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DEVELOPMENT OF INTELLIGENT TRANSPORT SYSTEMS IN PORTS

RAZVOJ INTELIGENTNIH TRANSPORTNIH SUSTAVA U LUKAMA

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Summary

Intelligent transport systems (ITS) represent a significant advancement and departure from traditional approaches to processing information and managing in traffic systems. Implementation of ITS provides direct advantages and more efficient, comfortable and safe transport flow. Progressive growth and the globalisation of the economic activity directly influence ports and terminals and their adjustment process. Accomplishing competition status and satisfaction of the users' requirements, decreasing harmful and aggressive impact on the environment is directly correlated to ITS implementation.

Efficient and rational transport of increasing quantities of different cargo requires that the ports be regarded as subsystems of traffic systems and backbone of integrated transport. Processes of liberalisation and globalisation of world economy stimulate ports, when making development plans, pricing, purchase or leasing of cargo handling mechanisation and introduction of automation systems to tend to achieve and keep comparative advantages related to other competitive ports. In order to stay alive on the maritime market, ports have to consider the possibilities of implementation of intelligent transport systems. Primary and specific characteristics of ITS in ports as crucial subsystem of the sea transport system, are considered in this paper.

Sažetak

Inteligentni transportni sustavi predstavljaju znatan napredak i odstupanje od tradicionalnih pristupa manipuliranja informacijama u prometnim sustavima. Njihova implementacija omogućuje izravne koristi te učinkovitije, komfornije i sigurnije odvijanje toka transporta. Progresivan rast trgovine i globalizacija gospodarskih aktivnosti izravno utječu na luke i terminale. Uspostavljanje konkurentskog položaja, zadovoljenje zahtjeva korisnika te smanjenje štetnog i agresivnog utjecaj na okoliš, izravno su povezani s implementacijom ITS-a.

Efikasan i racionalan transport različitih tereta, čije su količine u porastu, zahtijeva promatranje luka kao podsustava prometnog sustava i okosnice integriranog transporta. Procesi liberalizacije i globalizacije svjetske ekonomije potiču luke da pri donošenju razvojnih planova, utvrđivanju cijena, kupnji ili najmu prekrcajne mehanizacije i uvođenju automatizacijskog sustava nastoje steći i zadržati komparativne prednosti u odnosu na druge konkurentne luke. U cilju opstanka na pomorskom tržištu, luke moraju razmatrati mogućnosti implementacije inteligentnih transportnih sustava. U okviru ovoga rada razmatrat će se primarna i specifična obilježja ITS-a u lukama kao ključnom podsustavu pomorskog sustava.

1. Introduction
Uvod

The level of built-in intelligence (which follows from automation and computerisation) depends on the port system needs to accept, process, store and forward a certain amount of information in a short time relevant to smooth functioning.

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Intelligent transport system provides the possibility of realising greater traffic and economic profit not necessiting for high capital spends and not disturbing the legal and ecological standards.

Forming and establishing of intelligent transport means is directly related to development and application of sensor technologies, communication and information systems. Sensor technologies are used in designing systems for avoiding crashes of moving vehicles, guidance of transport means and other activities with the aim of protecting the means, cargo, people and environment. Information systems provide traffic participants with data in the form of voice, image or text and communication with traffic entities, control centre and other information providers (information to increase safety, information in emergency cases or for commercial purposes). For transmission fixed communication networks, cordless terrestrial and satellite communications can be used. Gathering of data assumes the need to have the tools for receiving, comparison, analysis, evaluation, selection, distribution, and storing of information, as well as forming of an available and comprehensive base of correct data that are easily accessible and easy to update in time.

