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Editorial

Dear readers,

The journal „Naše more" is now 95 year old because it started to be published in 1919. After a short period, a very long interruption followed, and it appeared again in 1954. So there is 60 years of its uninterrupted publication. It has been a very long and restless period. All over the world there are just few specialized seafaring journals and our publication might be considered to be our maritime heritage. After the death of professor emeritus Josip Lovrić, a long year editor in chief, ever since 1989., I took over „Naše more" and encountered great challenges : How to meet requirements in publishing scientific and professional papers and at the same time to raise quality i. e. quotations in significant data bases?

Therefore, I would like to say a few words about Editorial Board's decision as our mutual strategy for future work. We must be profiled for a specialized scientific area and we must be internationally recognized. Maritime related topics were logical consequence of seafaring orientation of our area and people who lived on seafaring. Therefore, technical sciences related to seafaring (technology of transport, marine engineering and marine electric engineering) must be a priority, while natural sciences f.e. papers in biology and biotechnology will also be accepted. Unfortunately, the citation in data basis Scopus (more than 10 years) is not a satisfactory reference nowdays. Therefore, the main goal would be indexing according to Science Citation Index Expanded (SCI-E) made by Thomson ISI (Web of Science). Numerous preparations must be done to access their monitoring which will last for years. First of all, all professional and scientific papers should be published in English. Consequently, I invite all the authors to help us by their contributions and to raise the quality of their articles, first of all by means of original and concise ideas of the papers i.e. topics which are innovative.

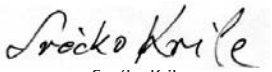
For the papers from other maritime related scientific areas (f.e. social sciences and humanities) as well as popular papers and ads, we decided to start a supplement as a special volume. Since we do not want to reduce the interest of the authors and the audience (we are at the top of the list of national journals), by means of this compromise we might remain interesting for wider readership by attractive formation of two volumes making a unit.

The journal has been published for a long period both in electronic and printed form (www.hrcak.hr, www.nasemore.com). We must maintain quality of a printed form so as to continue long term tradition, and we inted to send one copy on each ship with predominantly Croatian crew. It is our desire for our journal to be read among our emigrants especially where there are Croats living successfully from the sea - fishing, shipbuilding, cultivation of Mediterranean cultures etc. All the above mentioned requires a considerable financial means. Our plan is to maintain existing expenses and we do expect prosperity. Taking into consideration the fact that The University of Dubrovnik publishes several journals, we must be financially covered too. It is clear indeed, that we will need sponsorship in future.

Besides our publisher, The University of Dubrovnik, the journal is considerably supported by The Ministry of Science, Education and Sport of The Republic of Croatia. Accordingly, we must meet a very strict requirements : from International Editorial Board to proof of quotation in international data bases i.e. reviewing all the papers, professional editing and regular publication in prescribed terms. Besides the support of The Ministry and our Editor, sponsors are especially important, Atlanska plovidba d.d. being the most important one so far.

I am especially thankfull for the support and cooperation, above all for constructive comments, suggestions and remarks by means of which we might continue to sail successfully in the period ahead of us.

Yours sincerely,



Srećko Krile
Editor-in-Chief / *Glavni urednik*

Poštovani čitatelji,

Časopis „Naše more" navršio je 95. obljetnicu od svojih početaka 1919. godine. Nakon kraćeg djelovanja uslijedio je dugi prekid, te se ponovno pojavljuje 1954., pa je evo 60 godina njegova neprekidnog izlaženja. To je dugo i vrlo turbulentno razdoblje. U svijetu je malo pomorskih časopisa koji su se uspjeli održati toliko vremena, pa se „Naše more" već može objektivno svrstati u našu pomorsku tradiciju. Nakon smrti prefesora emeritusa Josipa Lovrića, dugogodišnjeg urednika sve od 1989., preuzeo sam časopis i susreo se s velikim izazovima kako odgovoriti trendovima u publiciranju znanstvenih i stručnih članaka i ujedno podići vrsnoću, to jest citiranost u značajnijim bazama. Zato bih s nekoliko riječi iznio zaključke Uredništva kao zajedničku strategiju za budući rad.

Moramo se profilirati za uže znanstveno područje i moramo biti međunarodno prepoznatljivi. Tematika o moru bila je logička posljedica pomorske orijentiranosti ovog podneblja i ovih ljudi, koji su od toga živjeli, zato bi u prvom redu to bile tehničke znanosti povezane s pomorstvom (tehnologija transporta, brodostrojarstvo i brodska elektrotehnika), dok bi se i dalje poticalo obavljivanje radova iz prirodnih znanosti, npr. iz biologije i biotehnike. Nažalost, citiranost u bazi Scopus ili nekim manje poznatim bazama za spomenuta znanstvena područja nije dostatna referenca. Zato bi glavni cilj bio postići citiranost po Science Citation Index Expanded (SCI-E), koji provodi Thomson ISI (Web of Science). Potrebne su pritom brojne pripremne radnje da bismo uopće i ušli u njihov monitoring koji traje nekoliko godina. U prvom koraku trebalo bi sve znanstvene i visoko stručne članke objavljivati na engleskome. Zbog toga pozivam sve autore da nam u tome pomognu, te da nastoje povećati kvalitetu svojih članaka, prije svega originalnošću i sažetošću tematike koju obrađuju, to jest koncentraciju na ono čime članak donosi nove pomake.

Za članke iz ostalih znanstvenih područja o moru (npr. društvene i humanističke) te za popularne i promotivne članke odlučili smo pokrenuti prilog (suplement) kao poseban svezak. Budući da ne želimo smanjiti zanimanje autora i čitanost (rangirani smo pri samom vrhu domaćih časopisa), ovim kompromisom možemo i dalje ostati aktualni za šire čitateljstvo i povećavati čitanost atraktivnim oblikovanjem dvaju sveščića koji zajedno čine cjelinu.

Časopis se već duže vrijeme objavljuje i u tiskanom i elektroničkom obliku (www.hrcak.hr, www.nasemore.com), S obzirom na to da se na Sveučilištu izdaje veći broj časopisa, moramo se i financijski samopokrivati. Jasno, te se dvije strategije ne podudaraju, pa nas očekuje i velika borba za sponzorstva. Nastojimo održati i kvalitetu tiskanog oblika kako bi se nastavila dugogodišnja tradicija a uz to ćemo slati i po jedan primjerak na svaki brod s pretežno hrvatskom posadom. Želja nam je da se naš časopis čita i u dijaspori, pogotovo u krajevima gdje naši iseljenici uspješno žive od mora - ribolova, brodogradnje, uzgoja mediteranskih kultura i slično. Ali, za sve nabrojeno potrebna su i znatna financijska sredstva. Naš je plan zadržati postojeće rashode uz sve pozitivne pomake koje tek očekujemo.

Uz našeg izdavača Sveučilište u Dubrovniku, izlaženje časopisa znatno podupire Ministarstvo znanosti, obrazovanja i sporta Republike Hrvatske. U skladu s time moramo zadovoljiti vrlo stroge kriterije: od međunarodnoga izdavačkog odbora do dokaza o citiranosti časopisa u međunarodnim bazama, što podrazumijeva recenziranje svih članaka, profesionalno uređivanje i redovito izlaženje u propisanim rokovima. Uz potporu Ministarstva i našeg izdavača posebno su bitni sponzori, od kojih je do sada najvažniju ulogu imala Atlanska plovidba d. d.

Zahvaljujem za sve potpore i suradnju u svakom obliku, nadasve za dobronamjerne komentare, sugestije i primjedbe, uz koju ćemo pomoć moći nastaviti uspješno broditi i u sljedećim vremenima.

Srdačno Vaš,

Port Competition in North Adriatic

Konkurencija među lukama Sjevernog Jadrana

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Summary

World trade has changes in the last decade and the container traffic flows are oriented in the several parts of European continent. European container port system is not a homogenous set of ports. It is established with a several big ports (Rotterdam, Hamburg, Antwerpen...) and a large number of medium and small sized ports. In this port category are also the North Adriatic ports (NA) and in this paper we analysed the container flows and the throughput made in this ports. In paper we present the state of the art in the North Adriatic ports regarding the container throughput, market share and container market characteristics.

KEY WORDS
container
throughput
North Adriatic ports

Sažetak

Svjetska trgovina se mijenja u zadnjem desetljeću, a tijekovi kontejnerskog prometa orjentirani su prema različitim dijelovima europskog kontinenta. Europski kontejnerski lučki sustav nije homogeni set luka. On se temelji na sedam velikih luka (Rotterdam, Hamburg, Antwerpen...) i na mnogo srednjih i malih luka. U ovu kategoriju spadaju također i luke Sjevernog Jadrana (NA), a u ovom radu analizirali smo tijek prometa kontejnera i teret koji je prošao ovim lukama. U radu iznosimo stanje u lukama Sjevernog Jadrana koje se odnosi na kontejnere, dionice na tržištu, ali i značajke kontejnerskog tržišta.

KLJUČNE RIJEČI
kontejner
obrtaj tereta
luke Sjevernog Jadrana

INTRODUCTION / *Uvod*

The phenomena of containerization lead to the increase of global container transport - it amounts to 8-10% on a yearly basis and reach according to the RMT [2] almost 602 million TEU in 2012. In Europe the growth has been very strong in last twenty years, but the growth was stopped in 2008 when the global financial and economic recession started to have full effect in ports and maritime industry. The ports of multi – port gateway region of North Adriatic (NA) did not followed the average of increase of container transport in the last 20 years (they had an increase of 7% on yearly base) but also the decline in container transport in NA ports in the years 2008 to 2009 was minimal. In this condition the fastest growth of container throughput was recorded at the Port of Koper, at an average of 14% per year, and reached 600.441 TEU in year 2013.

The ports of Koper, Trieste, Venice, Rijeka (NAPA – North Adriatic Ports Association) and Ravenna are located in the northern part of the Adriatic Sea, which penetrates deep into the middle of the European continent, providing the cheapest maritime route from the Far East, via Suez, to Europe. More than 100 million tons of water-borne cargo are handled in the NAPA seaports every year. Due to the tremendous variety of logistics services and the extensive traffic network, NAPA forms a perfect multimodal gateway to the key European markets [7]. The near-by fifth Pan-European transport corridor provides a quick link to 500 million European consumers. Large commercial and industrial hubs like Vienna, Munich and Milan are just few hours' drive away. The five entities combine their strengths in order to promote the northern Adriatic route and present themselves as an alternative to the northern European ports. In addition, the association anticipates cooperation in the development of maritime and hinterland connections, visits from cruise lines, environmental protection, safety and information technology. Perhaps the most phenomenal change has been the rapid increase in container traffic, which has increased almost exponentially in the northern Adriatic ports, on average 7% per year, though the rate has varied among ports [3].

North Adriatic ports of Koper, Rijeka, Trieste, Venice and Ravenna are located in proximity to each other. Due to their geographical characteristics they have special position in European ports system. They operate in relatively closed system in which the market and customers are limited and therefore the ports are forced to co-operate while they at the same time

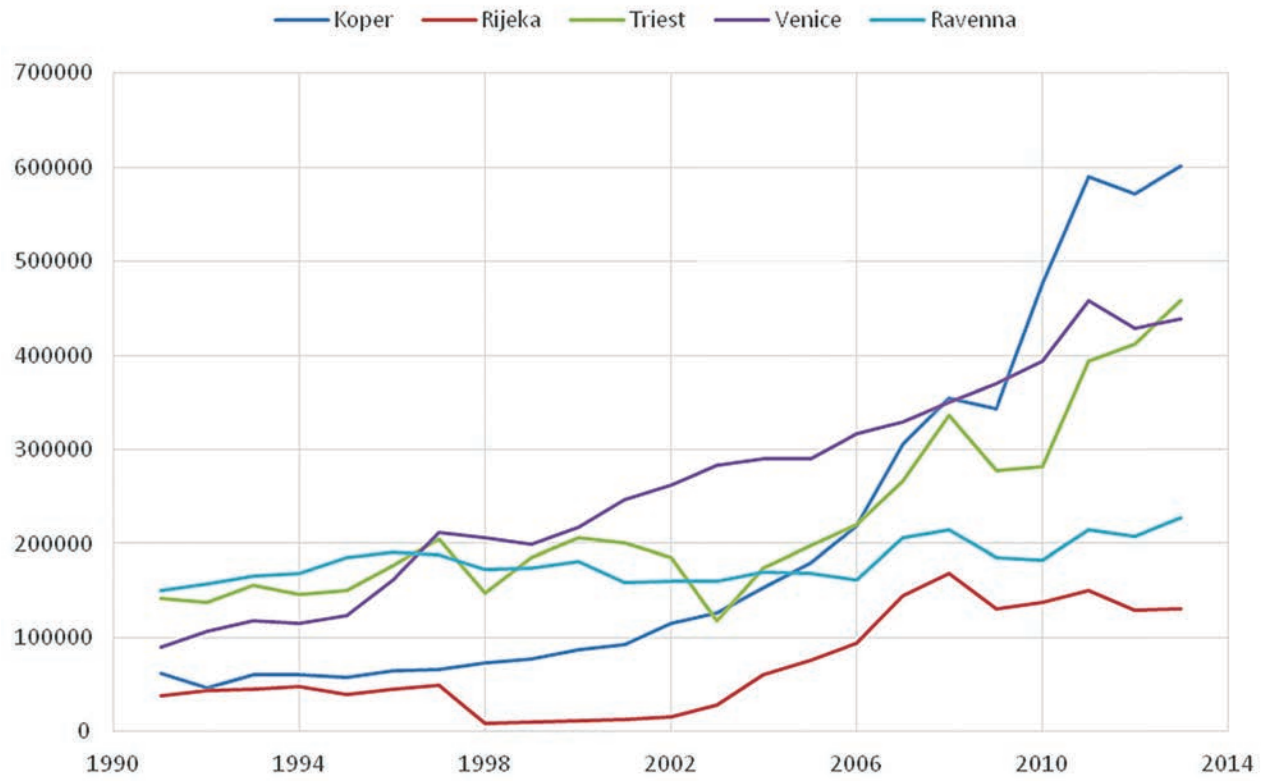


Figure 1. Containers throughput in 1000 TEU in period 1990-2013 at North Adriatic Ports
Slika 1. Kontejnerski obrtaj u 1000 TEU u razdoblju od 1990-2013 u lukama Sjevernog Jadrana

compete with each other. In addition they are located in the three countries, with different transport policy and different plans of development.

In this paper we will try to briefly outline the current twenty-year development of container traffic in the North Adriatic ports and then show some of the opportunities and threats in their further development. We used data on container throughput, which are available on the websites of the respective ports. The interaction between these ports is offering us a very interesting research topic.

THROUGHPUT IN THE NORTH ADRIATIC PORTS / *Obrtaj tereta u lukama Sjevernog Jadrana*

The data show (Figure 1) that in the last twenty years, the total container traffic in the North Adriatic ports have almost exponential increase on average 7% per year, but this growth wasn't the same for all ports. In this period, the fastest growth of container traffic was at the Port of Koper on the average by 14% per year, in the Port of Venice the growth was constant and the biggest loser in that period was the Port of Ravenna. The minimum throughput was and is still today in Port of Rijeka which is needed a lot of years to pick up the loss of traffic due to the state of war in Croatia and in last period the throughput slowly rise.

Interesting are the years 2008 and 2009 - years of the worst global economic and financial crisis. In Venice, during this period throughput is still steadily increasing by 5% per year, in all the other four ports fell by an average of 15%. The largest drop in traffic was recorded in Trieste, where it decreased by more than 58,000 TEU (17.5%), but if we compare the drop in percentage then the Port of Rijeka declined for a 22.5% (38 000 TEUs less).

Although the total container traffic in the northern Adriatic ports increase in last years it still represents a negligible proportion in total throughput of the European ports. The data in Table 1 indicate that container traffic in North Adriatic ports and in the European biggest container ports Rotterdam, Hamburg and Antwerpen. We can see that throughput in NA ports shows slight increase as it present 5.2 percent in 2010 it amounted to 6.1 percent of total throughput of this ports in 2013. In the proportion - the throughput of all North Adriatic ports present just 16.3 percent of the throughput, which has created Europe's largest port Port of Rotterdam in 2013.

Table 1. Container throughput in some European ports (in million TEUs)
Tablica 1. Kontejnerski obrtaj u nekim europskim lukama (u milijunima TEUs)

	2010.	2011.	2012.	2013.
Rotterdam	11.1	11.9	11.9	11.6
Hamburg	8.5	9.0	8.9	9.3
Antwerpen	7.9	8.7	8.6	8.6
NA ports	1.5	1.8	1.7	1.9
Total	29.0	31.4	31.1	31.4

Source: based on traffic data of respective port authorities

Despite efforts of the North Adriatic ports to invest in recognition and promotion of common maritime routes the cooperation between them is still mostly in principle. With new investments in the various ports, with major activities in joint promotion a proportion of containers passing through the port are still small. Despite longer transport routes the cargo destined to Central and Eastern Europe still select Western European ports Rotterdam, Hamburg, Antwerpen.

