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DEVELOPMENT OF TELEMATICS AND ITS APPLICATION IN WATER TRANSPORT

ABSTRACT

Significant increase in traffic demand at the end of the 20th century and the increasing anthropogenic environmental pollution have resulted in the need to introduce the telematics-supported intelligent transport systems in all the traffic branches. The work presents the development and the basic characteristics of transport systems managed by information and communication technologies. Also, the possible development and advantages of implementing telematics in the traffic along the river of Danube through Austria, as well as monitoring sea-going ships and containers in intermodal traffic.

KEY WORDS

telematics, intelligent transport systems, inland waterways, intermodal transport

1. INTRODUCTION

The development of the modern society of today is based on the implementation of different information technologies. As a significant factor of modern development, traffic systems also have to adapt to these tendencies. Information science today has been implemented in all the traffic branches.

Traffic information science is oriented towards solving of problems in the sphere of road, rail, air, water, post and telecommunication traffic by applying methods and devices that serve to collect, process and distribute traffic information.

The culmination of traffic information sciences consists of telematics (telecommunication and informatics) supported transport systems - intelligent transport systems (ITS). "Intelligent" behaviour of such systems is reflected in the level of information, ability to communicate, ability to learn, to deduce and to adapt.

Telematics (in loose translation: remote control) is a combination of information and telecommunication technologies. Telematics includes a wide range of technological connections that simplify the control of the whole transport chain through traffic information exchange. Telematic systems contribute to the improvement of the traffic flow, road safety, transport efficiency, environmental protection, and business economy. Telematics is also significant regarding its implementation in medicine and industrial manufacture.

The basic reasons for introducing ITS are the following:

- increase in the traffic route capacity (traffic significance),
- reduction of environmental pollution (environmental significance),
- savings in fuel, reduction in transport time (economic significance),
- increase in traffic safety (protection and safety significance).

2. THE NEED FOR INTRODUCING INTELLIGENT TRANSPORT SYSTEMS

Classical answer to continuous growth in traffic demands is the physical expansion of the traffic network, terminals, and the cargo-transport hubs. However, today, due to high costs and attitude towards the environment, such classical solutions are simply not possible any more. It is necessary to consider the solutions in the maximally efficient usage of the existing infrastructure.

Such solutions can be realised by means of advanced technologies of traffic management.

Advanced, intelligent transport systems of today operate in real time, are sensitive to traffic flow changes, combine different functions: traffic information, traffic demand management, regulation of vehicle access to certain parts of the network, light signalling operation control, informing of users at terminal zones.

Intelligent transport systems allow an increase in capacity of the existing traffic routes, reduction of environmental pollution (through reduced emission of exhaust gases, greater traffic safety and reduced need

to construct new traffic routes), saving in fuel and shortening of the travelling time.

3. DEVELOPMENT AND CHARACTERISTICS OF TELEMATICS-SUPPORTED TRANSPORT SYSTEMS

Telematics-supported intelligent transport systems use advanced computer, information and communication advances in order to increase mobility, safety and for better environmental protection. The main goal of applying intelligent transport systems is the establishment of complete understanding (communication) between the system users and those who manage the transport system.

The implementation of telematics results in real-time management of the traffic system, thus getting a direct answer from the traffic participants, and immediate reactions to a possible change in traffic regulation.

The development of intelligent transport systems started by its implementation in road traffic and features three phases:

1. *Classical traffic management method* using vertical, horizontal and light signalling.
2. *One-way systems for communication with drivers*, based on information transfer by means of radio (RDS), usage of digitised maps in finding the optimal way to the destination and changeable road signalling. The best known systems are CARMINAT and SOCRATES.
3. *Two-way systems for communication with drivers* – systems AUTOGUIDE, ALI-SCOUT-Siemens and ULISSEE. The driver sends real-time travel data on his/her route to the control centre. The obtained data change the existing database and in turn determine current optimal routes sent as information to other drivers.

Generally, the development of intelligent transport systems can be monitored through nine basic development areas:

1. navigation systems,
2. control and cash-free charging systems,
3. safety systems,
4. traffic control and management systems,
5. maintenance,
6. public transport,
7. commercial transport,
8. pedestrian traffic,
9. itineraries (detours) for emergency situations.

