Intelligent Transport Systems Used in Inland Waterway Transport and Their Contribution to Pollution Prevention

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Abstract. The paper presents the intelligent transport systems used in inland waterway navigation on the Romanian Danube sector, general information on their organization and operation at national, regional and local level, as well as the connection with other functional systems at European level - current situation in 2022. Intelligent Inland Waterway Transport Systems are an integral part of the River Information Services (RIS) platform. This term is geared towards ITS-specific services and connection to other modes of transport. Moreover, taking into account the objectives of these systems, an analysis will be made regarding their contribution in the field of pollution prevention on the Romanian Danube sector as a result of the development of the naval transport activity.

Keywords: intelligent transport systems · waterways · RIS · pollution prevention

1 Intelligent Transport Systems

1.1 Introduction

The term Intelligent Transport System (ITS) originally appeared in connection with telematics systems in road transport, later extended to all modes of transport (road, rail, air, river, sea) and then the coverage area. of this term should be further extended by including, in addition to systems, services.

In order to delimit the coverage area of the term Intelligent Transport System, it is necessary to define it as precisely as possible. The definitions related to ITS are different, in terms of the transport system to which it is addressed, but they have in common both the enumeration of the technologies used in the development of such systems and the results and role of ITS systems. Definitions of intelligent transport systems:

– Seoung Bunn Kim and Jacob Hinchman of the Georgia Institute of Technology: reducing energy consumption and increasing economic productivity. ITS technologies are varied and include: information processing, communications, control and electronics".
– Directorate for Transport and Energy of the Commission of the European Union: "ITS is the result of the application of advanced technologies to transport systems and methods to increase the efficiency, comfort and safety of transport by different transport".

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From the analysis of the evolution of intelligent transport systems and how to approach them, it can be said that ITS is a system resulting from the integration of electronic systems, communications, information processing and storage and control (local and remote) with transport (road, rail, air, river and sea) in order to increase economic efficiency, save lives, reduce environmental pollution, reduce transport times and increase passenger comfort.

ITS service providers are able to provide information to passengers through various channels before and during the trip, (eg on-board devices, web services, message boards, special kiosks, mobile phones, etc.), providing support for choosing the best way and the best route, but also information about travel costs.

ITS helps to provide a complete travel service: from planning and guiding a particular route to booking tickets and parking spaces. Links to tourist services provide additional services, such as hotel reservations, visitor information, and more [1].

ITS is applied in all modes of transport with a core of common mature technologies (identification and location of vehicles, voice and data communication with the vehicle, monitoring of traffic situations, information on traffic and travel, etc.) but also with specific elements of each mode of transport, which led to specific concepts and names, as follows:

– Road - ITS or Road ITS;
– Railway - ERTMS [European Railway Traffic Management System];
– Air - ATM [Air Traffic Management];
– Maritime - VTMIS [Vessel Traffic Management and Information System];
– Inland waters - RIS [River Information Services] [1].

1.2 Danube Traffic Management and Inland Water Transport Information System – RoRIS

The Danube travels about 1075 km on Romanian territory before flowing into the Black Sea. The impressive length and the covered territory give it a huge potential for the transport of goods and people, the river being at the same time an important link in the European naval transport on inland and mixed waters.

Romania adopted the new RIS concept - River Information Services and thus the RoRIS project appeared, the aim of which was to create a RIS system for the entire length of the Danube that would be perfectly compatible with the European Directive 2005/44/EC (RIS Directive) entered into force on 20 October 2005.

The first phase of the VTMIS project on the Danube started to be implemented by the Romanian Naval Authority starting with 2005 and was completed in 2009.

In May 2009, the implementation of the second phase of the Project "Danube Traffic Management and Inland Water Transport Information System - RoRIS 2" started. RoRIS is a complex system for monitoring and managing ship traffic throughout the Romanian Danube sector.

The aim of the RoRIS II project was to create a RIS system for the entire length of the Danube that is perfectly compatible with the European Directive 2005/44/EC (RIS Directive). Interconnection with similar systems in Austria, Hungary, Slovakia, Bulgaria and Serbia was also to be carried out in Phase II.