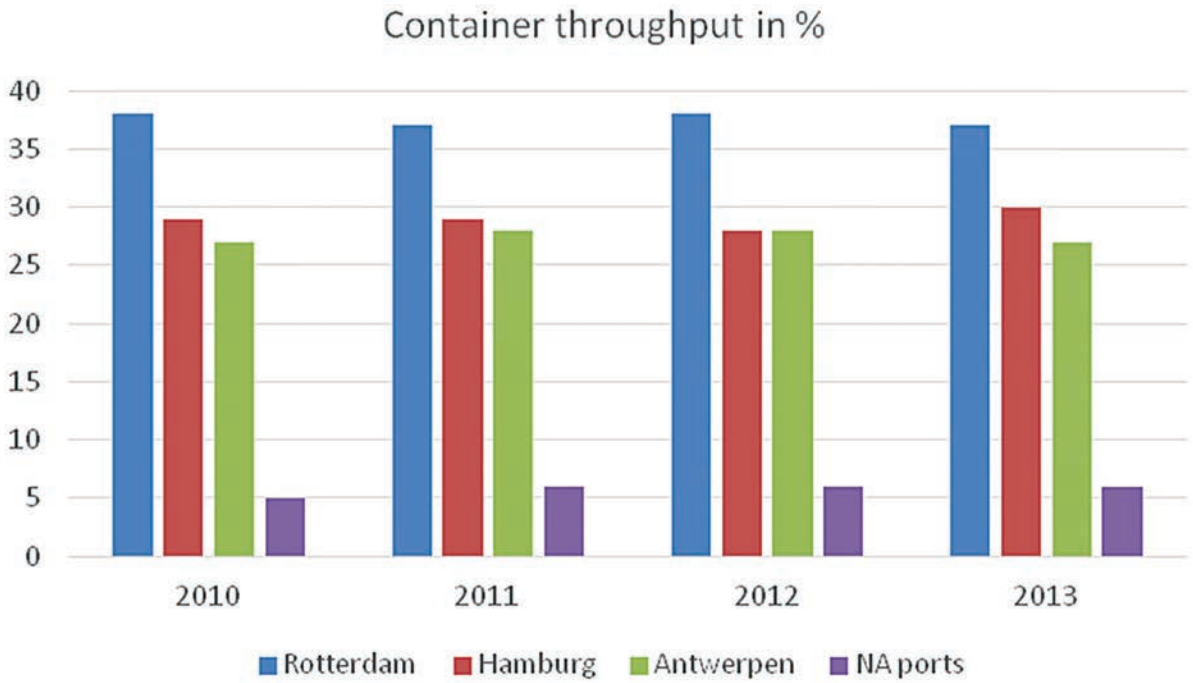


Figure 2. Comparison between containers throughput in NA port and some EU ports (in %)

Slika 2. Usporedba između prometa kontejnera u lukama Sjevernog Jadrana i u nekim EU lukama (u postocima)

MARKET SHARES AMONG THE NORTH ADRIATIC PORTS / *Tržišne dionice među lukama Sjevernog Jadrana*

With market share [1] we can show what fraction of the total container throughput at North Adriatic ports has fallen to a single port. Figure 2 shows that in 1991 the Italian ports have 80 percent of market share, but today it is around 60 percent. We can see almost a mirror image, which shows that the decline in market share of Italian ports is a reason for the increase in market share of Port of Koper. In the year 2012 there has been re-growth of Italian ports, as it had in 2011 and 2012, the highest growth the Port of Trieste.

An interesting comparison is the market share evolution between ports (Figure 3), which is also reflected in the almost mirror movement of shares between the ports of Koper - Ravenna and Venice - Trieste. In the present period, the largest decline in market share (20 per cent) had obtained port of Ravenna, the greatest increase in throughput port of Koper. Due to an increase in the share of Venice is also almost mirror decline in the share of Trieste.

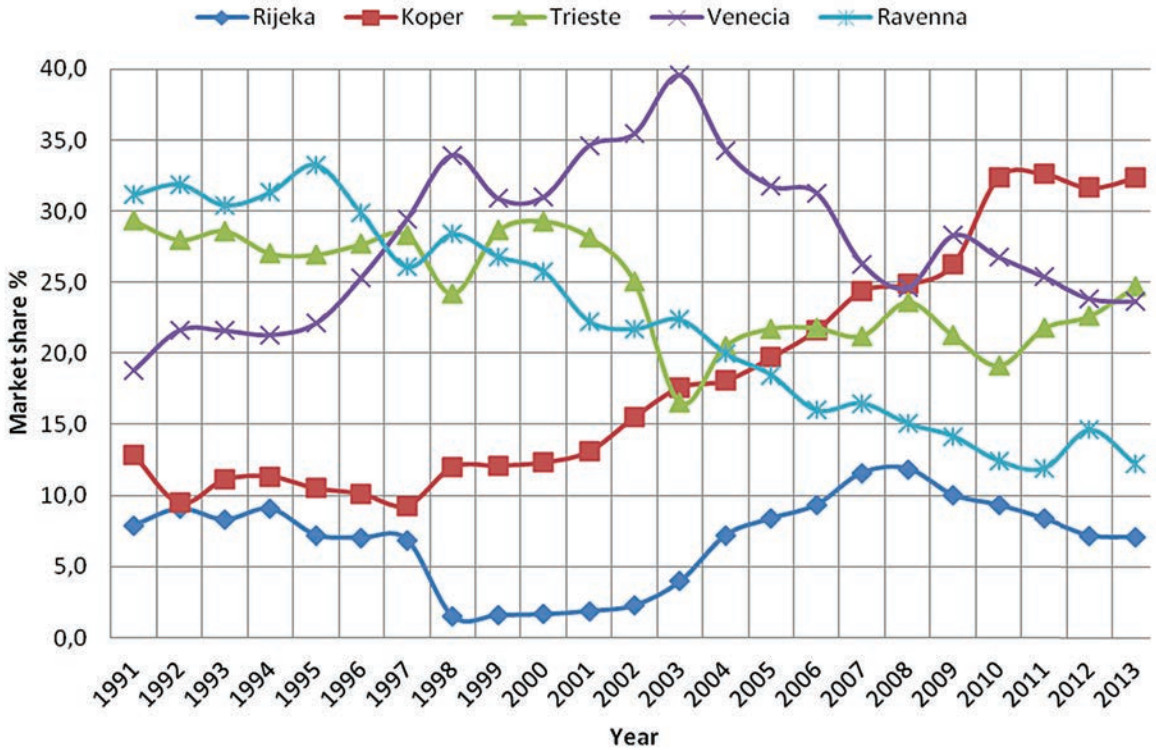
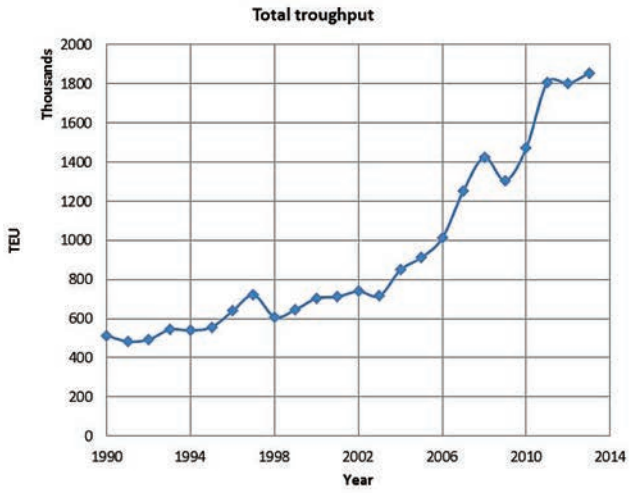


Figure 3. Market share among the NA ports

Slika 3. Tržišne dionice među lukama Sjevernog Jadrana



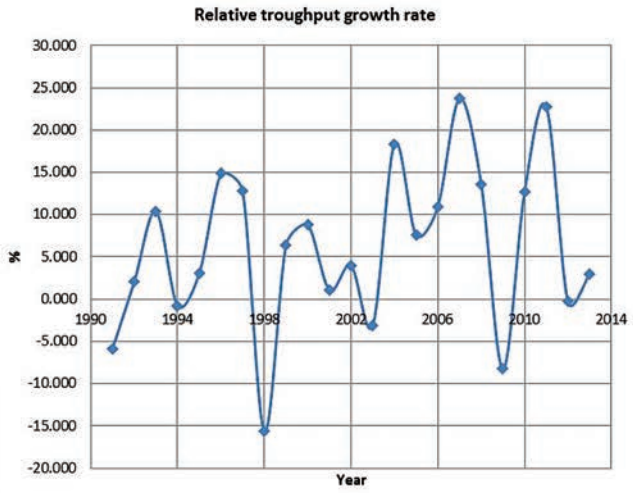
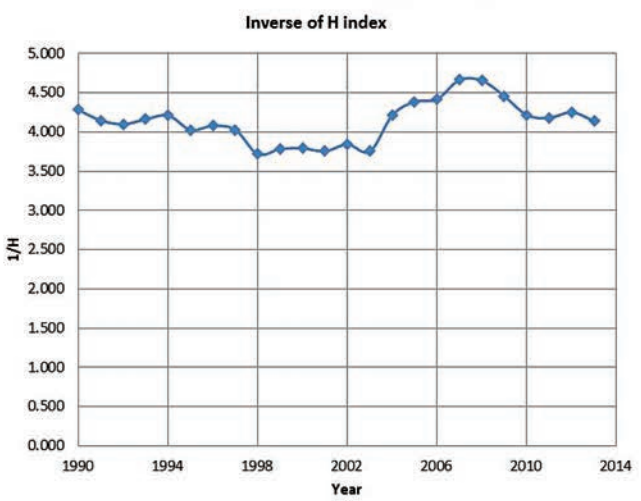


Figure 4. Evaluation of the characteristics in NA ports (1)
Slika 4. Procjena značajki u lukama Sjevernog Jadrana



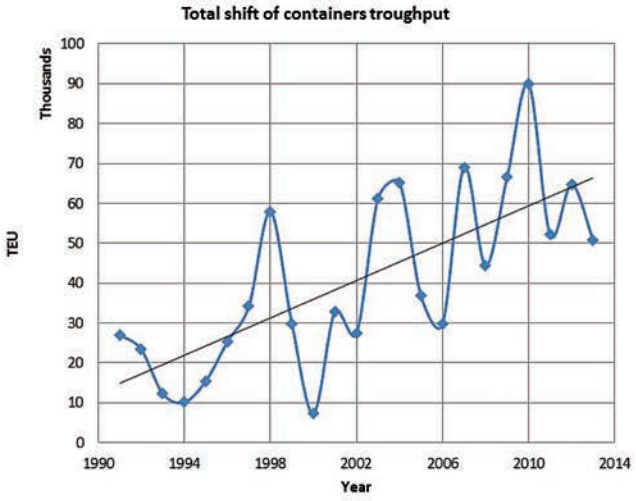


Figure 5. Evaluation of the characteristics in NA ports (2)
Slika 5. Procjena značajki u lukama Sjevernog Jadrana (2)

EVALUATION OF THE CONTAINER MARKET IN THE NORTH ADRIATIC PORTS / *Procjena kontejnerskog tržišta u lukama Sjevernog Jadrana*

The evaluation of the characteristics of all NA ports is shown on the graph on Figure 4 and Figure 5. As it is seen from the graph total conteiner troughput has steady growth until 2003 - the trafic increase. We can see a fall in the traffic in the period of economic crisis in 2008, after that the growth start to decrease. If we look on the second graph on this figure which repersent evaluation of relative troughput rate we can see very periodic behavior. However the growth rate was negative only in years 1991, 1998, 2003, 2009 in all other yera the growth rate was positive. The higher growth rate was in recent time 2007 an 2011 with approx 25.

Graphs on Figure 5 represent inverse of H-H index [1] on total container shift dynamics. From the first graph in Figure 5 we see that almost all the time in the period from 1990 to 2013 there was only 4 major players in container traffic. Exception was year 2007 and 2008 where almost all the ports in NA system contributes in container market. The second graph represent total shift of containers. It shoes growth over the analysed years and in last eight years oscillate around the value 50 thousands of TEU. This last graph shows all the competition dynamics of NA system where obviously the annually shift of containers is far from zero i.e. from equilibrium state. In fact, as it can be seen from the graph, competition on container market among ports increase on average over last twenty years.

CONCLUSION / *Zaključak*

Port competition is very often analysed and it depends of the criteria that we take in consideration. In this article we analysed the container throughput in North Adriatic ports. Good location, especially for the containers that came from Far East and are designed to the market of Central and South-East Europe, is the biggest advantage if we compare this ports with the North European ports of Rotterdam, Hamburg and Antwerpen. The market potential for the NA ports in the container market in 2030 appears to be ambitious in terms of the absolute growth

it implies +348% traffic growth from 2010 compared to 73% growth in the market as a whole and in terms of market share growing from the current 4.3% to reach 11.3% in 2030 [3]. Every port in NA port region is trying to increase throughput but not all are successful in this.

Co-opetition but in the same time competition in this multi port gateway region is very present as these ports share a same hinterland. It is also seen that shift of container throughput and market share is strongly emphasized between them.

In the article we conduct analyses that help us to understand a state of NA ports in the EU market and the relationship between them. Although the total container traffic in NA ports increased in recent years it still represents a negligible proportion in total throughput of the European ports. The data indicate that container traffic in northern Adriatic ports in the European Common throughput shows a slight increase – in 2008 it was 1.6 percent and it amounted to almost 2 percent in 2011. In the proportion - the throughput of all North Adriatic ports present just 15.2 percent of the throughput, which has created Europe's largest port Port of Rotterdam in 2011, but in 2013 it was already 16.3 percent.

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Overview of Standards for Electronic Navigational Charts

Pregled normi za elektroničke navigacijske karte

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Rukopis primljen / *Paper accepted*: 11. 3. 2014.

Summary

In the early 1980s, with the rapid development of geospatial technologies the development of Electronic Navigational Charts – ENC began. With a heavy emphasis on data security, because of its navigational purpose, the implementation of ENC was approached very cautiously. One of the key features of every product, which enables easier global use, is its standardization. The paper provides basic information related to the ENC and by studying all editions of publications for ENC, the reports of the Working groups of the International Hydrographic Organization – IHO and articles that followed the implementation process of ENC standards an overview of ENC standards is given, with the focus on two basic standards published in S-57 and S 52 publications. Also described is a new, currently under construction, standard for ENC (S-100) and the prediction of the future development guidelines with the concept of e-Navigation in mind.

KEY WORDS
maritime navigation
ENC
ECDIS
standards
S-52
S-57
S-100

Sažetak

Početkom 1980-tih naglim razvojem geoprostornih tehnologija počeo je razvoj elektroničkih navigacijskih karata – ENC. S velikim naglaskom na sigurnost podataka, zbog svoje navigacijske svrhe, implementaciji ENC-a se pristupilo vrlo oprezno. Jedna od ključnih osobina proizvoda, koja olakšava globalnu primjenu, jest njegova normizacija. U radu se pružaju osnovni podaci vezani uz ENC te proučavajući sve verzije publikacija normi za ENC, izvještaje radnih grupa Međunarodne hidrografske organizacije – IHO i članaka koji su pratili proces implementacije normi za ENC dan je pregled normi za ENC s naglaskom na dvije osnovne norme objavljene u publikacijama S-57 i S-52. Opisana je i nova, trenutno u izradi, norma za ENC (S-100) uz predviđanje budućih smjernica razvoja u vidu koncepta sustava e-navigacije.

KLJUČNE RIJEČI
pomorska navigacija
ENC
ECDIS
norme
S-52
S-57
S-100

INTRODUCTION / *Uvod*

The development of information technology and the importance of spatial data have led to a large number of geoinformation systems. Maritime navigation has experienced a rapid development in accordance with the development of electronic systems. The pace of development of Electronic Marine Navigation Systems is controlled by the development of international standards. Electronic Navigational Charts as an essential part of the new navigation system required a thorough preparation of standards. These standards had to align the requirements of users (mariners) with the rules of chart production (cartographers) and thus raised their level of communication. The basic rule, given the uniqueness of the navigational charts in their preparation, is to ensure safety of the data. The wider range of possibilities for electronic charts has impeded the development of quality standards. The process of developing standards for electronic charts has gone through the initial phase of development, testing phase, the primary implementation and is now developing ideas in the form of upgrades to increase the interoperability of ENCs.

To the authors' knowledge, only the standard published in S-57 publication was described in the works of Croatian authors [16]; [3], while most of the information about the historical development of ENC standards is in the official publications [5]; [7]; [10] and Information papers about S-100 publication for IHO [17].

ELECTRONIC NAVIGATIONAL CHARTS / *Elektroničke navigacijske karte*

Electronic Navigational Chart – ENC enabled the development of quality alternative to paper charts. National Hydrographic Offices, by the recommendations of the IHO, are responsible for the development and maintenance of official charts in the

jurisdiction of the state and have to ensure the distribution system to the user. Hydrographic Institute of the Republic of Croatia (HHI) in Split, released 94 ENC (2014) of which overview, general and coastal charts with 100% coverage area, and the approach, harbor and berthing charts in the degree of coverage of about 80%, and is using one of two Regional Coordination Centers for ENC, PRIMAR Norway to provide distribution.

Maritime navigation is increasingly based on Electronic Chart Display and Information Systems – ECDIS. The first electronic charts and systems related to them have appeared in the early 1980s. These charts have been scanned and digitized reproductions of paper charts – Raster Electronic Charts. There are two basic types of electronic charts: those that are in accordance with the Standards of performance for ECDIS and all other types of electronic charts, generally regarded as the Electronic Chart Systems – ECS. Charts in accordance with the Standards of performance for ECDIS can be divided into two basic types: Raster Navigational Chart – RNC and Electronic Navigational Chart – ENC. The RNC is the file format of the image and is created by scanning existing paper charts. This type of chart is easier and cheaper, and for navigation with RNC it is necessary to have an adequate paper chart. The ENC is a file containing the data that a program for displaying electronic charts interprets and creates an image on the screen. These charts are complex and expensive, and do not require an adequate paper chart for navigation if at least two ECDIS are on board. The ENC is a chart derived from the database with standardized content, structure and format [4]. The ENC is a small part of a navigational system on board, system that in the last two decades experienced a significant improvement, and so paper charts and compasses are joined by GPS, radars, etc.

The ENC unlike paper charts allows automatic threat detection, route monitoring, speed and other parameters in real-time and updating is easier and faster. It can also contain additional information from a variety of publications (eg, information from Sailing Directions, List of Lights), necessary for safe navigation. Thus the quality of content in the ENC database is the foundation of navigational safety and requires strict control. ENC as a database and ECDIS as a complex system require a full range of well-defined standards to ensure first and foremost a minimum level of data safety and quality.

STANDARDS / *Norme*

The standardization of spatial information is important for the establishment of transfer between different users, applications, systems and locations. Creating and adapting standards should cover the processes and procedures of defining and describing data, structuring methods and encoding as well as procedures for the distribution and maintenance of data. This ensures a uniform flow of data from the producer to the user [1]. Standardization of spatial information takes place at several levels: at the national level (each country defines its own standards), regional level (Comité Européen de Normalisation – CEN) and international level (ISO).