2. Idea and implementation of intelligent transport systems
Ideja i primjena inteligentnih transportnih sustava

The adoption and introduction of ITS can be considered from the scientific and commercial aspect. The scientific approach refers to the use of scientific knowledge and methodologies studying the way of understanding the concept of intelligence and the process of developing more intelligent devices. The commercial approach to artificial intelligence assumes the application of the system integrated with the environment using sensor technologies and trying to imitate human brain that has 6-7 billion sensor perceptors, in order to improve the transport process and realise profit.[1]

Intelligent transport systems include a wide range of support to transport network organisation and management and users' services. ITS tools are based on information, communication and integration. Gathering, processing, integrating and supply of information are the core of ITS.[2]

Intelligent transport systems are defined as application of information and communication technologies that improve and/or innovate processes of transport of passengers and goods in order to realise:[3]

- greater efficiency of transport,
- safer movement of people and goods,
- reduction of environmental pollution,
- increase of travel quality, etc.

The application of telematic systems, integration of electronics, telecommunication and computer technology resulted in improvement of technical means and technological transport processes. ITS influences on fixed and particularly variable costs in accordance with using the equipment that is not typical for traditional infrastructure and requires more complex and more frequent maintenance in order to establish an optimal level of system functioning.

3. ITS in ports
ITS u lukama

In considering port as an intelligent transport system, it is necessary to foresee the possible future development and requirements that do not exist today, but could appear with the development and advancement of automation, computerization and telemetric technology. Therefore, an increase in freight volume in ports, and development of more sophisticated systems of freight monitoring are to be expected, which will provide the possibility of identification and control of freight from the moment of entering the port by land or sea route, to the moment of leaving the port, regardless of the type of packaging and the physical state of the freight. Such system has to support receipt, filtering and processing of a great number of information from various sources and providing processed and systematized information to the interested parties.[4]

Information (thin line) and control (double line) model of communication at ports forms the backbone of the intelligent transport system architecture. The protocol of information (data about the current position, future planned position, the scope of activities that will be carried out in order to change the position and the planned time required) and data are shown at figure 1. Communication links are used in transmission of information and in establishing of the database. ITS is defined as a connection between information and communication systems that contribute to the integrity of the subsystems and integrity of the system with environment.

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[1] N. Maletić: Razvitak inteligentih transportnih sustava u vodnom prometu, Master's thesis, Fakultet prometnih znanosti, Zagreb, 2000, p. 30.

[2] I. Bošnjak: Inteligentni transportni sustavi, authorised lectures at the Postgraduate study, Fakultet prometnih znanosti, Zagreb, 2000, p. 1.

[3] K. Chen; J. C. Miles: ITS Handbook 2000, Artech House Publishing, Boston, 1999, p. 2.

[4] Č.Ivaković, N. Maletić, R. Stanković: Model of Port Teminals and Their Linking into the Global ITS System, 7th World Congress on Intelligent Transport System, CD-ROM, Torino, 2000, p. 1.

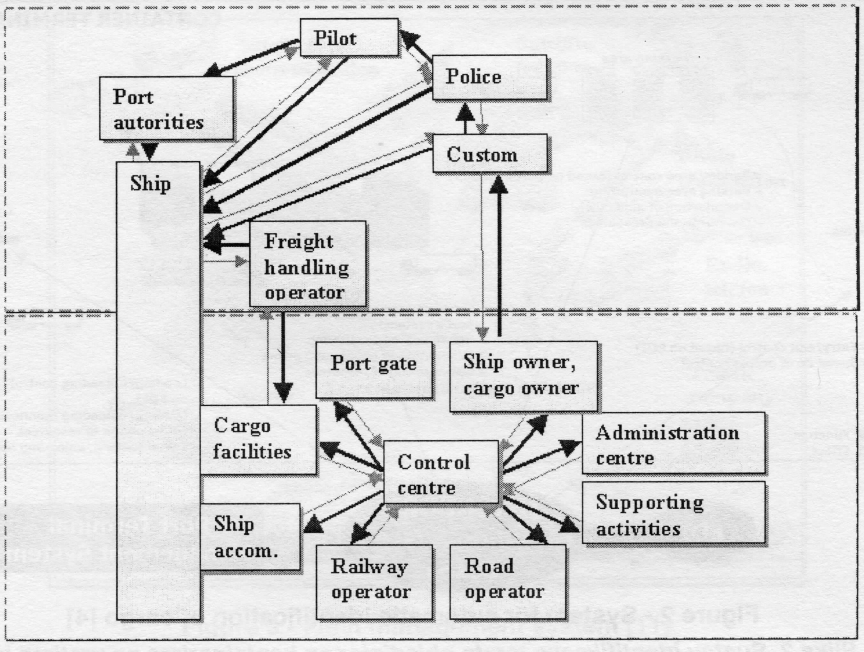

Figure 1 - Information and control model of communication links at ports [5]