The project is part of the TEN-T Priority Axis, respectively Priority Axis 3, the main intervention area 3.2 "Improving traffic safety on all modes of transport" aiming at ensuring European safety and security standards in shipping, respectively improving the Information on Ship Traffic Management (VTMIS) and provision of river information services on Romanian waterways [2].

1.3 Project Objectives

RIS systems - River information services have as a premise three main objectives:

- the transport must be safe (involves minimizing the number of accidents and incidents during the trip);
- the transport must be efficient (maximizing the effective transport capacity of the waterway, maximizing the loading capacity of ships, reducing travel times, reducing transport costs, reducing fuel consumption, reducing the effort of RIS users, providing efficient and economical links between modes of transport). transport, streamlining of ports and terminals);
- the transport must protect the environment (reduction of environmental hazard and reduction of pollution due to accidents, illegal actions and normal operations) [3].

These objectives are reinforced by the fact that the RIS systems provided must be reliable, efficient and law-abiding.

The objectives of the RoRIS project were set as a result of the fulfillment the following project-specific requirements:

- providing ship traffic management and information services inland RIS waters, in line with the requirements of RIS Directive EC/44/2005 and associated regulations;
- increasing the traffic of people and goods on inland waters by reducing the negative externalities of river transport, as a result of reducing shipping accidents and incidents, reducing transport times and costs;
- the creation of a single inland transport area by providing harmonization services at European level and by interconnecting national RIS centers.

The RoRIS II project is part of Priority Axis 3, KAI 3.2 which aims at "safer shipping by improving the Ship Traffic Management System and by River Information Services on Romanian Waterways".

The objectives of the RoRIS II Project, in line with the requirements of the European Parliament's RIS Directive EC/44/2005 and the specific European Commission Regulations on this Directive, are the following:

- increasing the safety of transport by: increasing the length of waterways provided with automatic identification and location services;
- increasing the number of support applications for RIS services;
- increasing the efficiency of transport by:

  - increasing the number of fixed stations for locating and identifying ships;

- increasing the number of VHF radio stations communicating with ships;
- increasing the number of surveillance radars;
- increasing the number of new pillars;
- benefits (effects) obtained from time savings (value of time) for passenger transport on the Danube;

– environmental protection due to:

- the benefits (effects) obtained from the reduction of the negative extremities for the transport of goods on the Danube;
- reduction of the number of navigation events/year/ship x km.

The objectives of the RoRIS II Project are part of the overall objective of the POS-T to "promote a sustainable transport system in Romania, which will facilitate safe, fast and efficient transport for people and goods with a level of service to European standards" [3].

1.4 RoRIS II System Architecture

In order to ensure the interoperability and operational harmonization of systems that are part of the RIS concept, it is absolutely necessary to develop a system architecture based on Directive 2005/44/EC and the results of European research and development projects in the field (IRIS I, IRIS II, GIS Forum, Platina etc.).

The RoRIS system has a hierarchical functional architecture structured on the following levels:

The local level - local centers - ensures the initial collection of data from sensors, the reception of data from different users, the transmission of data to different users and the transmission of data to the next level, the regional one;

Regional level - regional centers - receives data from the local level, filters duplicate data, transmits data at the national level, ensures coordination at the regional level and establishes links between regional centers;

National level - a national center that ensures the collection of data from the regional level, ensures the coordination of the entire system, performs the exchange of information with other organizations, provides external interfaces for other applications;

Terminals at the Ministry of Transport [4].

The RoRIS II system develops the network of ship identification and identification sensors type AIS (Automatic Identification System), radars and video monitoring type CCTV (Close Circuit Television). The concept and structure of the co-communications support network is completely redefined by the digital transfer of all information (including voice messages) into IP (Internet Protocol) technology.

All information is transmitted directly or via radio links dedicated to sensors to the communication nodes in the local, regional and central stations. The information is transmitted between all these communication nodes through an external telecommunications service provider.

1.5 RIS COMEX

RIS COMEX is a CEF-funded multi-beneficiary project that aims to define, specify, implement and sustainably operate the RIS Services Corridor following the results of the CoRISMa study. RIS COMEX started in 2016 and will last until mid-2022.