With the aim of establishing international co-operation regarding development of advanced transport technologies, 1985 saw the start of the **EUREKA** program in 19 European countries. The most significant projects within this program include:

- **PROMETHEUS** – Program for European Traffic with Highest Efficiency and Unprecedented Safety. This scientific project was started by the European Union automotive industry in 1986, with the aim of developing and implementing sophisticated information and communication systems in road traffic and development of intelligent vehicle. The project was completed in 1994 and 14 car manufacturers participated in its development.
- **DRIVE** – Dedicated Road Infrastructure for Vehicle Safety in Europe. This scientific program of the European Union for development of advanced information and communication systems in road traffic has three basic objectives: increase of safety, increase of traffic system efficiency and improved environmental protection. These objectives are achieved by controlling traffic and guiding vehicles along the network, using digital maps and databases on road networks.
- **CARIN** – Car Information and Navigation System. The system is used to guide vehicles along the network based on digitised data about the network obtained on a CD-ROM. The vehicle must be fitted with a computer, CD-ROM reader and the equipment which determines the location of the vehicle in space. The driver marks his/her current position and the destination, and the computer determines the optimal route and suggests to the driver how to get there along the network.
- **MOTIV** – Mobility and Transport in Intermodal Transport Systems. This is a research program which resulted from the programs PROMETHEUS and DRIVE. The basic objective is to provide an overall solution to traffic problems mainly in the densely populated areas by intelligent connecting of transport systems and by optimal usage of the existing capacities. The next objective is in increasing traffic safety by means of in-vehicle systems assisting the driver.

4. SOME APPLICATIONS OF TELEMATICS IN WATER TRANSPORT

4.1. Telematics in Traffic on Inland Waterways

Traffic on inland waterways has not been used fully yet, as reliable, cost-effective and environmentally friendly traffic branch for medium and long distances. This is precisely the reason, with a tendency to maximise operation efficiency, for substantial investments in inland waterway development in countries with developed inland waterway network.

In recent years the growth of cargo volumes transported via western parts of the Danube corridor VII has been obvious (particularly following the year 1992 and the opening of the Rhine-Main-Danube canal, which transported in the year 2000 over 8.5 million tonnes of cargo), and after removing the destroyed bridges on the Danube in Yugoslavia, a substantial increase in river transport is expected, also in its eastern part. The enlargement of the European Union allows greater freedom in trading, and lower transport tariffs in south-eastern Europe will create the basis for further increase of river transport. Accordingly, the traffic infrastructure in the Danube countries has to be adjusted to this corridor.

The Danube countries have recognised the importance of the Danube corridor VII by signing the Memorandum of Networked Transport Development in the region (6 September 2001 in Rotterdam).

On 2 October 2001 the European Commission adopted the instructions for the trans-European network. This stressed the importance of traffic on inland waterways, intermodal transport and interconnections.

In the recent and the next ten years the European Union has been and will be emphasising the great significance of maximal usage of transport, including optimal environmental protection. Therefore, inland waterway transport occupies a significant position, but only as reliable, efficient and adequately equipped traffic branch.

In the Danube countries inland waterway navigation will successfully integrate into intermodal transport chain if key problems in inland waterway traffic are solved:

- excessive delay of vessels due to customs formalities,
- unreliable information about vessel position and possibly transported dangerous cargo,
- insufficient information about the vessel arrival to a river port and excessive waiting for cargo handling.

One of the key elements to improve transport on the Danube corridor VII and for integration of traffic on inland waterways into intermodal transport chains is the purchase and usage of telematic equipment. These *River Information Services* (RIS) will increase the traffic safety and improve environmental protection, intermodal transport operations, using electronic information systems, for all the participants in the intermodal transport chain.

The advantages of River Information Services at the government level:

- increase of traffic safety on inland waterways,
- efficient traffic control on inland waterways,
- efficient control of dangerous cargo on inland waterways,
- efficient information exchange about the status of possible accidents (collision, environmental pollution, rescue),
- more efficient customs control,
- electronic monitoring of the conditions at terminals, depots,
- more efficient data and information exchange in international traffic on inland waterways,
- increased safety through free access to the information services (information to captains about water depth, waves, meteorological data – wind, ice),
- development of digital river maps according to European standards,
- accurate overview of waterways, navigation marks and river banks,
- general definition of administrative permit for cargo and passenger transportation,
- establishing of an efficient traffic management system based on the European standard (AIS, ECDIS) in all European countries that have significant inland waterway networks.