ISO is an international non-governmental organization for standardization, which together with the IEC (International Electrotechnical Committee) and ITU (International Telecommunication Union) deals with the planning, development and elaboration of international standards. While the scope of the IEC and ITU is narrowly specific (electrical and telecommunications), ISO covers virtually all other areas. Acronym ISO does not denote the notion „International Standard Organization", how is often thought, but comes from the Greek word „isos" meaning „equally". Its geographical definition, ISO standards are considered to be global (international) standards. Today ISO gathers 163 members, i.e. national Committees for Standardization. There are three categories of membership: full members (attend meetings and have the right to vote, 112 members), corresponding members (attend meetings but without the right to vote, 47 members) and subscriber members (follow the work of the organization without the right to participate in meetings, 4 members). The work is organized by Technical Committees – TC and Sub-Committees – SC, within the committees work is organized by Working Groups – WG. Participation is open and free for everyone, so members can be scientists, businessmen, manufacturers, ordinary users, and others. ISO standards are voluntary in its use, and each state decides whether a particular standard is incorporated into its legal framework or the laws and regulations will refer to it as the technical basis [1].

For digital geoinformation standardization, in 1994. ISO technical committee under the number 211, called Geographic Information/Geomatics (ISO/TC211) was founded. The scope of work for the committee is to establish a structured set of standards concerning objects or phenomena that are directly or indirectly associated with the position of the Earth. IHO is among other organizations that develop spatial standards related to ISO/TC211. The standards define methods, tools and services for data management (including definition and description), data collection, processing, analysis, data access, display and transmitting data in digital/electronic form between different users, systems and positions. In Europe for the issue of standardization the competent organization is European Committee for Standardization (Comité Européen de Normalisation – CEN). In addition to CEN, dealing with standardization there are other international organizations such as Digital Geographic Information Working Group – DGIWG [2].

From the manufacturers of hydrographic data point of view, the need for standardization stems from the fact that the high cost of data collection (hydrographic survey) requires the exchange of information in order to avoid duplication of effort and cost. Collecting hydrographic data often consists of a large number of hours of field work, large financial amounts of ship and crews daily expenses and the time-consuming job of processing data and their quality control. In this context, the exchange of information between hydrographic offices is an absolute necessity in order to ensure higher data quality and reduce cost of their collection. From the users of hydrographic data point of view, mariners need uniformity on a global scale because by ocean navigation a number of different banks are visited and they are forced to use a large number of hydrographic data obtained from different manufacturers.

IN THE BEGINNING – ENC EXCHANGE FORMAT / *U početku – ENC format za razmjenu*

With the emergence of new technologies, such as ENC and ECDIS in hydrography, marine cartography and navigation, they go through the initial process of integration at the local level. ENC was initially an idea that has been developing in large Hydrographic Offices, and each office developed its software

to produce ENC in its own format. The need for data exchange between Hydrographic Offices was the starting point in a joint effort by IHO, IMO (International Maritime Organization) and ECDIS manufacturers to define a standard format for the exchange of hydrographic data.

The first step was the establishment of the Committee on the Exchange of Digital Data – CEDD. The committee was tasked to do research on the basis of then existing software for ENC production and then existing formats, analyze different hydrographic data display and propose a standard format for data exchange. In the XIIIth International Hydrographic Conference in Monaco in 1987, the committee presented the first standard format that describes the basic structure of the data and defines a new format for data exchange, DX-87. The description of data structures was upgraded very quickly in the form of adding a definition of topological relations and codes to define objects, resulting in a new format for exchange, DX-90. The standard format indicated the problem of data exchange between Hydrographic Offices, however implementation of the format in practice did not go satisfactorily due to the small number of software for a quality transformation from ENC defined in individual offices in to a new format for the exchange. It was concluded that defining an exchange format was only a small part the incompatibility problem because Hydrographic Offices, in the absence of standard definitions, edited the hydrographic data in different ways appropriate to their internal organizations [14].

When the ENC from one Hydrographic Office was transferred to another office a problem of data integration in their system would emerge, and it was concluded that the main obstacle for the integration is the lack of a common definition of hydrographic objects and their characteristics. There was also a problem of displaying the data on ECDIS. ECDIS, a system for displaying electronic charts was using Raster Navigational Charts, but the obvious intention was to implement ENC.

S-57 PUBLICATION DEVELOPMENT / *Razvoj publikacije S-57*

Transfer Standard for Digital Hydrographic Data is published in the Special publication No. 57, or S-57. Standard is the outcome of the IHO Committee on Hydrographic Requirements for Information Systems – CHRIS, and first edition became the official IHO standard at the XIVth International Hydrographic Conference in Monaco, 1992. The aim was establishing an effective exchange of hydrographic data and has been extended to the problem of developing a set of data for the implementation of official ENCs into a newly developed ECDIS. The S-57 1.0 used the implementation methodology of the International Standard ISO 8211. ISO 8211 is a specification document that describes details of the exchange of information and is used for standardizing the processing procedure of such information. It was primarily developed to define data exchange between the unadjusted computer systems.

The first step was the conversion of local data (ENC database – ENC DB) in the Hydrographic Office into then standard format for data exchange DX-90. Then distributors could distribute either in the data exchange format or in a format made especially for hydrographic data display on ECDIS called System Electronic Navigational Chart – SENC. If mariners received a chart in DX-90 format, then a subroutine in ECDIS made a conversion into SENC format for display on the screen [13].

The S-57 1.0 consisted of three parts A, B and C:

- A – contains a description of the coding scheme for the definition of concepts such as hydrographic models, object classes, attributes and symbolizing codes,
- B – contains an introduction to the ISO 8211 standard for data transfer, the connection between DX-90 and ISO 8211 formats, the data structure of DX-90 exchange data set,
- C – contains basic conventions during digitalization for generating DX-90 data set from analog data in navigational charts.

In practice the need to upgrade the first edition of the S-57 quickly revealed in form of a document that will describe in detail all hydrographic objects in the real world, i.e. Object Catalogue (S-57 Appendix A IHO Object Catalogue). An example of the object and attribute catalog can be found on the internet [18]. Object catalog consists of two chapters and defines object class and object attributes (approximately 190 attributes are defined). Object classes are divided into: feature objects and objects.

Feature objects contain descriptive characteristics of the object (approximately 180 feature object classes defined), while spatial objects contain positional information (coordinates, depth). Four types of feature objects are defined:

- Geo – consist of descriptive characteristics associated with objects in the real world, most of the objects: (159 objects),
- Meta – contains information about other objects (13 objects),
- Collection – describes relationships between other objects (3 objects),
- Cartographic – contains information about the cartographic representation of real world objects (5 objects).

Feature objects have a unique six characters acronym, such as depth area – DEPARE, land area – LNDARE, lateral buoy – BOYLAT. For each object class three sets of related attributes are defined:

- Attribute set A – describes the individual characteristics of the object,
- Attribute set B – contains information relevant to data usage, e.g. for data presentation,
- Attribute set C – contains administrative information about the object and its feature data.

Attributes also have the six characters acronym, such as object name – OBJNAM. By upgrading the first edition of the object catalog in March of 1994 a second edition of the S-57 was released as S-57 2.0. In November, 1994 at the Sixth CHRIS meeting the idea of developing detailed specifications for ENC was discussed (ENC Product Specification – ENC PS).

In February of 1995 IHO organized a workshop attended by ECDIS manufacturers and representatives of the Hydrographic Offices to define the content of the ENC PS and it was found that in order to meet all the requirements of ECDIS manufacturers and Hydrographic Offices, a new edition of the S-57 publication had to be made [5].

As a result of the workshop a new working group TSMAD (Transfer Standard Maintenance and Development Working Group) was established, which started preparations for S-57 3.0 and a new edition of the associated ENC PS. TSMAD met four times during 1995/96 to complete the job. Changes in the new edition compared to 2.0 include:

- new ENC cell structure concept,
- new data updating system,
- binary format implementation as in addition to ASCII,
- addition of four levels of topology for vector data.

S-57 3.0 organization was also changed so that it consists of three main parts and two appendices:

- 1) General Information,
- 2) Theoretical Data Model,
- 3) Data Structure,
- Appendix A) IHO Object Catalogue,
- Appendix B) ENC Product Specification.

The S-57 edition 3.0 for ENC became official in November 1996. One of the most important innovations was a updating system of data in the ENC and in SENC. This system enabled the issuance of IMO permission to navigate via official ENC data in accordance to the Law of the Sea, when such data are maintained using update system from the S-57 3.0 [15].

Due to the large number of changes, it was decided that the S-57 3.0 will freeze, remain unchanged for a period of 4 years from the date of its official issue, in order to make the application for the Hydrographic Offices and manufacturers of ECDIS easier. In this period of implementation the Hydrographic Offices noticed a number of attributes that should be introduced in the Object Catalogue, and so it was agreed that after a period of four years a new minor edition S-57 3.1 should be issued, which will include 38 new attribute values in the object catalog. The S-57 3.1 was officially released in November 2000 and was frozen for 2 years. The IHO has twice made small revisions in cooperation with the manufacturers. The first was released in January 2007 (S-57 3.1.1) and the second was released in June 2009 (S-57 3.1.2).

S-52 PUBLICATION DEVELOPMENT / Razvoj publikacije S-52

Parallel with the S-57 IHO was developing a new standard for the presentation of ENC content on ECDIS (Specifications for Chart Content and Display Aspects of ECDIS) published in the Special publication No. 52, or S-52. In November 1988 Colours and Symbols Maintenance Working Group – CSMWG was established to develop the first edition. Based on two years of research and testing in June 1990 the S-52 1.0 was presented.

The objective of S-52 is to contribute to safe operation of ECDIS by:

- ensuring a base and supplementary levels of display for ENC data, standards of symbols, colors and their standardized assignment to features, appropriate compatibility with paper chart symbols as standardized in the Chart Specifications of the IHO,
- ensuring the display is clear and unambiguous,
- ensuring that there is no uncertainty over the meaning of colors and symbols on the display,
- establishing an accepted pattern for ECDIS presentation that becomes familiar to mariners and so can be recognized instantly without confusion.

A first draft of the S-52 publication was given to the Hydrographic Offices and ECDIS users for a revision, and in accordance with their proposals in the next five years there were as many as 5 new editions. The most important change was in 1994. completing Annex A – Presentation Library. The Presentation Library contains detailed descriptions of colors and symbols, and a detailed description of ENC display, it links each object class and attribute within SENC format with the appropriate presentation on the ECDIS display [7].

- The latest edition of the S-52 publication 6.0 was released in March 2010. It consists of:
- The Specifications for Chart Content and Display Aspects of ECDIS, which describes the requirements and methods in relatively general terms,
- Annex A, the Presentation Library as a separate document,

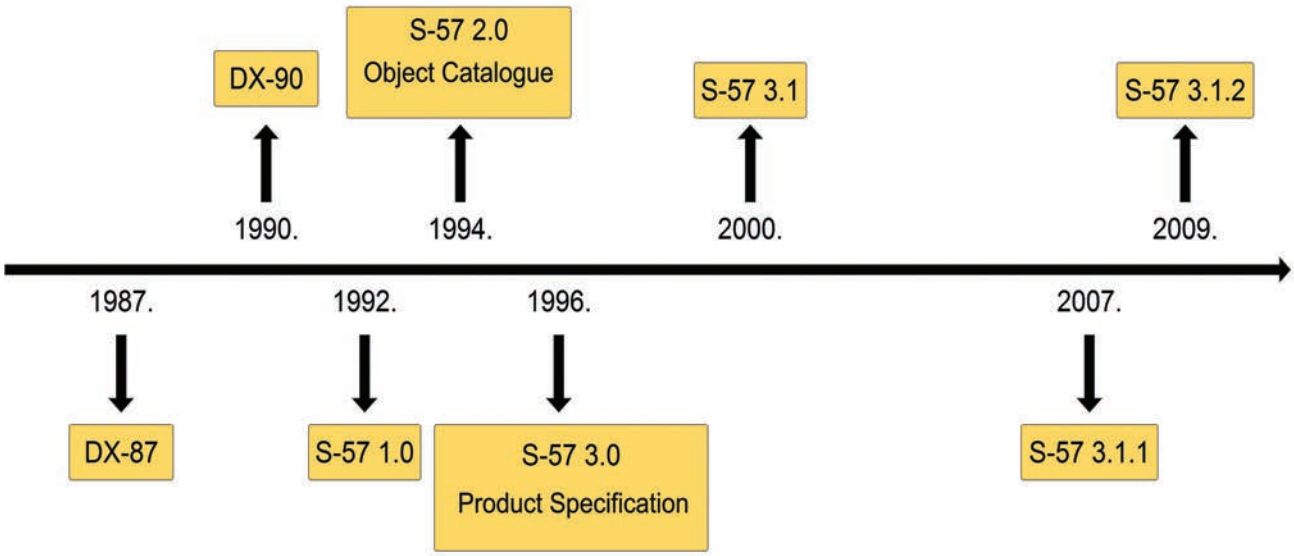

Figure 1. The S-57 publication development timeline
Slika 1. Vremenska skala razvoja publikacije S-57

- Annex B, which specifies procedures for initial color calibration of displays and the verification of that calibration,
- Annex C, which specifies a procedure for maintaining the calibration of displays,
- Appendix 1, Guidance on Updating the Electronic Navigational Chart.
-

OTHER STANDARDS / *Ostale norme*

The S-52 and especially S-57 were considered basic publications for ENC and for some time have been the only one. Over time some minor standards related to the ENC have evolved separately or from the S-52 and S-57, and all are available for downloading in publications at IHO site [19]:

- S-58, Recommended ENC validation checks,
- S-60, User's handbook on datum transformations involving WGS 84,
- S-62, List of data producer codes,
- S-63, IHO Data protection scheme,
- S-65, ENSs: Production, maintenance and distribution guidance,
- S-66, Facts about Electronic charts and carriage requirements.

The S-58 was previously Appendix B1, Annex C of S-57 Edition 3.1. in accordance with the IHOs decision to freeze the S-57 3.1 in November 2000, Appendix was isolated as a separate publication because of it's easier updating. The latest official version was released in February 2011 as S-58 4.2.0. The publication contains descriptions of the minimum checks manufacturers of ENC validity must incorporate. This software is used by Hydrographic Offices to ensure compatibility of their ENC data with the S-57, Appendix B1 product specifications for ENC [10].

All violations are defined as errors or warnings. Errors are defined as serious violations, or when the ENC data does not comply with the mandatory requirements of the ENC product specification, while warnings are defined as doubt of the accuracy of the data on the chart.

The S-58 4.2.0 contains a list of ENC data validation:

- checks relating to S-57 Data Structure,
- checks relating to ENC Product Specification,
- checks relating to ECDIS,
- checks relating to Use of Object Catalogue for ENC,
- checks relating to allowable attribute values for particular object classes.

The S-60 contains transformation constants and formulas to relate local/regional geodetic datum's to WGS-84. It was developed by the National Imagery and Mapping Agency – NIMA of the United States of America and it was ceded to be released as a special publication of the IHO. The first edition was released in June 1994, the second edition in November 1999, and the last official edition the S-60 3.0 in July 2003 with the last revision in August 2008 [6].

The S-62 data manufacturers list of codes was originally released in November 1996 as Appendix A to Annex A of S-57 as Codes for production agencies of IHO. As the list of codes is subject to change much more frequently than the S-57, subsequently was decided to publish it as a separate publication. It contains codes for IHO member states, codes for non-member states and codes for other relevant organizations.

The S-63, copyright infringement and unofficial distribution of nautical data were a serious danger of the digital age that the IHO had to face. At the 13th CHRIS meeting (Athens, Greece, September 2000) The Data Protection Scheme Working Group – DPSWG, which is responsible for making the scheme for data protection, and it was decided that the administrator of the standards will be the IHB (International Hydrographic Bureau). DPSWG presented the plan of development and CHRIS approved it in February 2002. The results were presented at the 14th CHRIS meeting (Shanghai, China, August 2002) and were sent to Hydrographic Offices.

In October 2003 S-63 1.0 was officially released. The publication was rebuilt twice, in March 2008 with the release of edition 1.1 and the last official edition in April 2012 S-63 1.1.1. The purpose of data protection is threefold:

- Piracy protection: to prevent unauthorized use of data by encrypting the ENC information,
- Selective access: to restrict access to ENC information to only those cells that a customer has been licensed for,
- Authentication: to provide assurance that the ENC data has come from approved sources.

Piracy protection and selective access are achieved by encrypting the ENC information and providing cell permits to decrypt them. Data Servers will encrypt ENC data provided by producer nations before supplying it to the Data Client. The encrypted ENC is then decrypted by the ECS/ECDIS prior to being reformatted and imported into the systems SENC. Authentication is provided by means of digital signatures within the data. The scheme allows for the mass distribution of encrypted ENCs on hard media (e.g. CD-ROM or DVD) and can be accessed and used by all customers with a valid license containing a set of permits [11].

The S-65 includes a guide defined by 10 basic steps needed to create, maintain and distribute ENCs. Additionally it contains a list of reference documents that serve as the basis for each step. The main purpose of the publication is to provide insight to Hydrographic Offices which are in the process of ENC creation (less developed countries) in the basic production processes in the preparation of ENC, and systems that must be in place to ensure production. Last official version S-65 2.0.0 was released in April 2012 [12].

The S-66, Joint Information Working Group – JIWG of Primar and IC-ENC Regional ENC coordination center – RENC issued in 2007 edition 2.0 of the publication by the same name. The IHO adopted the document in 2008 and in January 2010 released it as S-66 1.0.0. The publication was issued because the negative comments of ENC and ECDIS users (distributors, mariners, port authorities, etc.). The aim was to clarify all the information and tools on the market, which of them are official and which of them are in which situations mandatory for navigation [8].