The beneficiaries of the RIS COMEX project cover a considerable area of the European space, massively concentrated in the Rhine-Danube Corridor area. The partner institutions of the project come from 13 countries and are:

- Austria: viadonau (administrative coordinator);
- Netherlands: Rijkswaterstaat;
- Belgium: Ministry of transport or specific RIS authorities;
- Bulgaria: Bulgarian Ports & Infrastructure Company (BPI);
- Czech Republic: Ministry of Transport;
- Germany: Bundesministerium für Verkehr, Bau und Stadtentwicklung;
- France: Voies Navigable de France (VNF);
- Hungary: National Association of Radio Distress-Signaling and Information Communications (RSOE);
- Croatia: Agency for Inland Waterways (AVP) or IWW;
- Luxembourg: Ministry of Sustainable Development and Infrastructure;
- Romania: Romanian Naval Authority (RNA);
- Serbia: Plovput;
- Slovakia: Ministry of Transport, Posts and Telecommunications.

The RIS COMEX project aims at the implementation and cross-border operation of RIS services, based on the operational exchange of RIS data. These services must allow the management of traffic by the authorities and the management of transport by the logistics sector. The available national infrastructure and services are used for this purpose.

The main proposed objectives are:

- development of a general concept called “RIS Corridor Management” (based on CoRISMa results), in a dialogue between RIS providers and logistics users (eg carriers, ship masters, ship and fleet operators, terminal operators) for ensure the relevance of the services to be implemented;
- the permanent implementation and operation of selected parts of the whole concept providing increased quality and availability for services on the state of the channel, traffic and transport information, resulting in a considerable increase in efficiency in inland waterway transport and also contributing directly to the use of the general benefits provided by RIS, (for example: increasing the efficiency and protection of the environment in inland navigation as a mode of transport);
- defining the functioning mechanisms (legal, organizational, financial, technical, quality), in order to ensure a sustainable development and operation of harmonized RIS services and beyond the life of the project;
- harmonizing the concept of RIS data exchange through common development at European level and achieving unique specifications for “corridor” RIS services, avoiding the development of different concepts;

– progress on the harmonization of transport information services at European and/or corridor level, based on existing solutions and concepts (eg IVS90, ERI agent, R2D2).
– RIS COMEX, as a platform for bringing together public and private actors in the RIS corridor, will facilitate dialogue between river information service providers and logistics users (eg shippers, ship and fleet operators, operators). of terminals).

RIS COMEX will develop Harmonized River Information Services under the Digital Inland Waterway Area (DINA) initiative and will be a further step towards integrating RIS with other modes of transport [5].

Based on these objectives, the project aims in particular at:

– better planning of inland waterway transport (increased transport reliability);
– reduction of waiting and travel time;
– increasing the efficiency of inland waterway transport;
– optimal use of infrastructure (increasing capacity utilization rate);
– reduction of administrative barriers.

1.6 The Basic Concept

"RIS Corridor Management", as a concept, aims to improve existing RIS services and expand them on a route or waterway network to provide RIS services, not only locally, but also regionally, nationally and international.

Therefore, "RIS Corridor Management" will provide support for route planning, travel planning, transport management and traffic management, services that are currently available only in part or not at all.

In this sense, "RIS Corridor Management" is defined as a set of mutual information services between navigation authorities but also for the provision of information to waterway users and logistics partners, in order to optimize the use of inland navigation corridors within European waterway network.

It is clear that this definition indicates that it is absolutely necessary to exchange information between authorities as well as collaboration between public and private partners, in order to improve the performance of inland waterway transport and the use of existing infrastructure [5].

According to the results of the CoRISMa project, the services developed within the RIS COMEX project are classified as follows:

Level 1. Within the "RIS Corridor Management" level 1 services are those services that allow an accurate planning of the route, by providing static and dynamic information on the infrastructure (Fairway Information).

This is the basic level. Level 1 provides information on the major infrastructure needed to plan the route. At this level, there are answers to questions such as: how many locks are on the route? are they open what are the current water levels? where can information be obtained?

