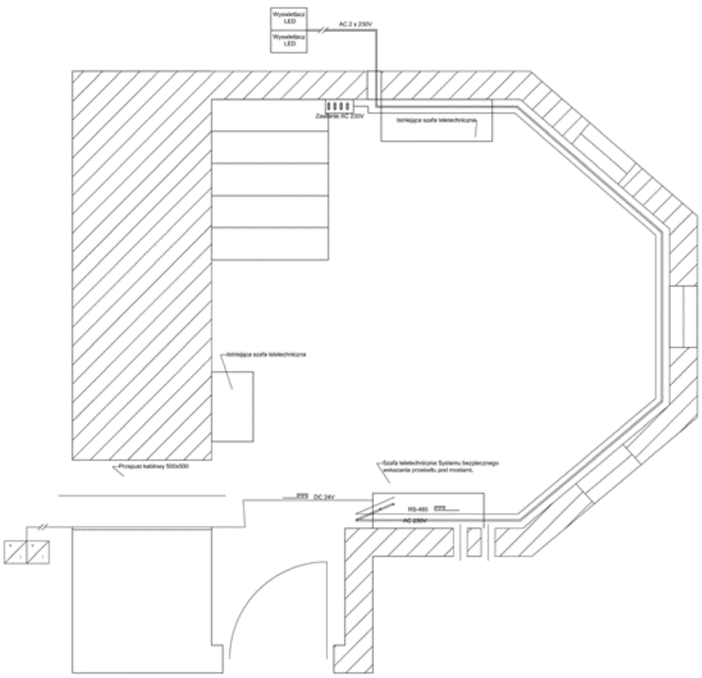
TELETECHNICAL CABINET

Located on level -1.

Adelid OM806025 metal switchboard with dimensions height: 800 mm, width: 600 mm, depth: 250 mm, in which will be installed:

- 2 x LPE battery with extended life parameters 110Ah/12V.
- 1 x LPE long-life battery 42 Ah/12V.
- 2 x Emergency power supply unit 800 VA.
- 3 x FX30 telecommunication modem.
- 2 x ModBus converter.
- Module with 4 x GPIO (configurable outputs/inputs).
- GSM/GPRS antennae.

Power supply to the cabinet and WLEDs - cable OMY 3x1,5 installed in cable trays 60x40. Such trays are already used in this facility.



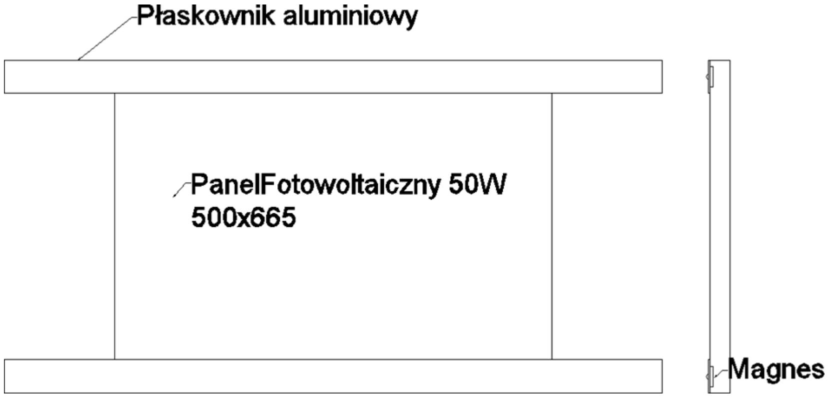
Picture 6. Teletechnical cabinet

PHOTOVOLTAIC PANEL.

The photovoltaic panel is used to keep the metering system (PPPW) charged.

It is installed in the window recess of the turret window at level 0 on the inflow side.

The size of the window opening is W 760mm H 1270mm, the glass size is 690mm x 1160mm respectively. Due to the limited light, a 50W/12V panel of 500 x 665 was used.



Picture 7. View of the photovoltaic panel and the flat bar fixing it to the wall.

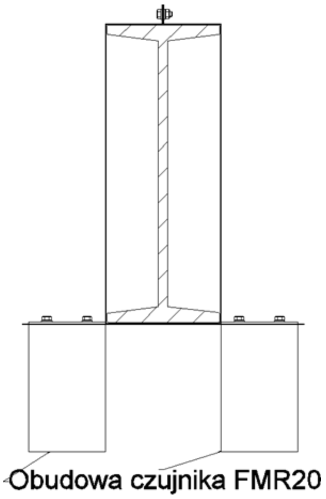
RADAR SENSOR HOLDER.

The bracket is made of 3mm thick stainless steel sheet, screwed.

Construction of PPiPD on the “Most Cłowy” in Szczecin.

Components:

- Two LED displays
- Two power packs with UPS, battery and bracket
- Two PPPW



Picture 8 . The method of mounting the FMR20 radar sensors.

POWER MODULE

The LED display is placed next to the power supply module on the adjacent support post of the barrier. The power block and the LED display will be connected by cables routed in a 30x35 metal cable tray fixed using dedicated brackets attached to the barrier in such a way as not to disturb any of the bridge equipment.

PPPW MEASURING EQUIPMENT, whose main components are:

a) 24Ah/12V battery.

b) Photovoltaic panel min 30W.

c) Durable steel housing.

d) Sierra Wierrles FX30 modem.

e) One MODBUS Converter.

f) One FMR20 radar sensor.

g) Mounting brackets.

The PPPW device works autonomously and does not require a mains power supply.

The system consists of three basic devices:

- PPPW: Water level measuring point

- WLED: LED display

- CS: The system centre, Server at the headquarters of the Inland Navigation Office on which the executive software and database are installed.