The advantages of River Information Services at commercial level:

- more efficient integration of traffic on inland waterways into intermodal transport through electronic integration of all the factors in the logistic chain,
- improvement of traffic efficiency at border crossings,
- better planning of cargo handling operations due to the existence of exact and reliable estimates about vessel arrival to the river port,
- optimal usage of inland vessels and reducing the waiting time for cargo handling services,
- reduction of administrative activities,
- more efficient planning and control of transport operations.

The advantages of River Information Services at social and economic level:

- increase in transport volume on inland waterways by taking over cargo from road and railway traffic, and consequently improved environmental protection,
- facilitating creation of a new logistic chain by introduction of high-quality transport services into the inland waterway traffic.

4.1.1. Introduction of River Information Services in Austria

Strategy of introducing River Information Services in Austria

Recognising the importance of River Information Services the Austrian Ministry of Transport, Innovations and Technology will integrate this service in the Austrian part of the Danube.

River Information Services will be introduced on the Danube using the following approach:

1. The initial centre and establishing of the basic River Information Services is planned for summer of 2002 for 30 km of the Danube section between the Freudenau and Greifenstein locks (Figure 1). This will determine exactly the technical approach and commercial value of services.
2. The expanded River Information Services on the Austrian route of the Danube will be fully set in 2003. All factors and interests of the inland waterway navigation (commercial and governmental) are going to be gradually connected.

Operation of the basic River Information Services

The basic objectives of the basic River Information Services include the following:

- valid traffic information (current vessel location, vessel identification, dimensions, vessel draught, information about transport of dangerous cargo),
- presentation of navigation on the electronic map,
- presentation of traffic information to the inland waterway transport control,
- support to the personnel of the Austrian locks for better planning of lock operations,
- reliable support to customs and state border officials with the aim of increasing the efficiency of customs and border vessel control procedures,
- control and monitoring of transport of dangerous cargo.

The telematic system of the basic River Information Services is composed of the following elements:

- electronic nautical map (ECDIS – presentation and information system of the inland navigation),
- positioning system,
- radio communication based on transponders (transceiver with automatic signal transmission) based on AIS – Automatic Identification System,
- data processing.

The electronic presentation on the map and the information system (ECDIS) are available to the computer onboard vessel, and communication and control centres on land. Positioning is performed by satellite systems to determine the position (e.g. NAVSTAR-DGPS) with the accuracy of several metres. Communication infrastructure onboard vessel will be based on the ship transponder, through techniques based on AS standard.

Data processing by means of computers provides efficient, updated, reliable and comprehensive information regarding overall inland navigation.

The following system components will be implemented into the development of River Information Services:

- ship segment,
- land segment,
- control segment.