FUTURE OF ENC STANDARDS (S-100) / *Budućnost normi za ENC (s-100)*

The IHO in the late 1990s saw the shortcomings of the S-57 concept. Although it proved to be a good standard that has enabled considerable development of ENC yet significant

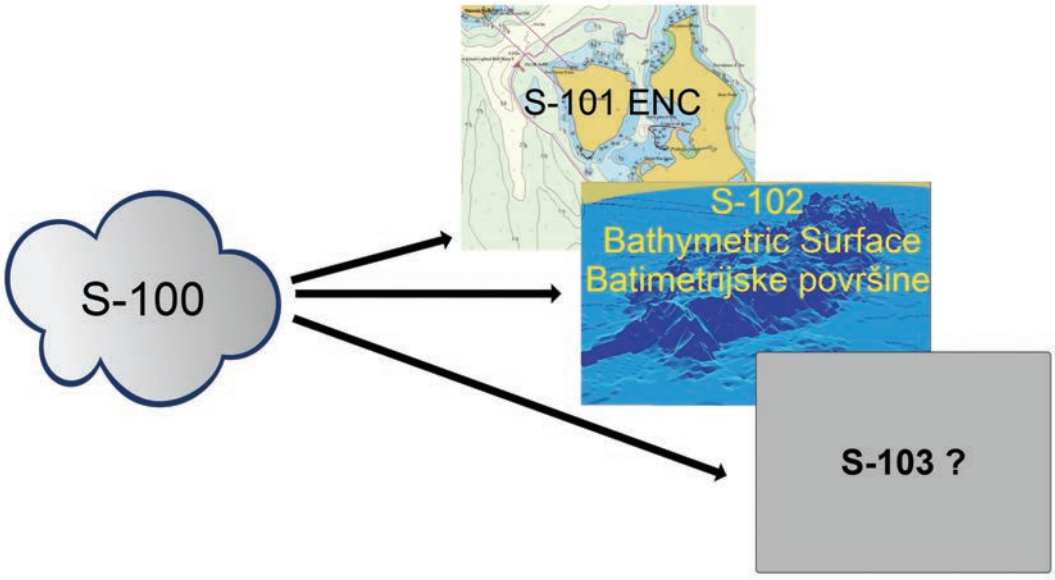

Figure 2. S-100 contains components for making different product specifications for all types of hydrographic data [9]
Slika 2. S-100 sadrži komponente za izradu različitih specifikacija proizvoda za sve tipove hidrografskih podataka [9]

restrictions were noticed:

- it is primarily developed to meet the requirements of ENC for deployment in ECDIS,
- it has an inflexible maintenance regime, repeated freezing of standards for long periods is counterproductive,
- the current structure of the standard does not support future technical requirements (grid bathymetry),
- installation of a data model within the format limits the flexibility and the ability to use a wider range of mechanisms for data transfer.

Because of these and other shortcomings CHRIS had planned a thorough revision of S-57 already in November 2000. Over the years, the use of S-57, many identified with the standard ENC product specification. This misconception has resulted in the conclusion of many in the ENC and ECDIS community that by a revision of the current standards radical changes in the current ENC would occur thus affecting the existing production. As that was not the intention, IHO replaced the name of the planned S-57 4.0 in 2005 to S-100: Universal Hydrographic Data Model.

Each publication subsequently released will follow the S-10n series, so that eventual issuing of a new product specification would follow as S-101 (Fig. 2) [17].

The TSMAD working group was put in charge to create and maintain the S-100 publication. Universal Hydrographic Data Model S-100 1.0.0 was officially released in January 2010 and it supports a much wider range of hydrographic data sources, products and customers. It is fully compliant with international spatial standards, especially with the ISO 19100 series of geographic standards and thus enables easier integration of hydrographic data and applications in geospatial solutions.

Other features include:

- Separating the data content from the carrier (file format). In this way, data can be manipulated and encoded without being permanently tied to a single exchange mechanism.
- Manageable flexibility that can accommodate change. The content of product specifications will be a subset of S-100, including separate feature catalogues. This allows the core standard to evolve (through extension) without the need to introduce new versions of product specifications.
- An ISO-conforming registry on the IHO web site containing registers for feature data dictionaries, portrayal and metadata. The registers accommodate both core hydrographic content and other chart related content, such as, nautical publications information.

All ISO standards developed by TC/211 are considered to be a part of the ISO 19100 series of spatial standards. For all types of spatial data these standards define methods, tools and services for development, management, processing, analyzing, accessing, sharing, and presenting information. Since January 2011 there are more than 50 standards in the 19100 series along with 20 additional standards in the development. These standards include the spatial and temporal schema, metadata, image and network data encryption, etc. The S-100 refers to a series of standards, and will be closely linked to all products and applications based on the 19100 series of standards (Fig. 3) [17].

A number of terms and definitions that were used in the S-57 3.1 have been changed to comply with the terms in ISO TC/211 standard. The most significant change is the introduction of the registry. Registry is designed as an information system within which there are secondary registers. Registry is a collection of tables in a database containing identifiers assigned to items with descriptions of related items. Descriptions may contain various types of information such as names, definitions or tags.

In the case of S-100, IHO has developed a registry on the internet [20] which enables a system to access and maintain a

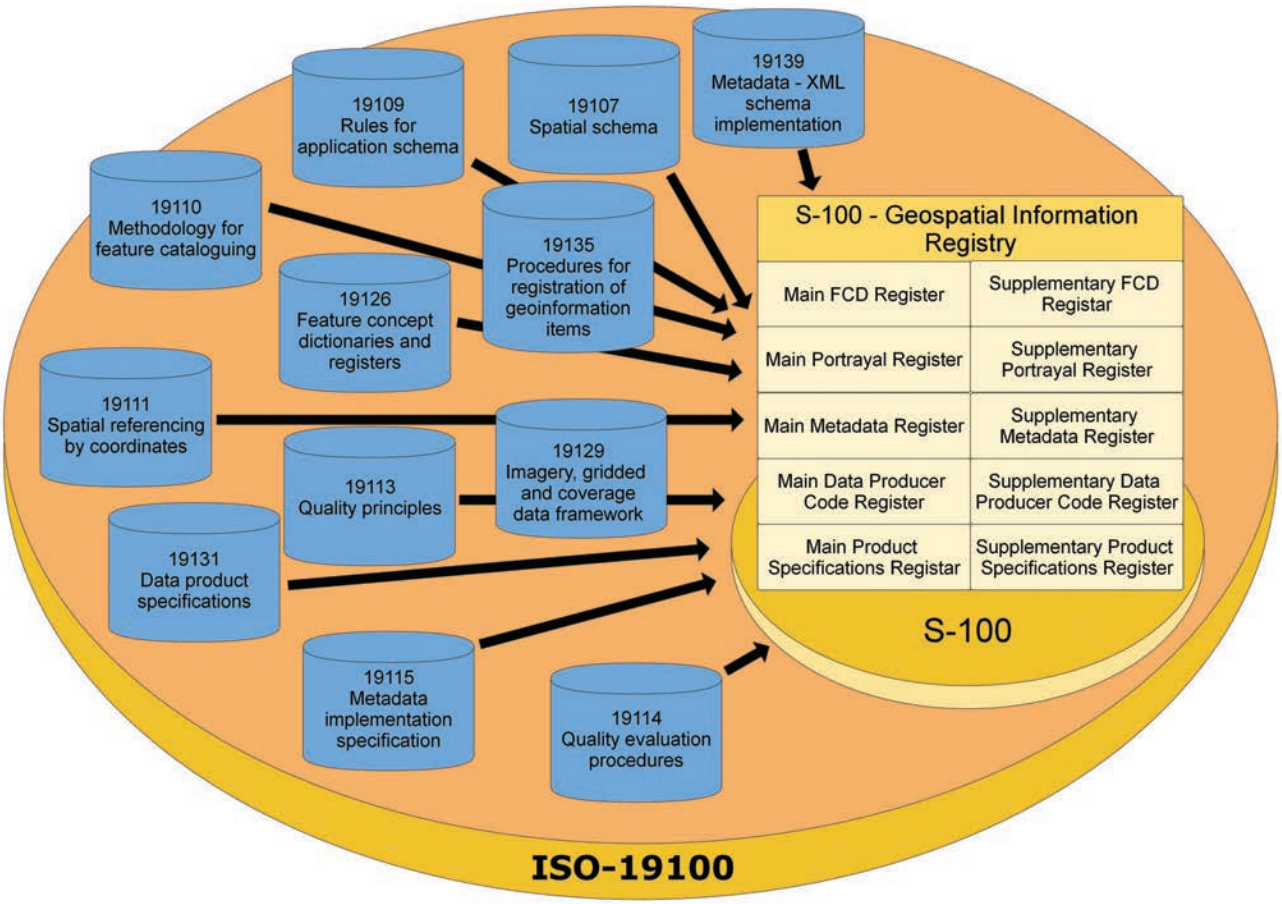

Figure 3. S-100 is compliant with the international ISO 19100 geographical series of spatial standards [9]
Slika 3. S-100 je usklađen s međunarodnim prostornim normama, serijom geografskih normi ISO 19100 [9]

variety of secondary registers.

Geospatial Information Register contains the following secondary registers:

- Feature concept dictionary – FCD,
- Portrayal register,
- Metadata register,
- Data producer code register,
- Product specification register.

IHO has, in order to make the implementation faster and easier, in January 2011 announced the publication Operational Pocedures for the Organization and Management of the S-100 Geospatial Information Registry also known as S-99 1.0.0. This publication describes the roles, responsibilities and procedures for the management and maintenance of S-100 and its secondary registers in more detail. ENC Data based on S-57 3.1 will continue to be official in the foreseeable future. Currently a ENC product specification based on S-100 named S-101 is in development. It is planned that the S-101 product specification system enables an updating system plug and play, improvements to symbols and software as well as more efficient use of additional data on the S-100. The S-100 and the S-100 product specification will take some time to work together with the S-57 3.1 and its product specification, so it is planned that all software related to ECDIS and ENC that are upgraded to S-101 are able to use data based the S-57 3.1 until the data based on old standards is no longer produced.

The IMO is planning in the future a new concept called e-Navigation, which is defined as: The Harmonized collection, integration, exchange, presentation and analysis of marine information onboard and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment.

For this purpose, IMO has established the Correspondence Group – CG for concept development and research of existing appropriate data structure. S-100 Geospatial Information Register was intentionally designed to be upgraded to the widest possible use of hydrographic data and other related data types. It is recognized that the S-100 Geospatial Information Register is suitable as the basis for the concept of e-Navigation. The CG stated in the beginning of 2011 in a report for the IMO that S-100 Geospatial Information Register should be used as a basic guide when designing e-Navigation concept, and subsequently if a more appropriate data structure isn't found to take into account the use of existing structures such as S-100 [17]. In this context, it is logical that the S-100 will play a key role in the organization of hydrography and other maritime disciplines in the near and distant future.

CONCLUSION / *Zaključak*

The standardization process for ENC is ongoing for about 30 years. Standards require constant re-evaluation and improvement as they must be in accordance with the technological development of the product.. We are in a transitional period were the whole navigation system could be improved on a global scale. Transitional periods are due to the

size and volatility of the market, always slow and difficult, from every aspect.

The aim of the study was to show how standards are developed, which organizations were involved in the beginning and what are involved today, what is the impact rating of users (mariners) and producers (hydrographic office) to changes in standards. The aim was also to draw attention to the whole system, which contains a number of people, institutions, regulations, meetings, specifications, which are often in the shadows, behind a product.

The future is already looming in the plans of the e-navigation concept. Despite the existence of technologies required for this innovative step, the challenge lies in ensuring access to all system components, including ENCs. Potential development of accurate and secure system of maritime information on land and at sea with global coverage is a worthy goal that will be developed in accordance with the S-100.

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The Possibilities for Application of Telework in Water Transport

Mogućnost primjene telework-a u pomorskom prijevozu

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Summary

Transportation is a key factor of modern economy. Lawmakers and employers are forced to rethink their approach to the form of employment concerning the state of the environment and an increasing number of accidents and traffic jams. One option, how to mitigate the negative effects, in the globalisation process, is to apply telework as a flexible form of work organisation. The purpose of this paper is to highlight the benefits that telework brings. Moreover, it points out the conditions that must be met in its implementation. In addition, there is an analysis of legislative aspect of and comparison of current state of telework in different countries. To conclude, the paper offers the analysis of the suitability of teleworking application for its position in water transport, because it poses an important role for the future of Europe in the development of transport infrastructure.

KEY WORDS

flexible managerial conception
telework
water transport

Sažetak

Transport je ključni čimbenik moderne ekonomije. Zakonodavci i poslodavci prisiljeni su promijeniti svoj pristup obliku zapošljavanja, s obzirom na stanje okoliša i povećani broj nezgoda i prometnih zastoja. Jedna opcija, kako ublažiti negativne efekte u globalizacijskom procesu je primijeniti telework kao fleksibilni oblik rada organizacije. Cilj ovog rada je naglasiti dobrobiti koje telework donosi. Uz to, ističu se uvjeti koji se moraju udovoljiti u njegovoj implementaciji. K tome, daje se analiza zakonodavnog aspekta i usporedba sadašnjeg stanja teleworka u različitim zemljama. Da zaključimo, rad nudi analizu prikladnosti telework aplikacije zbog njezine pozicije u pomorskom transportu, jer on igra važnu ulogu u budućnosti Europe u razvoju transportne infrastrukture.

KLJUČNE RIJEČI

fleksibilni menadžerski koncept
telework
vodeni transport

INTRODUCTION / *Uvod*

The economic rationalisation of production processes, technological progress and the development of information and communication technologies encourage dynamic development of teleworking. Rising processes of production flexibility and globalisation have driven this expansion. Transport is a key to economic growth and social cohesion, and it is factor forming the basis of modern economies in mentioned processes (Poliak, 2013). Requirements for transport services grow with economic growth and living standards. By 2020, it foresees a doubling of road transport within the EU new member countries. As results, we can expect more traffic jams, environmental damage, accidents and danger of loss of competitiveness of European industry, which must have cost-effective and reliable transportation systems due to supply chain management (Lednický, et al, 2010). It is in the interest of the EU to have and use more energy efficient transport system and transport stable economy. In regard of the state of the environment, it is necessary to be taken into account the condition of the greening transport (Križanová, et al, 2013). The literature review pointed out that road transport belongs to main sources of air pollution and causes major damage to the environment (Rypáková, Kormaňáková, 2013). For this reason, it is required to get the growth of road traffic under control and provide other, more environmentally friendly modes of transport resources in order to become competitive alternatives. The European continent is a maritime power thanks to the two-thirds of its maritime boarders, especially after the last enlargement.

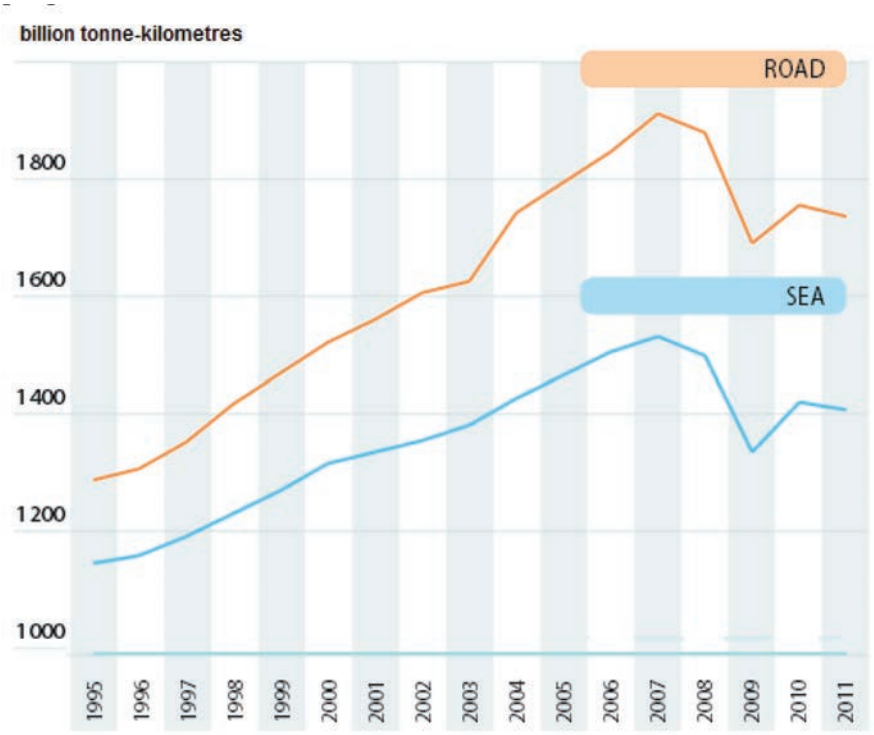

Figure 1. EU 27 Performance by road and sea for freight transport 1995-2011

Slika 1. EU27 vozarine cestovnog i pomorskog prijevoza 1995-2011

Source: Self processed based on: EU: EU transport in figures – statistical pocketbook, 2013.

Europe's long coastline and large number of ports predetermine the maritime sector to become a valuable alternative to land transport (Lednický, et al, 2010). Sea shipping in recent decades has demonstrated its ability to reach levels of competitiveness, which is usually attributed to road transport. From 1995 to 2004 performance in maritime coastal transport increased (in tonne-kilometres) in the 25 member countries by 32%, while the performance of road transport increased by 35% (EU,2013).

The growth performance of sea transport still continued, only exception was 2009, when it was significantly impacted by the global economic crises. Figure 1 presents the development of sea and road transport, which are almost identical what highlights the weight of sea transport in recent years. Maritime transport accounts for 90% of EU external trade, the shipbuilding industry has an annual turnover of more than 20 billion € (Stanivuk,2013). In addition, there is a positive trend in terms of the number of employees.

Estimates suggest that the total employment in blue economy may exceed the number 7 million jobs by 2020, if this is supported by training measures that are aimed at guarantee the presence of a mobile workface with sufficient skills and experience (Žarnay, Dávid, 2007). Current number of employees, number of enterprises and total turnover dedicated to waterway are shown in Table 1. Slovak republic is an inland country, Croatia is a coastal country, there is possible to see differences between the inland water transport and sea transport. We pointed the inland waterways, because for inland countries they have a great importance as well. If International River flows through the country and connects it with a number of seaports, transhipment cargo from seagoing ships on river vessels at sea port allows to get the goods to the inland effectively and environmentally preferred. Water transport presents a sustainable, viable and profitable mode of transport and plays an important role in transport infrastructure not only in Europe (Klieštik, et al., 2013).

Integral part of the approved project NAIADES (Navigation and Inland Waterway Action and Development in Europe) represents mainly investments in human capital, what means to support the development of education and training as a precondition of creating a healthy and competitive labour market (Sosedová, 2005). The development of water transport thus goes hand in hand with an increasing employment in this sector. Considering the large distance from the ports to corporate domiciles and employees' homes, there is a room for the application of flexible managerial concept – teleworking, as a type of flexible work arrangement, which can include other non-traditional setups (Hrašková, Rolková, 2012).