PPPW devices whose function is to measure the water level and transmit the measurement to the CS using the TCP protocol. Each point has the following functionality:

a) Measurement frequency from 1min-120min. Adjustable parameter

b) Reading the current geographical position.

c) Battery voltage reading

d) Intrusion alarm with immediate notification of PPPW violation.

e) Immediate transmission of collected data to CS using GPRS.

f) PPPW management via SMS commands.

g) Reading parameters transmitted from CS to PPPW

The main components of the PPPW are:

a) 24Ah/12V battery.

b) Photovoltaic panel.

c) Sierra Wierrles FX30 modem.

d) One MODBUS converter.

e) One FMR20 radar sensor.

f) Durable steel housing.

g) Mounting brackets

The main components of the LED display are:

a) 110Ah/12V battery.

b) UPS.

c) P8 multicolour LED display.

d) Sierra Wierrles FX30 modem.

e) Steel durable case.

f) Mounting brackets.

The system enables real-time monitoring of safe clearance, water level and display of clearance value on WLED.

The PPPW device is a fully autonomous water level measurement device. It performs measurements at set time intervals and the collected data is transmitted via GPRS communication to the CS.

Communication rules between system components.

- PPPW - CS device.

PPPW is equipped with a Sierra Wireless Fastrack FX30 modem. The modem has an installed SIM card of any operator. Communication is carried out in the general APN. The CS server has a static IP address. The FX30 to CS connection is based on the GSM network. Redundancy is the second same device operating on the card of another operator.

- WLED - CS.

The WLED is equipped with a Sierra Wireless Fastrack FX30 modem. It connects to the CS database via the DataManager software. The WLED communicates in both directions WLED-CS- WLED. It sends operating parameters such as mains and battery voltage information and retrieves operating mode data and values to display. The display can be managed from the position of the control application, setting digit colour, font type and brightness. Communication takes place in the general APN and is coded.

- PPPW - WLED

As described above (PPPW -> DataManager -> PostgresSQL -> DataManager -> WLED).
It should be noted that the implemented solution has its own communication protocol, which results in increased security of communication and the fact that SIM cards used in PPPW and WLED devices do not need a static IP address.

4.2 Evaluation Criteria

Relevance

The system of measuring and collecting data is essential for increasing the safety of inland navigation as well as collecting and collecting data in order to prevent threats. The collection of measurement data enables long-term testing in the field of monitoring grand status of inland waters. The collected data are also an important factor in improving the safety of inland navigation. Measuring devices combined with a display, located at the measuring site allows for a quick presentation of the hazard at each of the measuring places. The data collection system in the RIS Center is to be the culmination of the purpose of data collection - for Operators and all subsidiaries using the collected measurement data.

Efficiency

In order to increase the reliability of the system, it has been equipped with an alternative source power, in the form of a solar panel and batteries, supporting the operation of the system for a long time, and in the case of a display - for the time needed to maintain the display of measurement information.
System operation presupposes the use of a network interface for data transmission to server collecting the data. However, data security requires data collection in server rooms of the Inland Navigation Office.

Effectiveness

The system has been designed in order to play a major role of warning any passing vessels from insufficient clearance under bridge allowing to change the navigation route and prevent from possible damage or a danger of being stuck under the bridge which will have financial implications.
At inland watercraft speeds it is imperative that the inscription be visible from approximately 150 meters. The size of the selected display will allow to easily see the message from about 150-200m with normal visibility and air transparency. When visibility is limited to navigation conditions (fog, precipitation), the board is visible from 30-50m. The shape and dimensions have been selected in such a way that it is possible to display other relevant information requested in the RIS Center, such as 'Forbidden navigation' or data information 'on xx.xx - yy.yy shipping possible only with prior notification', such as on days when the Days of the Sea in Szczecin are organized. Measurement will take place using a microwave (radar) sensor. It is a method that gives the measurement result at 25-30 m with an accuracy of 0.1 cm. The non-contact method increases the reliability of the installation and makes it possible to

install the sensor outside the navigation window. The system has also been equipped with an alternative power source, in the form of a solar panel and batteries, supporting the operation of the measuring system for a long time, and in the case of a display - for the time needed to maintain the display of measurement information.

Utility

Due to its importance the system is going to be widely usable for every passing vessel. The data will be transferred and stored by the RIS Centre for the future needs and evaluation. The data stored will also be usable in the longer perspective for monitoring water levels during floods or drought and allow for planning future investments.

Sustainability

The planned installation is designed to dynamically visualize hydrological parameters, and after processing, collect data and visualize in the RIS Center. Based on the data the long-term effects of climate change can be monitored - floods, droughts and prevent them at the same time. The installation serves the safety of inland navigation for watercrafts.

4.3 Cost of the investment and its benefits

The cost of the entire investment has not exceeded the amount of 200 thousand Polish zlotys (circa 44 thousand EUR) including the technology, staff cost working on the installation as well as linking it to the RIS Center.

The potential benefits, as already mentioned are quite substantial. Undoubtedly, the most important is the increased safety, less accidents, or potential collisions with the bridges with insufficient clearance as the system provides very precise data. Safety of the navigation also means predictability and profitability which is a determinant and a condition for new investments of enterprises that decide to include this type of transport in their existing transport chains.

This investment despite relatively low cost of installation and maintenance (in comparison to other large and costly projects that are ongoing and planned for the future) can have in the longer perspective a very positive economic impact.

5 REFERENCES

5.1 The list of literature and sources

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5.2 List of PICTURES