Slika 1. Informacijski (tanka crta) i kontrolni model (dupla crta) komunikacija u lukama koji tvori okosnicu arhitekture ITS-a

Protokol informacija (podaci o trenutnom položaju, budućih planiranih aktivnostima, vrsti aktivnosti koje će se obaviti u namjeri da se izmjeni pozicija – status i potrebno vrijeme). Komunikacijske veze se koriste u prijenosu informacija i formiranju baze podataka. ITS-i se definiraju kao veza između informacijskog i kontrolnog modela koja pridonosi integraciji podsustava i integraciji sustava s okružjem.

3.1. Automatic identification of cargo, vehicles and drivers

Automatska identifikacija tereta, vozila i vozača

Sudden development of technologies of reading and transmitting information, radio-communication, differential GPS as well as systems for computer identification and code recognition, has a great impact on ports and terminals. That is specially reflected on the development of their computer and control tools regarding speed, comprehensiveness, reliability, flexibility and managing technological systems.

The system of identification, control and continuous monitoring of cargo at ports is manual, except for the ports with highly sophisticated equipment and annual traffic amounting to hundreds of thousands of tons. The documents that accompany the ship and the cargo are in the paper form, and reserving and lease of ship space is done by using phone or fax data transmission.

The application of automatic identification of cargo on entering the port system and on leaving it, and the integration with the system of Electronic Data Interchange (EDI) have influence on the improvement of operation safety in cargo handling, shortening of the stay at the port and in front of the port, fewer errors and increase of cargo throughput at ports and terminals.

In realising the integration of port with the environment, it is important to study the possibilities of development and application of systems of automatic cargo identification and its integration with the system of electronic data interchange

Automatic identification of cargo, vehicle and drivers means:

1. automatic identification of equipment for loading units,
2. automatic identification of vehicles,
3. automatic identification of drivers,
4. combinations 1-2, 1-3 or 2-3.

The used identification technologies can be radio frequency devices and smart cards. Depending on the type of identification, one or both technologies are used. Automatic identification of equipment and automatic identification of vehicles usually use radio-frequency tags (RF tags), whereas Smart Card technology is used in automatic identification of drivers.

Identification and monitoring of unitised cargo in real time is realised by means of the optical reading system and provides data on the current status and position, movements, arrangement of handling operations and report on all activities at the terminal.