Large distance is just one, but the main of the numerous reasons why application of teleworking (also known as telecommuting, virtual work, e-work, remote work) is suitable. People use transport as passenger mostly for commuting to work. Following table 2. shows the volume by modes of transport in the world. Employees drive several billion kilometres a year. As could be seen in table, the most of them are using their own cars. Telework aims at changing travel habits and reducing commuter and business driving as cost saving alternatives to building ever-increasing highway and public transit capacity. Reduced driving also lessens air and water pollution, energy consumption and highway maintenance costs. These can have a great impact to the environment at all.

The results of teleworking indicate benefits that include increased productivity, reduced absenteeism, reduced time and costs in service delivery and increased employee motivation and morale (Lendel, 2009). Many road and maritime companies encourage teleworking to facilitate flexible work practices that enable staff to balance their work and family commitments.

Table 1. Sea and inland water transport statistics

Tablica 1. Statistika transporta morem i unutarnjim vodama

Source: Self processed based on Kalina, T: Vodná doprava – neodmysliteľná súčasť dopravného systému, 2008.

	Employment by water transport (thousand)		Number of enterprises		Turnover by water mode of transport (million €)	
	Inland water	sea	Inland water	sea	Inland water	sea
SK	0.2	0.0	24	7	22	2
HR	0.0	3.8	15	1708	3	14885
EU27	42.0	182.2	9651	11082	7585	

PASSENGER TRANSPORT (billion person-kilometres) in 2012					
	EU27	US	Japan	China	
Passenger car	4822.1	5866.7	766.7	1676.0	
Bus +trolley bus+ coach	512.2	470.4	87.0		145.5
Railway	407.1	36.7	394	961.2	139.8
Tram + metro	92.9	17.3			49,6
Waterborne	36,6	0.6	4.4	7.5	0.7
Air (domestic/ intra EU27)	575.1	908.9	75.7	453.7	166.8

Table 2. Passenger transport in 2012

Tablica 2. Putnički prijevoz u 2012. godini

Source: Self processed based on EU: EU transport in figures – statistical pocketbook, 2013.

TELEWORKING PROS AND CONS / *Teleworking za i protiv*

Teleworking and telecommuting nowadays rapidly get into the consciousness of workers in various sectors of business services increasing numbers of teleworkers also present a future in EU (Telework in EU, 2011). The short and clearly definition says, "teleworking refers to a working arrangement or work style where an employee regularly does his or her work off-site, or outside of principal office. Teleworkers typically work from home one or more days a week and communicate with the office using telephones and over the Internet" (Štofková, et al., 2011). EU defines Telework as „a form of organising and/or performing work, using information technology, in the context of an employment contract/ relationship, where work, which could also be performed at the employer's premises, is carried out away from those premises on a regular basis" (Telewrok in EU, 2011).

The principle of telework is so limitation of the need to commute to the company and to perform the work at agreed hours and days of the week. Instead of a fixed time and the local mode teleworking allows optimize individual performing of work according to the needs of worker in terms of time and space (place of work is most often at home). Limitation of physical presence in the workplace can be partial or almost one hundred percent, depending on the type of work and the employer requirements. The teleworking includes following modes of work: work of mobile workers - businessmen, engineers, consultants, other professionals in the field, the work of distributed virtual teams with members in several locations, telecentre work close to home, uniting more workers of different professions, the work of students at universities who can study with all supporting documents «at hand «without having to physically go to school etc. (Lendel, 2009).

Currently, the performance of dependent work of employee that is made somewhere else than in the location of his employer, has some specific features that require different legislation than the employment of an employee who performs work at the employer. According to the agreement with the employer there can be a place of work different than the employer's workplace, this place could be a home or other place of work as well. There are jobs that are specifically connected to the employer's workplace, for example: administration in government - because of business hours or hours for the public, work of receptionist and others. When working at home - teleworking essence lies in the fact that its performance is in the working time, but these working hours can employee establish usually by himself (Hrašková, Rolková, 2012). Consequently, for these forms of employment are specified deviations of the rules of employment in place of work in the employer's workplace, such as provisions of the determined weekly working time and downtimes are not applicable to teleworking, with important personal obstacles to work. The company does not pay wages to employees, except for the death of a family member, it does not pay employees for overtime, wage surcharge for work on holidays, wage advantage for night work and wage compensation for the difficult job performance.

Teleworking is an innovative work conception, a form of employment which allows employees to work productively and provides the following benefits for the employee, the employer and the company (Hrašková, 2013; Lendel, 2012; Telework in EU, 2011; Telework uptake by industry, 2013)

For the employee:

- reduces time needed to commute to work
- reduces stress situations (avoid rush hour, conflicts in a team, office politics, cubicles and harsh lighting)
- reduces costs related to job
- provides better and more productive working environment
- increases the possibility of better organization of work and private responsibilities as well
- improves quality of life, health of employee
- provides the opportunity to work for disadvantaged (disabled) people.

As also our survey showed, most employees who have experience with teleworking, perceive improvement of quality of their lives. Behind this view is a number of factors such as higher job satisfaction, less stress, greater flexibility in organizing work-time or opportunity to spend more time with family.

For the employer:

- offers the opportunity to acquire and retain
- skilled workers,
- reduces absenteeism, sick leave,
- reduce overheads in the company (for energy, equipment),
- saves office space,
- increases productivity and employee satisfaction,
- increases loyalty to the organization.

Teleworking is so useful for example for foreign companies to start their activities in waterways transport or for new companies, it is preferable to create well equipped home office for their representative than to rent the entire building along with a full service personnel, or for distribution companies as well. Although teleworking is not suitable for all categories of employees, many employers would allow their employees to

work remotely at least part - timely.

According to market research, the 57% of workers in the U.S. prefer working at home and only 36% prefer to work in the office. In Europe, it is exactly the opposite situation. E.g. in Sweden 49% of employees prefers an office environment and only 34% the home office (Telework uptake by industry, 2013; Telework in EU, 2011; Lister, Harnish, 2011) .Different situation is in Japan, where the share of teleworkers varies only about 1% (Kalina, 2008).

In U.S., there are also telecommuters who are working for local (1.1%) state (2.2%) and federal government (3.2%). In 2011, there were commuters who were working for private profit organisation (2.4%) and private non-profit organisation (2.7%) of total non-self-employed population (Transportation implications of telecommuting, 2011; Lister, Harnish, 2011).

In EU countries is situation very heterogeneous. The figure 2 shows incidence of telework in the EU and Norway.

Further development is difficult to predict because of tradition and conservatism in the way of working (Telework in EU, 2011).

For the whole society:

- reduces amount of traffic during the hours of increased traffic, it may also help reduce the costs of roads and their maintenance
- reduces air pollution
- increases employment and labour flexibility
- contributes to reducing of social exclusion
- improves of working engagement of disabled people
- contributes to development of marginalized regions.

For some organizations and individuals, teleworking can represent a dramatic shift in how they perceive the workplace and the job itself. Although in Slovakia teleworking is not much spread, in Western Europe this way of employment is already extended. Most popular is teleworking in Scandinavia, but it is used increasingly in the UK and even The Ireland, where people prefer traditional forms of employment recently. Because this type of work brings for certain type of people some cons, not all Europeans inclined to teleworking, this form of employment is refused especially because of following:

- limiting the possibility of direct communication with colleagues at work – isolation of employee is setting the stage for better concentration and thus higher productivity, but some people miss the interaction with colleagues in the office
- work excessing the limit can cause stress - shift to teleworking opens access to work 24 hours a day, teleworkers can be lured to work more hours, than obligatory working hours
- teleworker must determine the rules in relation to work - teleworking provides more flexibility in program of personal issues, work from home can be carried out only under the condition that the employee will not be disturbed at work by family members,
- distrust of superiors - the management believe that teleworking is a good idea, but still doubt about whether working from home is the best for their company, many of them are suspicious of employees, of their ability to organize working hours outside the traditional workplace.

Advocates of teleworking, however, highlight many benefits of working from home - environmental, social and economic (Majerčák, 2013). They argue that the environment and, finally, the traffic situation, especially in big cities would be helpful if all the people do not go to work every day. Although the work from home for an employer is generally assessed positively, the results of research show that it works to the mutual satisfaction, if an employee spends some day of the week in the company to have a feeling that remains in the center of company life, does not feel lonely when working alone, has no sense of exclusion from the team.

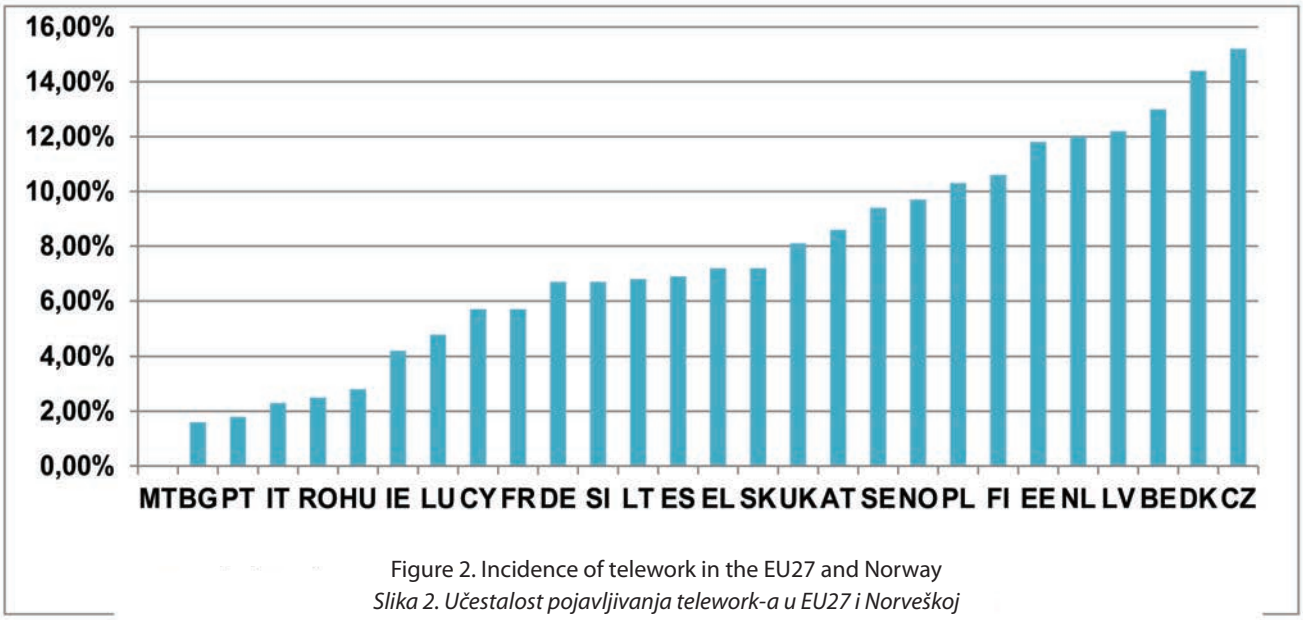

Figure 2. Incidence of telework in the EU27 and Norway

Slika 2. Učestalost pojavljivanja telework-a u EU27 i Norveškoj

Source: self processed based on: EU: Telework in EU, 2011.

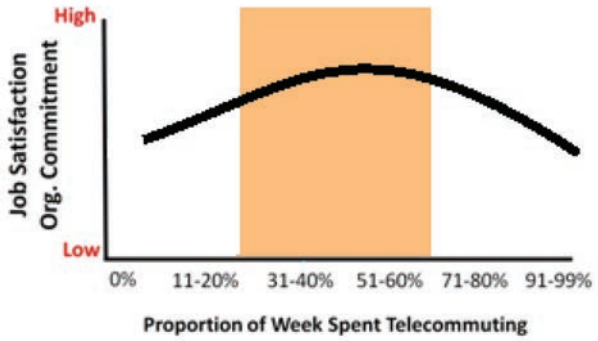

Figure 3. Job satisfaction vs. Telecommuting proportion
Slika 3. Zadovoljstvo na radu u usporedbi s telecommuting proporcijom

Source: The virtual Leader: Should You Play Big Brother to Your Teleworkers?, 2011.

SUITABILITY OF TELEWORK IN WATERWAY TRANSPORT / *Prikladnost telework-a u vodenom transportu*

Mentioned facts are reason why men less frequently do working from home, or it is done usually later in lifetime. Women generally use their maternity leave to transition to teleworking, after maternity leave they often struggle to adapt again to work and teleworking can help them shorten the time spent away from work, or allow them to work at least part-timely and not lose working habits. Working from home can greatly help disabled people or parents who care for young children. There is great possibility of geographic organizational development, by using remote workers from all over the world, which is associated with a greater pool of employees, higher educated people or specialists. Teleworking is also ideal for professionals who work independently on tasks and they do not need special equipment, computer or laptop with required software, Internet connection and telephone are enough.

A suitable job for telecommuting application must meet the following criteria:

- work must be "portable" (everything needed for the work can be taken home, or can be available by the means of communication),
- work does not require too much personal contact with colleagues, partners or customers,
- work has well defined beginning and end (outputs), so everyone knows what is the expected outcome (report, financial balance sheet, website, graphics, etc.).

Therefore, there is a list of job position in water transport that may be administrated in-home (private profit companies responsible for shipping goods or transport people or government organisations); there for instance: programmers, document translator, logistic manager, customs agent, accountant, actuary, administrative assistant, advertising executive, agent, analyst, appraiser, auditor, shipbroker, CEO, clerk typist, consultant, contract monitor, data search specialist, economist, financial analyst, researcher, telephone operator, receptionist (sending/ receiving electronic mail), logistic software engineer, telemarketer, telephone operator.

Our survey also has shown what employees, who have already contact with telework, are doing:

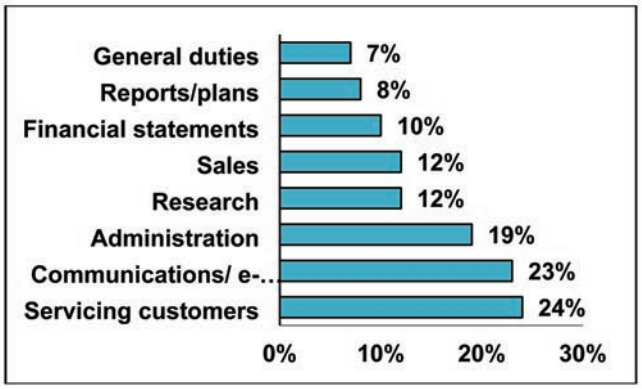

Figure 4. What does teleworker do?
Slika 4. Što radi teleworker?

Source: Self processed

Of course, service staff on boats or ferries (i.e. sailors, captains, pilots, waiters, cleaners etc.) and employees who have to have contacts with customers are not allowed to stay and work at home.

MEASURABLE INDICATORS – ENVIRONMENTAL, SOCIAL, ECONOMIC / *Mjerljivi indikatori – ekološki, socijalni, ekonomski*

The economic benefit of teleworking is not easy to measure because a number of factors are the reasons for increase in productivity. The benefits of teleworking, however, can be measured in cases where the results are electronically monitored (Cisko, et al., 2013). Possibility of working remotely brings not only higher employee productivity and savings on travel, but the staffs also offers great flexibility, which significantly contributes to employee satisfaction, thereby increasing their work effort and quality of work.

POSSIBLE TRANSPORTATION INFLUENCES OF TELECOMMUTING / *Mogući utjecaji telecommuting-a*

In Australia, government supports all possibilities of telework. It counted the impact more than 163 000 employees. Nearly all (94%) pledges came from the federal government, enabling federal employees to save a collective 13 million $ in commuting costs, avoid 14 million miles of travel and gain back more than 716 000 hours (Sensis Business Index, 2008).

REAL APPLICATION / *Stvarna primjena*

As was mentioned in introduction, by 2020 water transport sector should employ 7 million employees. Let imagine that just one quarter of them will be teleworkers.

Data for calculation:

- 70% of teleworkers are using their own cars,
- they are commuting to work (port or to office) about 100kilometres a day in average,
- one way takes 1.5 hour,
- 210 working days,
- CO2 emissions of fuel consumed 2500g/l,
- average price of gasoline is 1.5€.

Table 3 presents results.

Table 3. Transportation impacts of telework

Tablica 3. Utjecaj transporta na telework

Transportation impacts	Calculated data
Saving car km travelled (millions)	28 000
Saving in gallons of gasoline (millions litres)	46.7
Value of gasoline saved (millions)	70
Saving CO2 emissions (tonnes)	16666.7
Annual hours saved for average telecommuter	630
Total annual hours saved (millions)	7640

Source: Self processed

THE LEGAL STATUS OF TELEWORKER / *Zakonski status teleworker-a*

Teleworking is a way of working, which is quite close to nature "freelance work", work on the business license, work of the contractor, work under the agreement for work etc. However, it is not like that in many ways. From all aspects, especially in terms of legal rights and obligations of a remoted employee, there are different rules and statutory provisions (with respect to the Labour Code, trade laws, tax laws, social security laws, health insurance, pension insurance etc.). Teleworker is in easier situation, because like for any other employee the employer is fully responsible for him to many authorities.

In European Union, there is one important differentiation with regard to the implementation of the European Framework Agreement on Telework is whether it creates „hard" or „soft" law in the respective Member States.

„Soft law"is the term applied to EU measures such as guidelines, declarations and opinions. In contrast to 'hard law' instruments such as regulations, directives and decisions, soft law measures are not binding on those to whom they are addressed. However, soft law can produce some legal effects and is sometimes presented as a more flexible instrument in achieving policy objectives. In the typology of Marginson and Sisson (2010), hard law involves standard rights and obligations, while regulating core issues – such as pay and working time. It relies on sanctions, is complete and compulsory. Soft law, on the other hand, involves minimum provisions only, regulates „soft issues" such as stress and telework, is incomplete, open-ended and permissive.

As the "autonomous route" of implementation gives actors in the Member States the choice of how to transpose the European Framework Agreement, a variety of instruments have been used. The 21 countries that reported some form of implementation of the agreement can be grouped into three main clusters. The most widespread way of implementing the European Framework Agreement has been through collective agreements. Nine countries used collective agreements and these had been concluded mainly at national or intersectional level. In a second cluster of six Member States, implementation was achieved through various forms of „voluntary" measures – such as joint guidelines, codes and recommendations on telework which are based on the proposals and policies set forth in the agreement. In a last group of six other Member States, national legislation has been enacted in order to implement the European Framework Agreement.