The main task of this level of service is to provide information about the route, from the point of origin to the final point of destination.

Level 2. Within "Corridor Management", Level 2 services are those services that allow the calculation of travel times for travel planning and traffic management, by providing traffic information.

This level is based on the previous one, adding traffic information. Be logical: once we have the infrastructure information, we also need the real traffic image. We need useful information such as: how many ships are on the channel? what is the estimated time of arrival?

Knowing the traffic situation on the corridor, stakeholders can better plan their journey, or find out the position of their own ships on the waterway network;

Level 2 is subdivided as follows:

- level 2a: the actual traffic situation is taken into account (eg actual traffic density, actual waiting times);
- level 2b: predictions during a journey (eg estimated traffic density, estimated waiting times) are also taken into account in a reasonable manner.

Level 3. Within the "Corridor Management", the level 3 services are those services that allow the logistics partners to manage the transport.

It is the last level, which is therefore based on levels 1 and 2, and introduces a new dimension: information for third parties on logistics and transport management. Interested private entities in the logistics chain can benefit from personalized services that provide specific information (eg information on ship position or estimated time of arrival of ships for authorized logistics users, travel and cargo reports), designed to increase efficiency within logistics processes (Fig. 1).

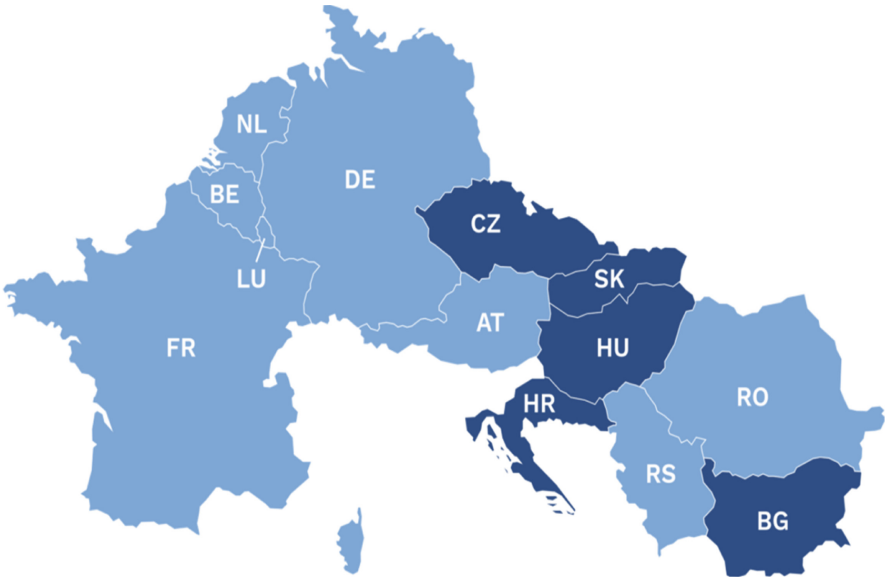

Fig. 1. RIS corridor map [9] [source https://www.riscomex.eu]

Fig. 2. RIS CEERIS home page [9] [source https://www.riscomex.eu]

In order to address the existing fragmentation of national RIS systems and the lack of harmonization of RIS data exchange, the RIS concept activated the RIS Management Corridor which was established within the CoRISMa project.

This ambitious goal will be achieved through two joint systems that will be closely interconnected and will be operated in a sustainable and joint manner by the affiliated partners: VisuRIS COMEX and CEERIS.

Joint procurement for CEERIS - Electronic Reporting Information System from Central and Eastern Europe - was successfully completed on August 11, 2020, after which it was passed in the testing period at the level of each RIS center.

Interconnection tests are currently being carried out between the national RIS centers, and the platform will become operational during the current year.

In the meantime, the Contracting Authorities are working on a legal basis for the sustainable operation of CEERIS.

CEERIS will be available to users until mid-2022. By then, a tight implementation schedule is ahead of project partners (Fig. 2).