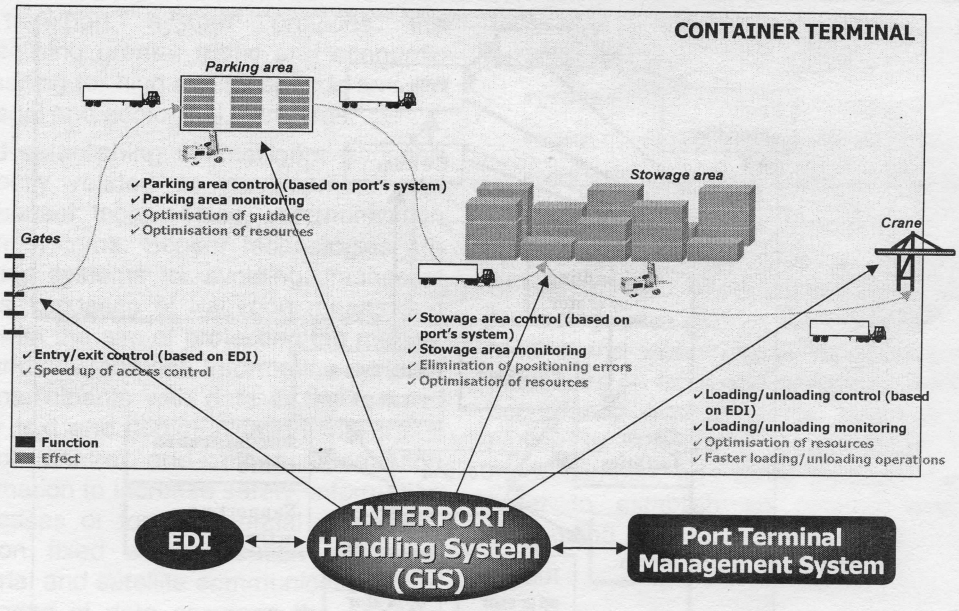

Figure 2 - System for automatic identification of cargo [4]

Slika 2. Sustav identifikacije tereta objedinjenog kontejnerima na vratima luke

Glavne funkcije jesu: protok dokumenata i komunikacije, kontrola pristupa s kopna, kontrola parkirnih područja, kontrola inventara, kontrola ukrcaja-iskrcaja, širenje informacija.

Such design can be compatible with EDI transactions over the Internet or by conventional forms of transfer e.g. by fax. The usage of Internet eliminates standstills and congestion at the exit from the port since it successfully eliminates the cause - information lag between the terminal and the operator and inadequate communication system. [5]

Figure 2 shows the physical architecture of the system for identification of unitised cargo - by containers at ports door. The main functions are: document generation and communication, land access control, parking area control, inventory control, loading-unloading control, information dissemination. The factors that make the identification difficult are:

- different fonts used on containers
- colour and size as well as different quality of the background
- presence of folds that cause distortion and shading of letters
- scratched and corroded areas.

The system of identification and monitoring of containerised cargo can be applied to all other types of cargo regardless of aggregate state and type of packaging provided that all logistic units[6] pass by the code reader and that the code consists of groups of signs that carry sufficient data about the cargo. Data have to include:

- the owner
- direction of movement
- destination
- content and weight of the unit
- special designations if the cargo needs special treatment.

Control of handling mechanisation is based on the same principles as identification, monitoring and control of unitised cargo, i.e. on the use of radio-devices, laser scanners, Bar Code technology, graphical interfaces and transponders (active and passive). Active ones are those located on the mobile equipment, whereas passive ones are located on non-mobile equipment and their role is to confirm that the given activities have been carried out correctly.

According to Guy Robinson[7], the average time of cargo standstill, with continuous end-to-end monitoring and control, can be reduced by at least 20% of the total cargo travelling time. The power of intelligent transport systems would be even more pronounced if e.g. 10 million radio-frequency tags were purchased and distributed in such a way as to cover all containers that participate in the traffic in Europe. The price of one device would amount to approximately 5 euros (approximately 38 kunas) i.e. less than 0.2 euros (approximately 1,5 kunas) per European Union citizen.

[5] N. Maletić: Razvitak inteligentnih transportnih sustava u vodnom prometu, Master's thesis, Fakultet prometnih znanosti, Zagreb, 2000, p. 55.

[6] Logistic unit = handling unit = transport unit = storage unit

[7] Guy Robinson is the manager of European projects related to communications at the European Commission at Brussels. Source: Splash out on Intelligence, ITS International, Route One Publishing Ltd, New Jersey, March/April 2000, p. 36.