HOW TO APPLY THE TELEWORK / *Kako primijeniti telework*

HOW TO PROCEED: / *Kako nastaviti dalje:*

- It is not always the intention of the organization itself to build employment policy that supports telecommuting. If the employee feels that his case is correct or even the only appropriate way, then he must persuade the employer about the following matters:
- how much will be saved for employees transferred to work in remote mode, compared to finding substitutes for office work,
- there is a possibility to try out a new style of work during a probationary period,
- there is no need to lose contact with other employees, as it will maintain effective telephone and electronic

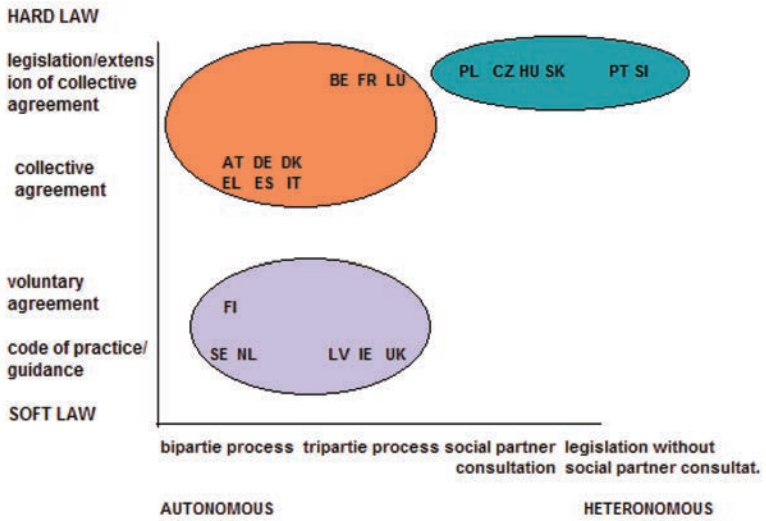

Figure 5. Forms of implementing telework agreement

Slika 5. Oblici implementacije telework sporazuma

Source: EU, Telework in the European Union, 2011.

Note: blue: implementation through national legislation, orange: implementation through collective agreement, violet: implementation through soft law mechanisms

communication with a focus on specific tasks without loss of time and money, and according to personal needs regular communication (the presence in team meetings and meetings with management and so on), or at least by voice or video conferencing.

For employee own agreement with the employer it is appropriate to apply for the following requirements:

- reimburse the operating costs for telephone and other connections (ISDN, cable TV with the possibility of data transmission and internet access) or to pay the installation of a telephone connection (cheaper in the name of the owner households than of the employer), the best use of call-back for communication with corporate network and the internet,
- reimburse the additional costs associated with work - own office equipment, hardware and small articles of consumption clearly applied only to work for the employer, an alternative way is to use only the company's computer equipment, both because it is covered by corporate support (repair, reinstallation, upgrading software, etc.), and secondly, the company will gradually depreciate it,
- distinguish between own costs, which would exist in any case, and additional working costs at home, and on the basis of this division apply requirements to the employer - of course, the goal is win-win situation for both sides within a reasonable compromise of terms of reimbursement of specific costs.

CONCLUSION / *Zaključak*

Teleworking is not a solution for everyone, but in most cases, it can substantially reduce costs, accelerate product development and increase sales. If a business plan explains the benefits, then there is no problem to get top management agreement to remote work. Reducing the costs of the employee with respect to its higher productivity is stated even over 50%. Implementation of the new organization of work represents a significant change for each company, and therefore teleworking is not possible to be started immediately. It should be started with a small (pilot) number of employees. Continuously, the results of the pilot operation will prove the effectivity and then the amount of staff can be increased.

Application of teleworking is possible only in an environment where management is aware of the possible beneficial effects of a new working style, has full confidence in the disciplined and well organized staff. Company policy with regard to teleworking must include clearly defined rules for evaluation of employees (with regard to the objective of reducing cost and higher performance) and must be in accordance with a collective agreement and general rules and laws (Labour Code, social security etc.). For new style of work to create awareness and higher levels of staff engagement, all of them should be informed about the successful and beneficial impacts on the results of the company, in other words on increasing productivity (and satisfaction) of individual workers. The company should not force anyone to take this kind of work for their own if they do not want to.

The European Union supports the programs related to spread potential of waterway. With the increasing volume of maritime and inland water transport performance goes hand in hand with the demand for new labour. However, since education in this area is specific, workforce may be different deployment and future employer does not have to meet with the willingness of employees to relocate or commute to work every day. Workforce will need to be effectively deployed. In field of water transport and shipbuilding industry it is a room where telework can find its place and where it is even recommended. It is not only because of increasing labour productivity, but also in terms of ecological aspect as could be seen several times in our paper.

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Procedures and Deck Officer Training in Cases of Intentional Radar System Jamming and Deception

Procedure i obuka palubnih časnika u slučajevima namjernog ometanja sustava i obmane

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Summary

This study analyses the procedures of radar system users in cases of intentional radar jamming and deception, with particular emphasis on safe navigation. Along with the procedure analysis, the study also deals with training methods of deck officers for jamming countermeasures to maintain certain accuracy of surveillance and safe navigation. The article also defines a decision tree – safe navigation which offers the radar operator the possibility of choosing "the course of action" based on the type of interference, assessed threat and the activities necessary to ensure safe navigation. Such research is of extreme importance for educating and training of maritime officers, especially deck officers, in thematic units relating to accuracy and reliability of the radar system exposed, in this case, to intentional interference.

KEY WORDS

marine radar
interference (jamming)
detection
safe navigation

Sažetak

Ova studija analizira procedure radarskih korisnika u slučajevima namjernog zagušenja i obmane, s posebnim naglaskom na sigurnu plovidbe. Skupa s analizom procedure, studija se također bavi metodama koje časnici palube koriste i protumjerama da bi se održala određena preciznost i nadzor sigurne plovidbe. Članak također opisuje stablo odluka - sigurnu navigaciju koje nudi radarskom operatoru mogućnost odabira «tijeka djelovanja» temeljenog na tipu interferencije, procijenjenoj opasnosti i aktivnostima potrebnima za sigurnu navigaciju. Takvo istraživanje je od iznimne važnosti zbog obrazovanja i obuke pomorskih časnika, posebno palubnih časnika, prigodom tematskih jedinica koje se odnose na točnost i pouzdanost izloženog radarskog sustava, a u ovom slučaju namjerna ometanja.

KLJUČNE RIJEČI

pomorski radar
interferencija (ometanje)
praćenje
sigurna plovidba

INTRODUCTION / *Uvod*

It is a well-known fact that interference with the radar system can endanger safe navigation. It is therefore essential to identify radar limitations in real usage conditions when exposed to intentional types of jamming. Intentional radar interferences are very rarely to hardly ever analysed in seafarer training, even though they exist and are widely applied. Previous research has shown that the awareness of intentional jamming on the radar display is insufficient which directly endangers safe navigation, thus adding value to this approach.

The situation in navigation has, in this sense, become even more complicated due to an increased number of pirate attacks and decreased prices of electronic jammers. The development of contemporary radar systems is taking into account the resistance to intentional jamming, but efforts are nevertheless insufficient because there is a human factor at the end of the decision chain. Therefore, there is a problem of correct directing, accuracy and timely reactions of the deck crew members.

Namely, the question is how to avoid erroneous reactions which are very likely due to insufficient know-how as to overcoming momentary conditions of the radar system because of, for example, intentional interference, when the radar is functioning correctly but giving a false image of the actual surrounding. Research efforts and the knowledge of the effect of intentional radar interference on safe navigation must be directed at finding *standard operative procedures* which would help avoid erroneous activities (mostly due to a false image of the actual surrounding) and thus enable safe navigation.

Starting from the above stated, *the study problem* is defined as the level of training of systems operators for safe navigation under intentional (selective) jamming to which both the

technical system and man are exposed to. The study subject is the level of knowledge and reaction of deck officers, i.e. operators of the marine radar system in interpreting "radar images" under jamming, for proper decision-making. Wrong decision can lead to far-reaching consequences which could result in ship collision, sinking, grounding, etc. *The study objec*t is an operative procedure of the radar system operator (deck officer) and the protocol by which the latter has to operate while identifying intentional (selective) jamming , all for the purpose of ensuring safe navigation. The correct course of action according to the operative procedure and protocol should always answer to two questions:

1. Is there intentional (selective) jamming ? and
2. If there is, how and what actions should be taken to ensure safe navigation?

Unlike unintentional interference impacts, the impact of intentional (selective) jamming on the correct and reliable performance of the radar system is insufficiently researched (bibliographic units detailing intentional jamming are very few), so the purpose of the study was to broaden the knowledge of the problem and to improve the identification of jamming and ensure, through sufficient training, increased safe navigation. The study's hypothesis is that an improved and more precise processing of received information of the navigational radar system under intentional (selective) jamming and a high quality training of deck officers can enable better navigational safety under contemporary threats posed by intentional jamming.

The first part of the study focuses attention on defining the procedure methodology under radar jamming, whereas the second part suggests ways of enabling deck officers to identify and counteract the impact of intentional jamming.

1. DECK OFFICER'S PROCEDURES IN THE CASE OF INTENTIONAL JAMMING / *Postupci palubnog časnika u slučaju namjernog ometanja*

Today, safe navigation is increasingly reliant upon the radar system (e.g. ARPA radar) in various navigation areas and in determining the position of the navigating vessel. It is therefore necessary to define procedures in case of intentional jamming.

Procedures suggested in case of identification and existence of intentional jamming with the radar system can be divided into:

- threat assessment,
- procedures optimization,
- change in navigation plan and
- increased surveillance.

The necessary procedures are:

- usage of the alternative radar system, or new operating frequency of the radar
- determining the current vessel position with other electronic devices
- radio contact with nearby vessels and port authorities and reporting on the current state.

In accordance with the above stated, the following decisions are possible:

a. continue navigation,
b. continue navigation with increased surveillance,
c. reroute and
d. stop navigation.

Besides the above stated, it is also necessary to make a record of the incident , which will later be used for the analysis of the procedures undertaken. In accordance with the author's experience and research of intentional jamming and the fact that thus far literature has not methodologically detailed the documentation of such events, it is suggested the notes contain the following elements

- Chronology of events, as shown in Table 1. (research has shown that the most dominant shadow sector is in the direction connecting the radar jammer and the jammed radar).

- Description of the area where the jamming occurred - determine the jamming direction based on the most dominant shadow sector of the radar screen.

c. A list of engaged devices and procedures undertaken to prevent intentional interference:

- which other devices were used and what the operating radar frequency was used
- what information about the situation in the environment of the existing vessels and navigation

Table 1. Chronology of incident
Tablica 1. Kronologija nezgode

Time	Procedure undertaken
T1 + 1 min	switch to a radar system operating in a different frequency band
T + 2 min	switch from automatic to manual vessel control
T + 4 min	verify the current position of surrounding vessels with alternative radar systems (VTMIS, radar systems of surrounding ships)
T + 5min	increase the number of the crew members on the bridge of the ship
T+5 min	decrease the cruising speed to a safety speed
T+10 min	compare the established position with the position obtained from other electronic devices (AIS, GPS, ECDIS) (AIS, GPS, ECDIS)[2]
T+ 10 min	make the change of the navigation plan
T+ ……	continue navigation according to a new navigation plan, with increased surveillance and usage of other methods of determining the position

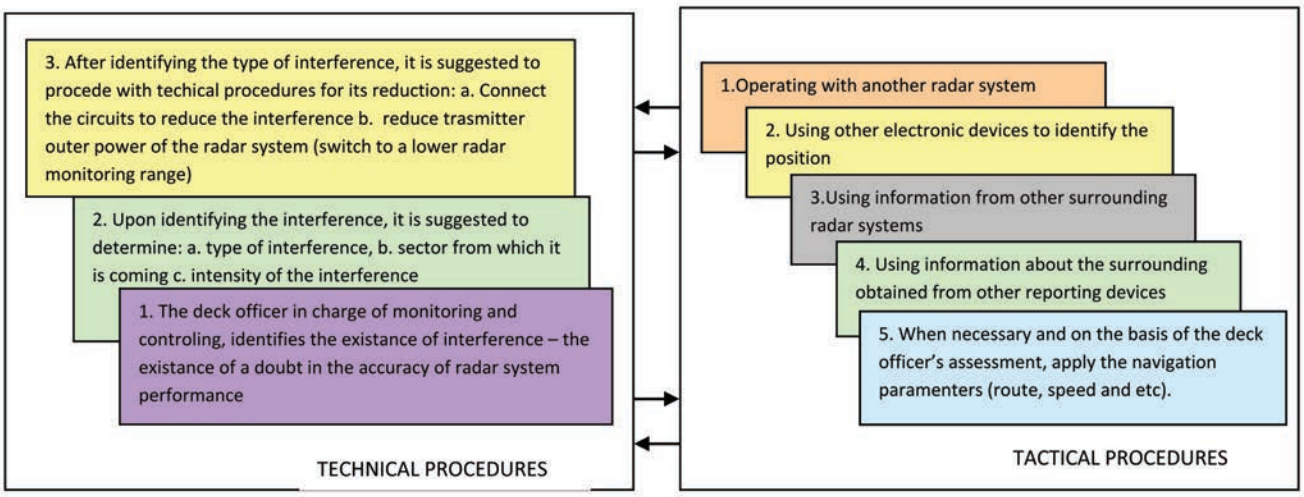


Figure 1. Procedures of the radar system operator in case of intentional jamming 4
Slika 1. Postupci operatora radarskog sustava u slučaju namjernog ometanja 4

features was obtained from AIS subsystem,

- ECDIS comparison of the current position with the situation on the map
- The results of procedures undertaken which reduced the effect of intentional jamming and protected safe navigation.

Records are made by the deck officer on call and approved by the ship commander. As a contribution to the study, Table 1 suggests procedures for radar system operators in cases of intentional jamming. The procedure is shown in Figure 1. and is divided into two units: technical and tactical.

Figure 1. shows procedures of the radar system operator in case of intentional jamming . The procedure is divided into two units: technical and tactical procedures.

Considering how the defined sub processes have not yet been detailed in the literature available, Table 2. offers the possibility of better understanding of the jamming process as well as procedures suggested.

The most important step is assessing and determining the degree of threat because this creates prerequisites for a high quality choice of tactical and technical procedures.

Tactical measures suggest rerouting (changing navigation plans) in a way that would avoid running aground or colliding with the objects in the navigating aquatorium.

Technical measures ensure the choice of alternative technical devices, thus ensuring an accurate position and vessel route.

Based on previously mentioned, upon completion of procedures in case of intentional jamming, and taking into account the applied technical and tactical procedures, the following data is present:

- chronology of incident during procedures undertaken
- the area where the jamming occurred
- engaged devices and procedures undertaken
- results of the procedures undertaken to reduce jamming

Mentioned data are entered into the database and can serve to develop simulation models in the deck officer training process.

It is also noticed that there are seven sub-processes, described in Table 2., which are conducted during intentional jamming.

Every sub-procedure is actually a sum of actions that is

Table 2. Sub-processes in case of jamming 4
Tablica 2. Podpostupak u slučaju ometanja 4

NAME OF SUBPROCESS	DESCRIPTION OF THE SUBPROCESS
Detection of jamming	After the start of jamming, the officer identifies the situation on the radar screen which is not in accordance with the expected one.
Identification of jamming	Considering the situation, he tries to diagnose jamming elements: type, area where it is originating from, intensity and severity of the impact on data
Normal continuation of navigation despite jamming	Unless impact on the data is dominant, navigation proceeds with increased caution.
Technical procedures to reduce the impact of amming	Undertake action that involves using and connecting system circuits to reduce the impact of jamming.
Tactical procedures to reduce the impact of jamming	Undertake action and procedures which imply the use of tactical procedures to reduce the impact of jamming (operating on other radar systems, use of data obtained from other electronic devices, rerouting the vessel and etc.)
Continue navigation after exiting the area affected by jamming	Continue navigation after the end of jamming.
Records	Make a record of the undertaken and executed activities and procedures.

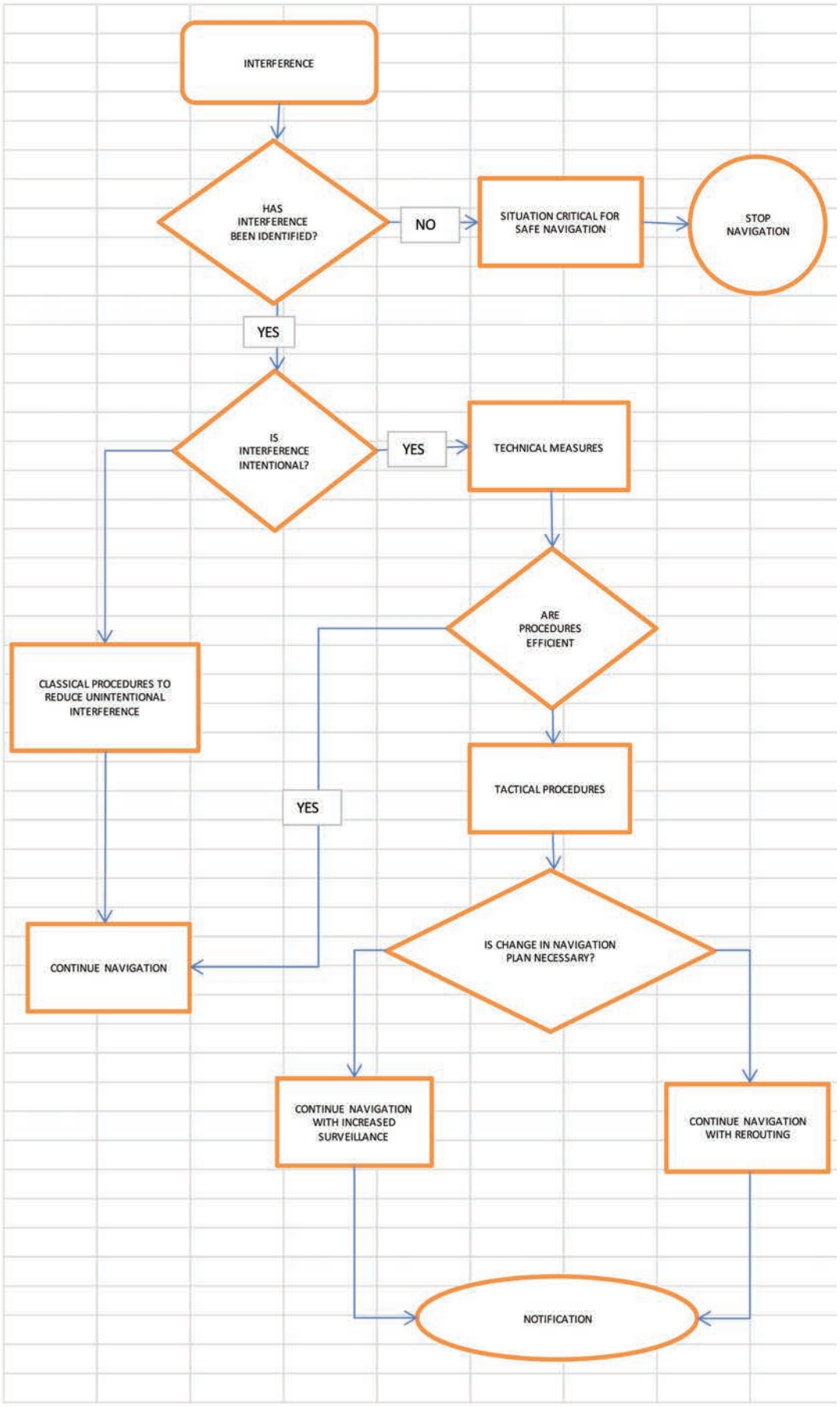


Figure 2. Decision tree – safe navigation 4
Slika 2. Stablo odluke - sigurna navigacija 4

directly carried out by the deck officer.