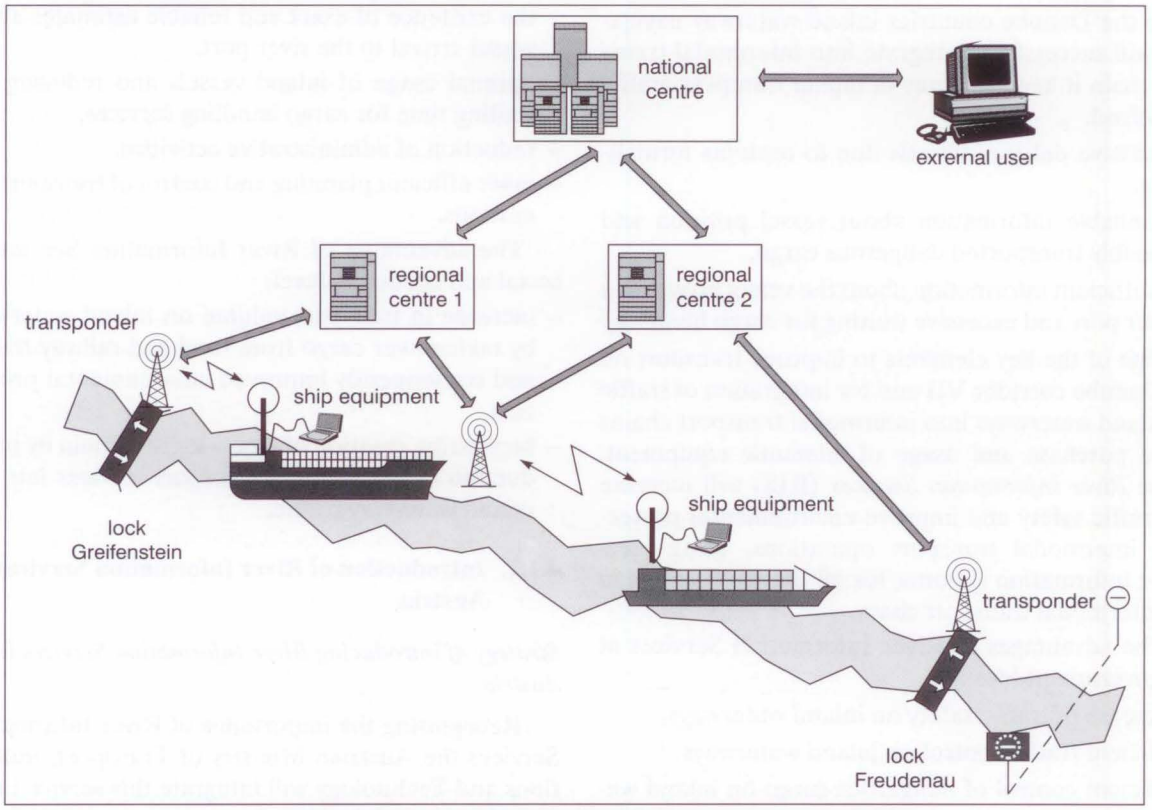

Figure 1 - The concept of basic River Information Services in Austria

The ship segment consists of the ship transponder system (radio modem for data transfer), positioning system and computer for communication data processing. Computer with electronic map of inland waterways can display the vessel's proper position, as well as the positions of other vessels.

The land infrastructure (land segment) will be set along the waterway and will consist of the land transponder system and information exchange network with the control segment.

The control segment consists of regional and national centres and processes all traffic information. In Austria the regional centres will be located at the locks as assistance in their operation. Here, current traffic information can be presented on the electronic river maps, but all the vessels fitted with transponders can be monitored by the authorised bodies.

The national centre has been set in the Austrian supreme shipping body. There, all activities in inland navigation can be monitored and controlled. External users (governmental and commercial) can have access to current traffic information if adequately authorised.

Functionality of expanded River Information Services

Whereas basic River Information Services are focused on creation, presentation and processing of direct information about river traffic regarding implementation by authorised bodies, the expanded River Information Services process direct information on river traffic and combine them with other information necessary for inland navigation.

The following groups will have advantages of improved services:

- authorised bodies for border control,
- authorised bodies for customs control,
- authorised bodies for environmental protection,
- lock operators,
- inland ports,
- shipping operators,
- forwarders and logistics,
- shippers.

The following information services are expected to be developed and used:

- greater control and monitoring of the ship by authorised bodies,
- electronic pre-informing of the authorised bodies about the border crossing of passengers and personnel,
- electronic pre-informing of the authorised customs officials about the cargo,
- electronic registration of dangerous cargo,
- traffic management by means of a lock operation planning system,
- providing accurate and reliable vessel positioning in the port of loading,
- international data exchange on river transport.

River Information Services at the European level

All the countries on the Danube and Rhine have acknowledged and published the significance of River Information Services at the European Conference on Traffic on Inland Waterways in Rotterdam, in September 2001:

"...invite all the involved governments to found the European River Information Services (RIS) by 2005 based on the standard that will be formed within the European Community, UN/ECE and River Committees since River Information Services contribute to safer and more efficient transport on inland waterways..."

As result of this conference it was concluded that two comprehensive measures have to be undertaken at the European level:

- *First step* – Preparation to establish River Information Services at the European level!
- *Second step* – To set and start operation of River Information Services in each country!