2 Contribution of Intelligent Transportation Systems in the Field of Pollution Prevention

The applications used in the RoRIS system fully cover the basic objectives and comply with their requirements for safe, efficient and environmentally friendly inland waterway transport (Figs. 3 and 4).

Disaster Mitigation Assistance is an application used in the RoRIS system and aims to record ship and transport data at the beginning of a voyage in a RIS center and update the data during a voyage.

In the event of an accident in the area of competence, the RIS Center transmits the data to the emergency services for the organization of the intervention.

Depending on the risk assessment, a disaster mitigation service may only certain types of ships and convoys or all ships (for example, extremely large ships, ships carrying dangerous goods, special transports and special tugs) [6].

Fig. 3. RoRIS service interface (internal site) [11] [source: RoRIS Drobeta Tr. Severin]

Fig. 4. RoRIS service interface (external site) [10] [source: www.roris.ro]

It shall be the responsibility of the master of the vessel to report the information requested by the competent authorities, mainly concerning:

- Statistical data on ships in convoy (type, name, flag, official number length, width, draft)
- Variable data (number of crew members, number of ships in the convoy, length of the convoy, width of the convoy, draft, direction of navigation, current position, etc.)

– For each type of cargo (type and quantity of goods, port of loading and port of unloading, etc.
– Only for dangerous goods (name and code of the goods, hazard class, packing code, UN code of the goods, number of blue cones).

Regulation 414/2007 on technical guidance for the planning, implementation and operational use of river information services (RIS), point 5.4. recommends the installation of a ship reporting system with a database and adequate means of communication [6].

Navigation position and direction (direction of travel) must be reported:

(a) when the ship enters or leaves the coverage area of a RIS center;
(b) at specific reporting points within a RIS coverage area established and communicated by notices to seafarers or published as special navigation rules;
(c) in the event of a change in the data during the journey;
(d) before or after stops longer than normal.

Logistics/transport management information can be found in the RIS logistics applications and includes:

(a) travel planning;
(b) transport management;
(c) intermodal port and terminal management;
(d) cargo and fleet management.

The planning of the voyage is the responsibility of the master and the shipowner. The voyage planning includes both the planning of the loading and the determination of the draft of the ship (loading) according to the cargo to be transported, and the planning of ETA and any loading or unloading operations during the voyage.

RIS river information services should support travel planning by:

(a) the waterway information service;
(b) strategic traffic information;
(c) operation of locks and bridges.

Transport management aims at organizing the transport chain outside the navigation area by freight brokers and transport quality managers. It aims to:

(a) overseeing the activities of fleet managers/operators and contracted terminal operators;
(b) controlling the conduct of contracted transport operations;
(c) monitoring unforeseen risks threatening the reliability of such shipments;
(d) completion of transport operations (delivery and invoicing).

Competent authorities need to design their information systems so that the flow of data between public and private sector partners becomes possible [6].

Technical standards and specifications shall be used in accordance with:

(a) Guidelines and criteria for inland waterway management services (Inland VTS Guidelines), (worldwide), IALA Recommendation V-120, June 2001;
(b) Regional Agreement on Radiotelephony Services on Inland Waterways (Basel), 2000;
(c) technical specifications for inland ECDIS as defined in the RIS Directive;
(d) technical specifications for ship tracking and location systems, such as inland AIS, as defined in the RIS Directive;
(e) technical specifications for the electronic reporting of inland waterway vessels as defined in the RIS Directive;
(f) technical specifications for notifications to masters of inland waterway vessels as defined in the RIS Directive;
(g) OMV's Harmonized Commodity Description and Coding System (worldwide);
(h) United Nations Code for the location of UN/LOCODE trade and transport activities (worldwide);
(i) United Nations (EDIFACT) standard (worldwide);
(j) UN/UN Standardized Terminology for Inland Waterway Radio Connections (Europe), 1997 [6].

For ships carrying dangerous goods, in states where the reporting task is in force, the master of the ship shall, before the start of any voyage, report the following details to the competent authority of the State in which the voyage began:

– name of the vessel;
– official ship number;
– deadweight tonnage;
– description of the dangerous goods transported according to the transport document (UN number or identification number, official transport name, class and, if applicable, packing group and/or classification code) together with the quantity in each case;
– number of people on board;
– port of destination;
– the planned route.