The decision tree for protecting safe navigation is shown in Figure 2.

The decision three shown in Figure 2. whose aim is to enable safe navigation, is the direct result of the knowledge gained and procedures suggested in the previous section of the study and represents an original contribution to safe navigation.

The decision tree is in the shape of an algorithm and offers the radar operator the possibility of deciding on "a decision path",depending on the type of jamming, threat assessment and activities necessary to undertake for safe navigation.

The choice of the decision path, depending on the information collected, is divided into two units:

a. when the assessed threat of intentional interference can be reduced to an acceptable level and is not critical for safe navigation (continuation of navigation with increased surveillance) and

b. when the assessed threat is unacceptable and critical for safe navigation (re-routing or stopping navigation).

The suggested and standard operative procedures shown enable effective protection of safe navigation in cases of intentional jamming with radar systems. They are to be elaborated in detail for each case: vessel, platform, monitoring station and etc.

Along with the defined actions and standard operative procedures, it is also necessary to conduct adequate deck officer training for confronting intentional jamming through the educational system at Maritime colleges. This type of training will be outlined in the following unit.

2. DECK OFFICER TRAINING TO COUNTER INTENTIONAL JAMMING */ Obuka palubnog časnika da se suoči s namjernim ometanjem*

Deck officer training to counter international jamming should be carried out through the education process and a suitable training. The curriculum and syllabus of such training should combine various explanations of the radar image.

Radar image is different from the natural panoramic image of the human eye for the following reasons:

- different wavelength of light and radar waves,
- reflections of individual objects are neither in size nor shape proportional to natural ones,
- depending on the direction and distance separation, close objects merge,
- existence of radar shadows,
- existence of false reflections and interferences,
- existence of blind sectors and etc.

2.1. IMPACT OF INTENTIONAL JAMMING ON THE RADAR SCREEN */ Utjecaj namjernog ometanja na radarskom zaslonu*

Due to the existing differences in radar images it is necessary to show the trainees, through simulator training, the various images on the radar screen when exposed to different interferences. Those impacts can be:

- Object distortion – it is reflected in relatively enlarged dimensions in relation to real ones. Directional object distortion is caused by horizontal beam width and is reflected in angular object enlargement. Longitudinal object distortion is caused by the impulse width while radar shadows represent dark places which appear due to the shape of obstacles, their position and the inability of EM waves to reflect against geometrically occluded areas.
- False and interfering reflections – these are the reflections whose position on the radar display does not correspond to the real one, giving erroneous (false) information on objects. The cause of this is mostly multiple reflections, reflections due to side lobes, reflections against parts of its ship, secondary reflections and etc.
- Intentional interference - detailed in the author's PhD thesis.

During the training process it is of pivotal importance to approach interpretation of the radar image in cold waters in high latitudes due to sub - refraction and possible icebergs whose smooth and bent surface can be detected from a relatively small range.

When studying these radar reflections it is necessary to point out the fact that they differ according to:

- size (related to gain)
- detection range,
- shape,
- fluctuation,
- acuity,
- mobility.

The main characteristics of the reflection based on the object features are:

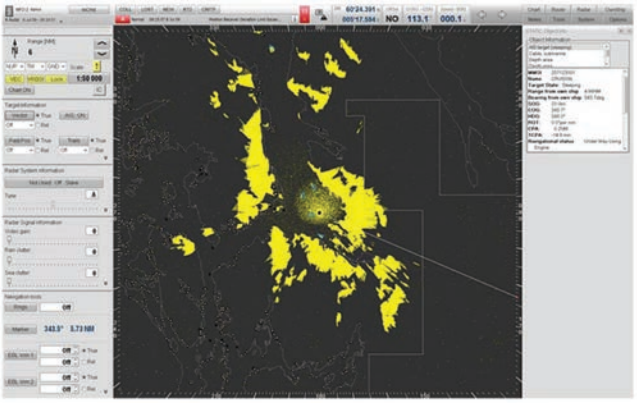
for ground objects:
- objects appear in expected positions, according to its location on the map,
- reflections do not have movements of their own,
- reciprocal positions of these reflections do not change,
- reflections are most often big and "dense"

for vessels:
- reflections are not expected according to the map,
- they have their own movements,
- they fluctuate, but do not disappear (they appear whenever a EM wave passes through)
- they are narrow (in relation to the radial line)
- they appear at a medium range (which depends on the size of the vessel, material and route),

for boats, buoys and other small objects:
- they appear at small ranges,
- their fluctuation is prominent, with disappearances in certain EM beam passages in wavy sea)
- reflections are stronger than individual reflection (dot) of interferences.

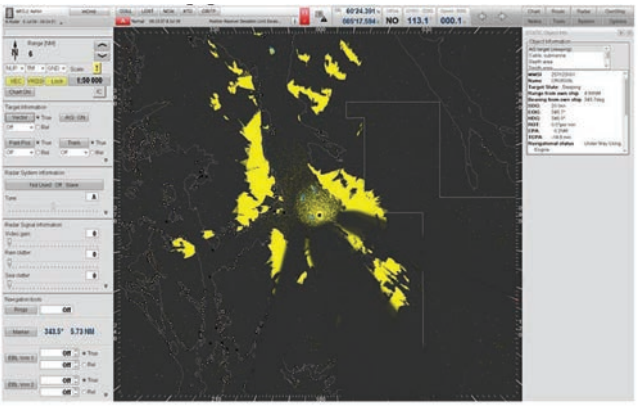
The visual aspect is extremely important in the learning process of beginners. It is therefore essential to use electronic methods to show radar images which can identify interferences.

In the following pages we will show what interferences look like on the Konsberg Maritime K-Bridge ARPA radar screen. (Figure 3. a,b,c,d)



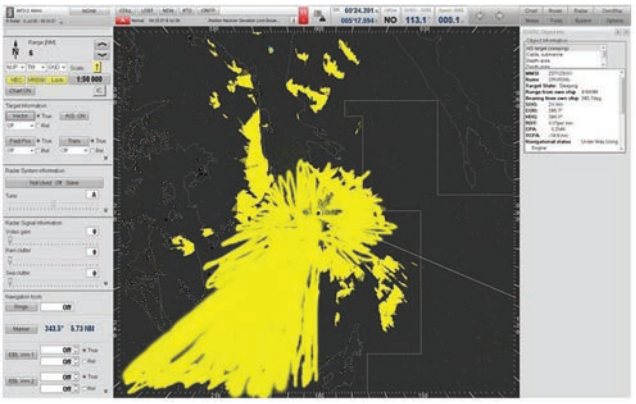
3. a. Radar display without the impact of intentional interferences 9

3. a. Radarski zaslon bez utjecaja namjernih interferencija 9



3. b. Radar receiver in saturation in the 160^0 sector 4

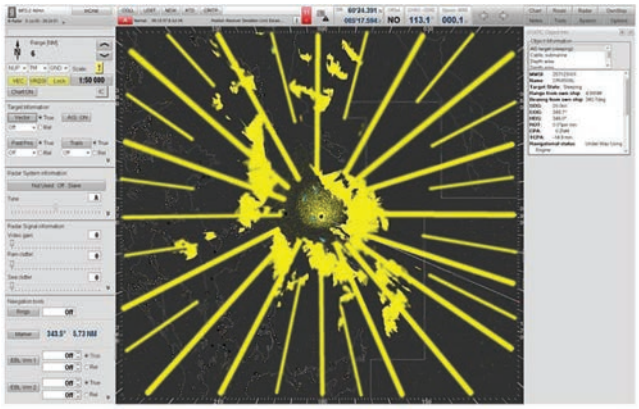
3. b. Radarski prijamnik u zasićenju kod 160^0 sektor 4



3. c. Noise generated for sector 210^0 4

3. c. Buka koja je proizvedena za sektor 210^0 4

Based on the ARPA radar features and possible errors in its correct functioning, seafearer training must emphasise that mistakes can also be triggered by intentional (selective) jamming using certain jamming modes. It is of pivotal importance to point out that there are two key areas in which intentional



3. d. Amplitude modulated interference 4

3. d. Interferencija 4 prilagođene amplitude

(selective) jamming can manifest iteself in ARPA radars:

a) while monitoring objects and danger assessment and

b) exchange of navigating vessels and imitating them by emitting false alarms, imitating channels and narrow passages and imitating search and rescue actions

Regarding the navigation safety, such jamming can often be applied in the presence of high speed vessels and in locations of dense traffic, when, for example, the radar operator fails to interpret the minimum bypassing distance and navigation time to the minimal bypassing distance correctly, i.e. leading to interruption of object monitoring because it has simply vanished from the screen because the echo of one of the navigating vessels was artificially increased in relation to the other so the computer continued to monitor the vessel with the stronger echo rather than the one with the higher priority.

Table 3 shows some of the jamming modes and their manifestations on the ARPA radar. The table unites error manifestations in ARPA radars and the effect such jamming can have on navigation safety.

In accordance with Table 3, the following will show dependency between radar ranges in relation to reflective surface of the target for the given detection coefficient. Table 3 shows dependency of the radar range on the radar reflective surface (σ).

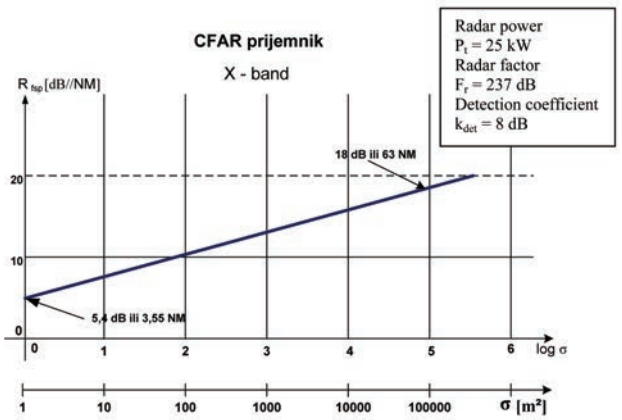


Figure 3. Diagram shows dependency of the radar range on the reflective surface of the target 4

Slika 3. Dijagram prikazuje ovisnost radarskog dometa na površinu koja reflektira cilja br. 4

Table 3. The effect and manifestation of jamming modes in ARPA radars 4

Tablica 3. Efekt i manifestacija načina ometanja kod ARPA radara 4

Jamming modes	Jamming effect	Manifestation on the ARPA radar
SPOT-NOISE JAMMING - bandwidth noise jamming	Inability to detect the aim (high noise density within the reciever bandwidth)	Reflection disappearance (island and objects) in the area where the jamming originated from
REPETITIVE REPEATER	Generating false objects	Appearance of objects on unexpected locations
PSEUDORANDOM SEQUENCING JAMMING	Inhibits object monitoring i.e. determining aim coordinates	Detecting objects with false coordinates, incorrect bypass course calculations
SCAN FREQUENCY JAMMING – generating gate speed error	Generating gate speed error (false Doppler aims)	Appearance of moving objects with false speeds
RGWO- Range Gate Walk-Off DELTA JAMMING AGC JAMMING - AGC(Automatic Gain Control)	Range time gate walk off from the aim Error in tracking the angle Error in tracking the angle Angle error	Detecting objects with false coordinates and speeds
BARAGE NOISE	Masking the expected reciever radar signal	Light fans on the radar screen that cover object and land refletions – inability to detect objects

Correspondingly, we are analyzing different object detection (detection targets) at sea and their possible masking in noise. Table 4 shows examples of parameters of civil radars used in navigation.

On the basis of Table 4, calculations are made for detection coefficients of known detection threshold (SNRmin, Signal-to-Noise Ratio at which reliable detection occurs) from 12, 5 dB for specific types of radars (A-E) and radar range in relation to specific types of navigating vessels (Table 5) representative by the size of radar reflective surface.

In accordance with the stated in Table 5, various diagrams for those types of radar have been made.

Figure 4 clearly shows how radar range increases with the increase of radar power i.e. the fishing vessel of the radar reflective surface 6 m2 is at the end of radar visibily whose power is Pt=2,2 kW. Also noticeable is that radars stronger than

Table 4. Typical examples of civil radar parameters for navigational purposes in X-range (Gallman P.) 11

Tablica 4. Tipični primjerci parametara civilnog radara za navigacione svrhe kod X-dometa (Gallman P.) 11

Example	A	B	C	D	E
R (NMi) - radar range	16	48	96	120	120
P_t (kW) - radar power	2.2	4	12	25	50
θ_H (°) – bandwidth horizontally	6.2	2.4	1.8	1.23	0.95
θ_V (°) – bandwidth vertically	25	27	25	20	20
G_t (dB) – antenna gain	21	25	26	29	30
F_n (dB) – noise factor	10	6	6	6	6
B_n (MHz) - width of the frequency noise band	7	3	3	3	3
F_r (dB) – radar factor	201	219	227	235	241

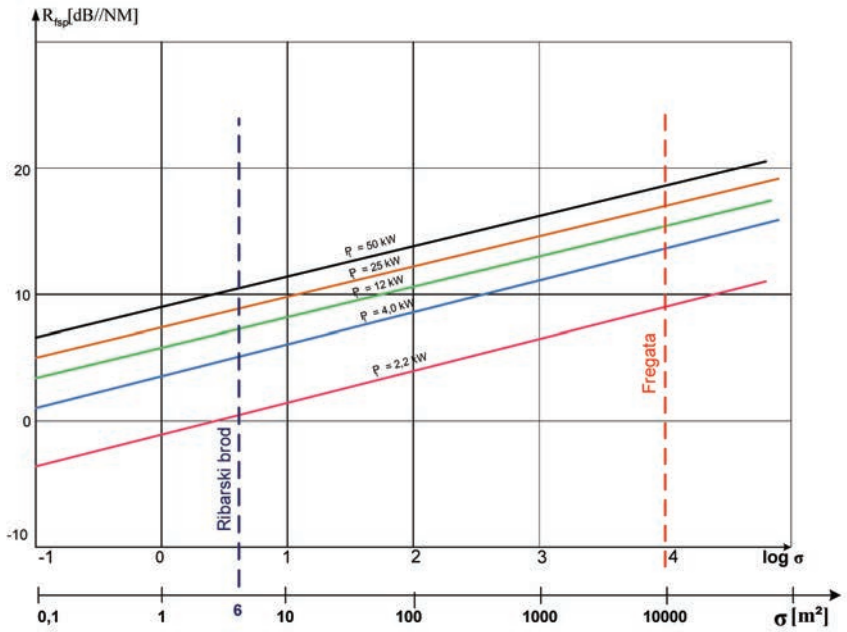


Figure 4. Diagram showing dependance of radar range on the reflective surface of the target for different radars 4

Slika 4. Dijagram koji pokazuje ovisnost radarskog dometa o površini cilja koji reflektira za različite radare 4

Table 5. Calculations of the detection coefficient and range for specific types of radar and navigating vessels 4

Tablica 5. Kalkulacije koeficijenta praćenja i dometa za specifične tipove radara i brodove koji plove 4

	P_t[5] (kW)=2,2	P_t (kW)=4	P_t(kW)=12	P_t (kW)=25	P_t (kW)=50
k_{det} (dB)	**-1.0**	**3.51**	**5.51**	**7.51**	**9.01**
R_{fsp}[6](NM) (Fishing vessel σ ~ 6m2)	1.2	4.62	8.22	11.22	13.45
R_{fsp} (NM) (Fishing vessel σ ~ 1000 m²)	4.46	17.41	30.97	41.68	50.58
R_{fsp} (NM) (Bulk carrier σ ~ 5.000 m²)	6.66	26.00	46.23	63.09	75.50
R_{fsp} (NM) (Warship σ ~ 50.000 m²)	11.85	46.23	82.22	112.20	134.28
R_{fsp} (NM) (Tanker σ ~ 1.000.000 m²)	25.00	97.94	174.18	237.68	284.44

Tablica 6. Syllabus of the necessary training

Tablica 6. Silabus potrebne obuke

	Title	
	ANALYSIS OF THE RADAR IMAGE	
Lectures organization	**Lectures**	
	10	10
Ensuring quality lecture performance	Report on lectures and exercises held	
Training content:	**Unit:**	
	The starting point of the training: STCW 78/95 Convention **Training components:** • Description of radar systems used on SOLAS vessels • Familiarization with the problem of electronic jamming with radar system and aspects of electornic countermeasures applicable on SOLAS vessels • Familiarization with tactical and technical procedures applicable during intentional jamming with the radar system • Assessment and risk analysis in cases of intentional jamming • Monitoring, surveillance and navigation in cases of intentional jamming • Documentation and files management • Reporting in cases of intentional jamming **Purpose:** • Familiarize students with the process and methodology of procedures in cases of intentional jamming. **Competencies and understanding:** • Understanding and identifying intentional radar jamming • Navigational training during intentional jamming **Knowledge and skills:** • Identifying intentional radar jamming • Quality equipment for executing work assignments **Types of training:** • lectures • work on the simulator	
Student responsabilites	Regular attendance at lectures, practical training and exercises on the navigation simulator	

Outcomes	• Explain and apply the knowledge on radar system of SOLAS vessels • Explain and define the impact of intentional jamming to safe navigation • Explain and use the knowledge of intentional electronic jamming • Explain and use technical procedures to protect against jamming • Explain and use tactical procedures to protect against jamming • Explain and apply ways of reporting in cases of jamming • Apply the acquired knowledge to maintaining safe navigation under intentional jamming

Evaluation of the acquired knowledge and skills	
NOTE: The final grade will be based on the success achieved in all marking elements listed. All elements have to be marked with a passing grade.	
Marking elements	**Points**
Activites at lectures	10
Practical work on the simulator	50
	40
Total	**100**
Student obligations	**Attendance (in percentages)**
	Regular students
	50%
	80%
	Forms for recording student attendance
	The professor's signature
	Obligatory for the professor's signature : 1. achieving a sufficient percentage of attendance at exercises, 2. achieving a sufficient percentage of attendance at lectures.