4.2. Application of Telematics in Intermodal Transport

Intermodal transport is such a technology which uses simultaneously two advanced and suitable transport means, from two different transport branches for the transportation of goods, and one transport means together with its cargo represents the load of the other transport means from another transport branch, and the transportation process runs between at least two countries.

The most frequently used technologies of intermodal transport are:

- *Ro-Ro* – vehicles of road and railway traffic branch horizontally loaded on a ship,
- *piggyback transport* – road vehicles, loaded on a railway car,
- *barge transport (pushing vessels)* – inland waterway vessels loaded on sea-going ship.

Containerisation has proven from its very beginnings as a technology which provides numerous advantages for the owners of transport means, owners of cargo, shippers, operators of cargo handling activities, and insurance companies. Therefore, cargo that participates, particularly in maritime traffic, is to a great extent unitised by containers.

An important factor in realising efficient and economic service, as well as increase and development of intermodal transport has proven to be EDI - a system of Electronic Data Interchange. As part of EDI, the systems EDIFACT (Electronic Data Interchange for

Administration, Commerce and Transport) and EDITRANS (Electronic Data Interchange in International freight Transport) have been developed. These systems assist in collecting and storing of information about the position of single ships, and form databases that provide shippers with simpler fleet management and provide information about all the potential users of the ship space, its availability and accessibility. The collected and stored data about the fleet area available to all the transport chain users.

The real-time identification and monitoring of the unitised cargo of intermodal technology are realised by means of a sensor system of optical reading which provides data on the current status (loaded or empty), movement, operation schedule regarding clearance of vessels, and reports on terminal activities. The mentioned data about the cargo can be found also on the Internet.

The implementation of automatic identification of intermodal cargo when entering and exiting the port and integration with the electronic data interchange system (EDI) improves the handling operations, reduces the time of delay in the port and in front of the port, and increases the cargo flow in ports, berths, and terminals. The container identification system can be applied also to other types of cargo, independent of the aggregate condition and packaging method, provided that all cargo units pass the "code" reader and that the "code" consists of groups of symbols that carry sufficient data on the cargo. The data have to contain information about the owner, movements, contents and the weight of the cargo.

5. CONCLUSION

With one-way information, and especially two-way information exchange (traffic participant – control centre) significant improvements in traffic flows and accordingly greater safety and improved environmental protection have been achieved.

Today, numerous telematic systems have been developed in the world, which have been implemented in all traffic branches and are especially efficient in information technology connections of all factors in intermodal transport chain.

By introducing intelligent transport systems in inland waterway traffic, this inexpensive, safe and environmentally friendly traffic branch is becoming increasingly significant. The biggest disadvantage of this traffic branch, lower vessel speed compared to road and railway vehicles, is reduced by the development and application of advanced navigation and information systems, which enable navigation by night and in adverse weather conditions (e.g. fog). Sustainable and environmentally acceptable traffic on inland waterways provides a solution for congested road infrastructure and offers transportation alternative for the countries of central and south-eastern Europe.

Especially important is the implementation of telematics in intermodal transport, since information about current location of cargo and transport means may be obtained at any moment, consequently allowing exact planning of further activities in the transportation chain.

Apart from many advantages of telematic-supported intelligent transport systems the most important are the following: increase of safety and traffic route capacities, lower environmental pollution, fuel savings, shortening of transport times and cargo handling activities, as well as better information level of all traffic participants.

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SAŽETAK

RAZVOJ TELEMATIKE I NJEZINA PRIMJENA U VODNOM PROMETU

Značajnim porastom prometne potražnje krajem 20. stoljeća i sve većim antropogenim zagađenjem čovjekova okoliša pokazala se potreba za uvođenjem telematikom podržanih inteligentnih transportnih sustava u sve grane prometa. U radu je prikazan razvoj i osnovne značajke informacijskim i komunikacijskim tehnologijama upravljanih transportnih sustava. Objašnjen je mogući razvoj i koristi primjene telematike u prometu rijekom Dunav kroz Austriju, te praćenje pomorskih brodova i kontejnera u intermodalnom transportu.

KLJUČNE RIJEČI

telematika, inteligentni transportni sustavi, unutarnji plovni putevi, intermodalni transport

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