This reporting obligation shall apply to both upstream and downstream crossings in the territory of each State, in accordance with the requirements of the competent authorities.

The information may be transmitted orally (for example, by radio-telephone or, where appropriate, by an automatic radiotelegraph messaging service) or in writing [7] (Fig. 5).

3 Conclusions

If we refer to the transport of goods, we can say that this activity cannot be characterized as one with essentially polluting features.

And yet, considering the fact that significant quantities of goods are being transported (from 1,000 to 18,000 t of cargo per convoy of river vessels), we appreciate that a possible naval accident can lead to the dumping of significant quantities of goods.

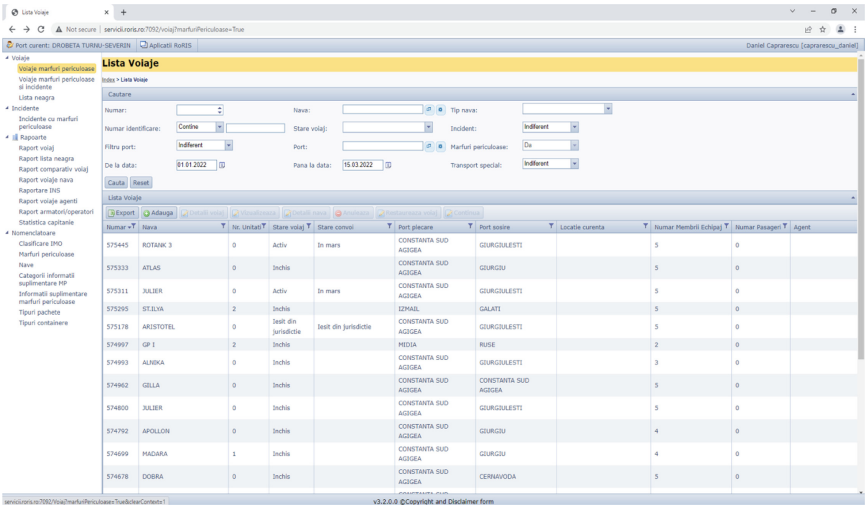

Fig. 5. Application interface Electronic travel reporting - dangerous goods travel [11] [source: RoRIS Drobeta Tr. Severin]

Thus, depending on the type of discharged goods, pollution can occur with severe effects on the aquatic environment.

In the case of discharges into running water, the mixture of discharged goods is quite fast so that it cannot be limited and controlled in a timely manner.

When dangerous goods or residues are transported, the potential for pollution is greatly increased and the effects of accidental spills are often impossible to measure [8].

Thus, shipping activities are accompanied by an important risk factor. Despite all the technical-organizational and managerial measures taken by shipping companies and authorities, naval accidents occur with significant consequences, the most important of which are loss of life, material loss or damage to the marine environment through pollution. The events that are taking place require the need for rapid and far-reaching interventions that lead to the minimization of material losses and the saving of endangered human lives.

Pollution prevention is achieved through well-developed legislative systems depending on the geographical position of each country and international law, as well as the specific conditions of certain countries or geographical areas where certain restrictions are imposed to protect species of wildlife and endangered flora.

Combating pollution involves compensation, fines and depollution costs.

Intelligent transport systems used in inland waterway navigation help to ensure optimal conditions for environmental protection and water pollution. Electronic reporting of voyages, monitoring of ships carrying dangerous goods in inland waterways are one of the main objectives of river intelligence services.

The achievement of this objective is currently achieved through the appropriate use of RoRIS applications, respectively Electronic Travel Reporting (SHR), Disaster Mitigation (CAP), Notice to Navigator (NtS), Ship Registration, Navigating Personnel, Monitoring of Perishable Goods -big.

External users (shipowners, ship agents, ship masters) are required to enter in the Electronic Travel Reporting (SHR) application the data relating to the travel requirements to be performed in accordance with the predefined requirements of the application. and which complies with the regulations in force.

The competent authority is obliged to verify the information sent to the RIS centers and to apply the regulations in force.

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