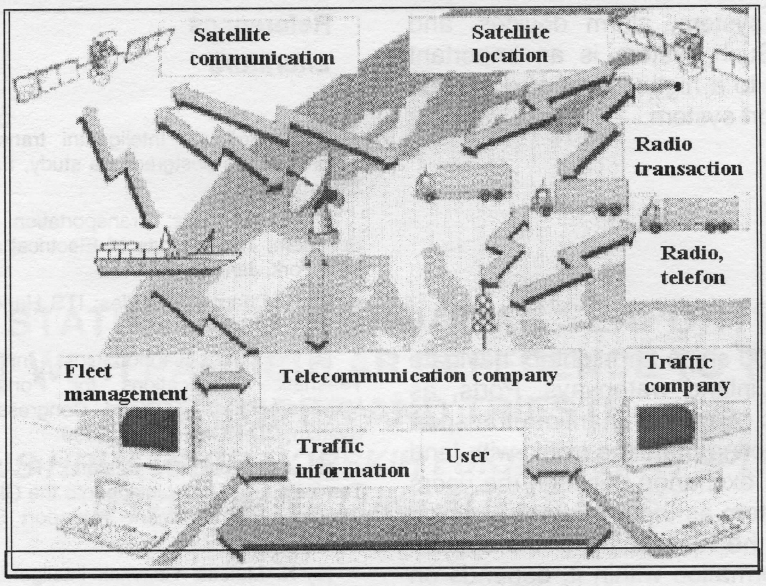

Figure 3 - Fleet management system [11]

Slika 3. Sustav upravljanja flotom

On podrazumijeva upravljanje satelitskim komunikacijama za dobivanje informacija, dijeljenje informacija, protok informacija, njihovo flitriranje te stvaranje baze podataka praktične i dostupne svima zainteresiranima, tako da svojim terminalnim računalnim stanicama mogu jednostavno pristupiti bazi podataka.

Direct linking of data obtained by identification, electronic data interchange and EDIFACT system can increase the benefits of the identification system. That concept makes the stored information about the cargo - its properties and status, appropriate vehicles and drivers as well as documents accompanying transport and cargo, available to all potential users of port services.

3.2. Vessel traffic service
Sustav upravljanja plovidbom

To improve the navigation process and increase the safety of ship, cargo, passengers and crew in complex and dangerous situations, there is a tendency of developing a comprehensive automated system that would provide safe navigation in all regions and in all possible weather conditions.

Process of equipping the port with the VTS - Vessel Traffic Service system has to be coordinated and attuned to ITS. Determining the ship trajectory upon entering or leaving the port, as well as navigation along canals makes it possible to gather information about traffic, which can then be analysed, filtered and used by all those who need it.

In the model of obtaining the assumed trajectory, two modes of operation are used:[8]

1. off-line,

2. on-line.

In off-line mode the trajectory is estimated based on the assumption that parameters of the approaching vessel (speed and path) do not change in time. Together with VTS system usually there is ARPA (Automatic Radar Plotting Aids), a device whose task is to check that the parameters of the vessel remain unchanged while moving along the trajectory. In on-line mode, the trajectory is modified and adapted if the vessel parameters change.

3.3. Fleet managemen system
Sustav upravljanja flotom

EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport) and EDITRANS (Electronic Data Interchange in International freight Transport) systems can help in gathering and storing information about the position of certain ships.

Application of technology of transponders and adequate communication infrastructure (mobile communication systems - GSM and system for determining position - GPS) ensures the monitoring of ships. That system make it possible to collect data and create a database which is used by ship operators for better fleet management, providing information to all the potential ship space users about its availability.

Upgrading of the fleet management system can consist in adding electronic graphs and diagrams that enable simpler and more understandable presentation of data on computer displays,

[8] R. Smierzchalski: An Intelligent Method of Ships Trajectory Planning at Sea, Elmar- 41st International Symposium Electronic in Marine, Zadar, 1999, p. 241.

sophisticated control system, alarm devices, and computer database. Such system is an important factor of raising safety to a higher level of operation and efficiency of the port system.

Conclusion
Zaključak

Today, about 350,000 ships and lighters navigate across the seas and inland waterways. Ports, as distribution and logistic centres of maritime transport have the role of connecting maritime traffic with land traffic. The information exchange between the users of such a complex system as the port system, which is the key feature for the functioning of the system and processing of information within it, depends on the identification of entities and creation of a database. Fleet management which means the manipulation of information about ships and systems for navigation management and systems for identification of entities form ITS applications which result in integration of technical means and technological processes of a port system.

By integrating ITS of a port system with other related sub-systems of the maritime system ITS architecture of the maritime system can be established as a component of the national ITS architecture.

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