2,2 KW will detect the target of the stated reflective size.

However, if, with such conditions, we generate jamming whose manifestations on the ARPA radar are defined in Table 3. it is obvious that this will inevitably further threaten range, visibility, and accuracy of recieved data directly linked to the type of jamming, sector where it originated from and the jammer power. Experience (of the author while working with operative radar jammers) has proven that the increase of radar power (by increasing radar range) in cases of jammer- responder (jammer analyses and responds to every inward impuls) only achieves the opposite effect i.e. radar reciever is jammed by a stroner jamming signal.

Correspondingly, the following part recommends a training syllabus for deck officers in cases of intentional jamming for the purposes of taking necessary actions in cases of intentional radar jamming.

2.2. SYLLABUS OF THE NECESSARY TRAINING / *Silabus potrebne obuke*

Table 3. shows the outline of the curriculum and syllabus of a sailor in charge of the watch on the ship bridge.

The syllabus is the result of years of work and research conducted in the area of radar jamming, lectures of radar system operators in cases of intentional jamming as well as lectures held at Maritime colleges. Research has practically shown that radar system operators have numerous times failed to recognize radar jamming and have accordingly not been able to take necessary measures.

The number of lectures and exercises can vary depending on the type of simulator and radar device used for the training. If necessary, it is suggested to make the adjustment for the training group in question.

CONCLUSION / *Zaključak*

The results of this study are directy applicable in everyday marine practice. They can directy affect an increased safe navigation because the very application of these results reduces the danger of intentional jamming.

This can be achieved through:

- knowing the models and the corresponding procedures as described in Chapter 1.,
- identifying jamming, as detailed in Chapter 2.1. i.e.
- an appropriate deck officer training in countering intentional jamming, as described in Chapter 2.2.

Worth noting is the contribution to a broader scientific knowledge of the impact of intentional jamming to safe navigation. as a result of years of work on the issue of radar system jamming in a series of articles dealing with radar system jamming 2, 4, 10, 12, 13, 14.

All of the stated has special significance in educating and training marine officers, deck officers, especially in thematic units relating to accuracy and reliability of the radar system

exposed, in this case, to intentional jamming. Insufficient research of the impact of intentional jamming on the correct performance of the radar can endanger safe navigation. As mentioned previously, intentional jamming and research into radar system jamming has mainly been conducted in the military structure domain which has made research results unavailable to the broader scientific study and consequently caused insufficient training of deck officers on SOLAS vessels..

It is therefore suggested to continue with permanent research and training in identifying radar limitations in real usage conditions when the radar is exposed to various types of jamming. Also suggested is to keep up to date with the development of radars used on vessels and of systems for intentional jamming and changing and adjusting of the necessary educating and training.

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Regional Public Transportation Services Modelling

Model usluga regionalnog javnog transporta

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Summary

This paper has discussed the issue of public transportation services. These services are essential part of social welfare and their providing is accepted in all developed economics without any doubts. The discussion pops up once their extent is doubted. The aim of this paper is to introduce the model describing the extent of public transport services as the support needed for the decision about the structure and extent of public transport services. There hasn't ben such a general model described yet. The idea of general model describing the public transport services that could be used as the comparation base for comparing chosen regions hasn't been realized yet due to the regional differences in characteristics of certain villages, regions and their public transport services. The output of the analysis is the advanced model constituted of multidimensional linear regression function that serves to describe the public transport services in chosen regions.

KEY WORDS

regional public transport services
public transport services model
regression analysis

Sažetak

Ovaj članak razmatra pitanje usluga javnog prijevoza. Te su usluge bitan dio društvene dobrobiti i njihovo je osiguravanje prihvaćeno u svim razvijenim ekonomijama bez ikakve sumnje. Diskusija se nastavlja kada je u pitanju opseg. Cilj je ovog rada uvesti model koji će opisati opseg usluga javnog transporta kao podršku potrebnu za odluke i strukture i razmjera usluga javnog prijevoza. Takav općeniti model još nije bio opisan. Ideja generalnog modela kojim se opisuju usluge javnog transporta koji bi se mogao upotrijebiti kao usporedna baza za poredbu odabranih regija, još nije ostvarena zbog regionalnih različitosti i karakteristika određenih sela, regija i njihovih usluga javnog prijevoza. Ishod je analize napredni model koji se sastoji od multidimenzionalne linearne funkcije regresije i služi da bi se opisale usluge javnog prijevoza u odabranim regijama.

KLJUČNE RIJEČI

regionalne usluge javnog prijevoza
model usluga javnog prijevoza
analiza regresije

INTRODUCTION / *Uvod*

The public transport services are organized in every region of the European Union and all the competent authorities are subsidizing the operation of transport connections to fulfill the transport needs of their inhabitants. Although the system directly influences the life conditions in the region and in the same moment it is significant cost of the regional government, there is no general model describing the extent of public transport services, which could be used as a benchmarking tool.

The issue of public transport services in the Czech Republic is legally defined in the Act No. 194/2010 Coll., on passenger public transport services and on amendment to some acts. This Act defines the public transportation services as essential part of the regional harmonious development as the part of sustainability and specifies the extent of public transport services that shall provide transportation in all weekdays primarily to schools and education institutions, to the public authority bodies, to the employment places, to health care institutions providing primary health care and to satisfy cultural, recreational and social needs, including transport back.

The pioneer work in the issue of regional public transport in the Czech Republic is the study introduced by Bulíček and Mojžíš. "The mathematical expression of this relation (in the form of functions) is able to be reached in the way of multiple linear regression based on results of the survey." (Bulíček, Mojžíš 2009). This idea of multiple linear regression model is adopted into the presented model. The model is designed to evaluate the sufficiency or insufficiency of public transport in certain region and to enable the comparison among regions. The presented model identifies the key elements determining the public transport services in Czech regions.

The question of the sustainability is widely discussed especially in the last decade, the transport problems connected with unlimited increasing of car ownership and the needed infrastructure are more relevant lately. "Transport authorities,

especially those in developing countries where rising income stimulate increased car ownership rates, are often concerned with maintaining or increasing levels of public transport use. Therefore, the ability to identify clients at risk of abandoning the system can be valuable for remedial measures, allowing for more focused quality improvements." The travelers are very sensitive to any kind of change in public transport, the careful preparation respecting all the needs of the travelers is needed. The model discussed in this paper could be accepted as a benchmarking tool to find out the harmonious equilibrium. The remedy of previous nonsensitive changes can last long time. All the problematic is described in Bass, Donoso, Munizaga (2011).

The evaluation process that would measure the quality of public transport services is complicated as the other ones when involving interactions among soft factors. These factors are set of social, political, demographical and economic variables. "Operational extent of regional public passenger transport is depended on character of solved region, especially on the number of inhabitants. Number of passengers is also able to be influenced by some other socio-economic characteristics like structure of industry, unemployment rate or average income of inhabitants in the region." (Bulíček, Mojžíš 2009).

This paper is focused on the problematic of public transport services from the social point of view, the aspect of fulfilling transport needs on sufficient basis is respected when creating the model. The other analysis of transport services don't usually discuss the problem from this point of view, the usual ones are the technological, mathematical, for example fuzzy mathematic applications introduced by Ralević, Gladović, Pamučar, Dobrodolac, Đorović (2012) or a model of moving collectives interaction by Regirer, Smirnov, Chenchik (2007). The combination of technological-mathematical issue usually leads to the vehicle routing problem, the routing problem applied on the region is discussed in Pacheco, Caballero, Laguna, Molina (2013), the literature review in area of this tasks is done by Drexl (2012). The other point of view is economical one, this one is closer to the discussed model and it is on the opposite side, the cost reducing very often is the criteria function. Nice overview of economic aspects is done by Ljungberg (2010). The social issue isn't discussed deeply enough and the question of sufficiency of certain level of public transport services isn't solved.

The issue of social aspect in public transport comes more into the focus when discussing the urban public transport, but the need of deeper involvement of these factors is generally accepted. "There is still room for improvement in aspects of spatial coverage and for a greater focus on the factors which explain the social need for transport which are not usually considered within planning." (Jaramillo, Lizárraga, Grindlay 2012). The sustainability of public transport services must include the social sustainability too. "Public transport and government agencies must balance the sometimes competing objectives of economic and social sustainability. In general, more frequent, higher quality, and financially efficient public transport also helps achieve social sustainability. However, in some circumstances financial efficiency and social equity might not be fully compatible." (Buehler, Pucher 2011).

THE MODEL / *Model*

The idea of the model is based on the presumption that the number of public transport connections serving certain unit

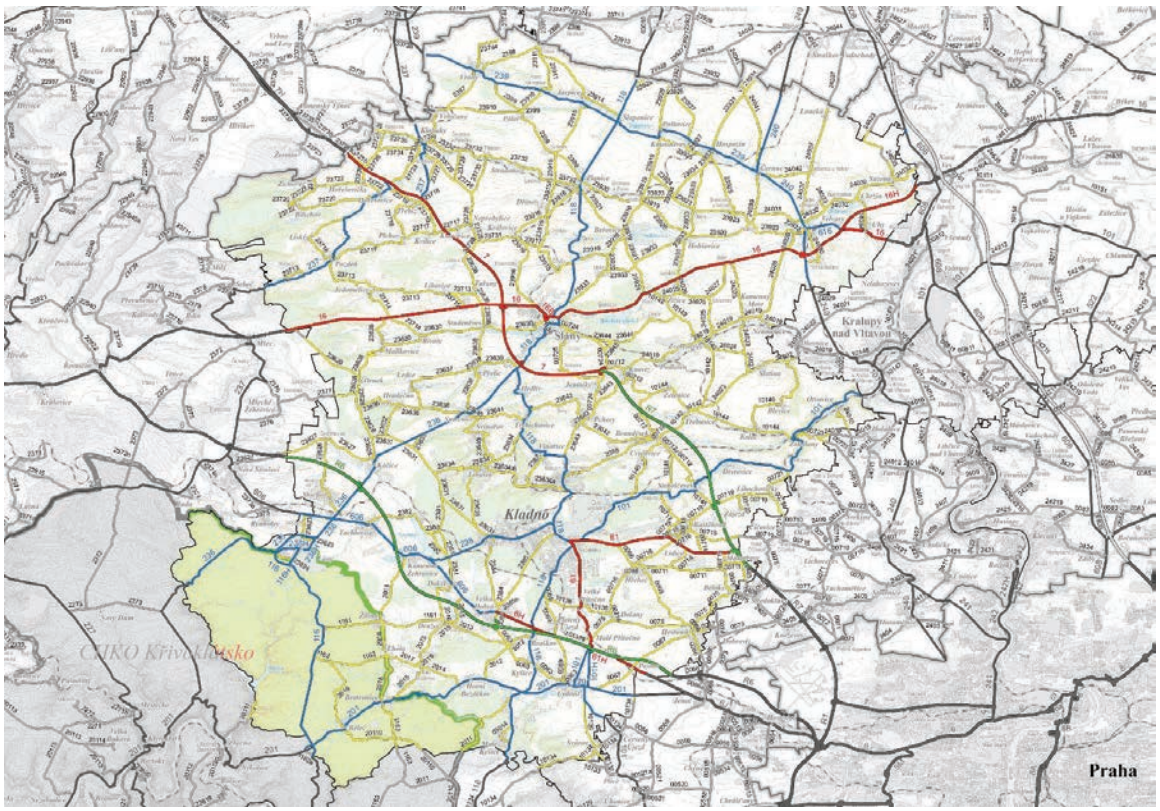

Figure 1 Kladno region (area of the region colored)
Slika 1. Karta oblasti Kladnog (područje u boji)

Source: Road and Motorway Directorate of the Czech Republic (2014) http://www.rsd.cz/sdb_intranet/sdb/img/kraje/st.png

Table 1. Critical values of parameters b_0 to b_{12} for t-test
Tablica 1 Kritične vrijednosti parametara b_0 do b_{12} za t-testiranje

Parameter / **Parametar**	**Shortened description of the variable with its assigned parameter** / **Skraćeni opis varijable sa njenim pripadajućim parametrom**	**Critical value** / **Kritična vrijednost**
b_0	Absolute parameter of the regression model	8,633
b_1	x_1 – population	17,364
b_2	x_2 – distance to a municipality with an extended authority	2,212
b_3	x_3 – sum of distances to Kladno and Slaný	- 4,978
b_4	x_4 – amount of units with population of 4 000 within 5 km distance	3,549
b_5	x_5 – amount of units with population of 2 000 within 5 km distance	3,117
b_6	x_6 – station or stop on a nationwide or a regional railway line	5,540
b_7	x_7 – primary school	2,437
b_8	x_8 – road with intensity over 10 000 vehicles / day	5,742
b_9	x_9 – road with intensity over 5 000 vehicles / day	2,669
b_{10}	x_{10} – intersection of frequented roads	9,045
b_{11}	x_{11} – exit from a motorway or an expressway	4,601
b_{12}	x_{12} – radial road from Prague to a district city	12,668

Source: author

during weekdays can be used as the mark of level of public transportation services. Every unit represents residential units (villages, independent parts of villages) according to the parcelling of the Czech Statistical Office. The statistical methods are used for calibrating and validating of the model. The calibration is proceeded on real data from the district of Kladno in Středočeský region. The model consists of a multiple linear regression function generally describable as:

$$y=b_0+b_j \cdot x_j$$
$$\text{for } j=1,2,\ldots 12.$$

Multiple linear regression function with one dependent variable y and 12 independent variables x_1 to x_{12} is the base of the model. The independent variables x_1 to x_{12} represent particular factors where a statistically significant influence was proven on the amount of transport service connections in the observed units on a weekday.

The dependent variable y is an estimation of above described regression function. The estimation is counted for the amount of all public transport service connections in all stops and stations in certain unit's area during a weekday (typical weekday without the holiday restrictions). The traffic mode isn't important for the estimation, all the public transport connections (buses as well as train connections) have the same value. The quality of the estimation is compared to the real situation in Kladno district; data of the amount of bus connections and trains were obtained from valid timetables on 31st October 2013[1].

[1] The exception is the unit of Čabárna, particularly road III/2388, since the closure of its part in a section of Velvarská street in Kladno-Hnidousy due to sewerage construction and the unit of Netřeby, particularly street III/00716 that is closed for bus transport in a section between Netřeby and Dolany due to a damage by floods in June 2013. In these sections, timetables valid before the restrictions were used.

The coefficients b_0 to b_{12} are bounded with certain independent variable x_1 to x_{12} and their value is the outcome of the model. The coefficient b_0 symbolises the basic amount of public transport connections for imaginary unit when all the other variables are equalled to zero.

The independent variable x_1 is given by the populations of certain unit. Czech Statistical Office's Statistical lexicon of municipalities 2013 issued by 31st October 2013 is used to get the exact number of inhabitants in every unit.

Next variables x_2 to x_5 are based on the geographic location of the unit in relation to other units in the region. The presumption says that closer location to the regional centre brings stronger connection to that centre. Distances of the observed unit and two centres of the region (two largest units and the only municipalities with extended authority in this region), Kladno and Slaný, determine the independent variables x_2 and x_3. The hypothesis of stronger connection on the routes between the largest municipalities of the region than between comparable cities on interregional basis sets the variable x_3 as the sum of distances to Kladno and Slaný from observed unit. Another assumption says that more public transport connections are provided in densely inhabited areas, so the information about the density of population surrounding the observed unit is added in next variables. Variable x_4 determines the number of units with population of 2 000 to 3 999 (Buštěhrad, Libušín, Tuchlovice, Unhošť, Velvary, Vinařice) in the distance to 5 km. Variable x_5 determines the number of units with population of 4 000 and more (Nové Strašecí, Stochov and Kralupy nad Vltavou in Mělník district, too) in the same distance.

The precondition that rail transport results in a higher level of public transport services includes the artificial variable x_6. This variable equals 1 if there was a railway station or a stop on a nationwide or a regional railway line in the unit's area that serves

to a regular passenger transport[2]. If there was not, then $x_6 = 0$.

Similar precondition is applied on artificial variable x_7. This variable deals with the existence of primary school in the unit's area. The value of the variable reaches 1 if there was primary school in that area. The value equals zero in other case. The idea is based on the hypothesis that the children from other units have to travel with public transport to the school located in the unit's area.

Block of variables x_8 to x_{11} follows. The existing road network in the region determines the values of these variables in the same way like the existence of the station or stop on the railway line in the unit's area. The most important factors are the frequented roads and the intersections of frequented roads. Artificial variables x_8 and x_9 are focused on trafic intensity on roads going through the unit. These variables equal 1 in case that there is a road with traffic intensity higher than 10 000 vehicles / 24 hours, or with traffic intensity from 5 000 to 9 999 vehicles / 24 hours, respectively. Artificial variables x_{10} and x_{11} are focused on important road intersections. Variable x_{10} equals 1, if there was an intersection of two roads in the unit or in its immediate proximity and the traffic intensity on the less frequented road exceeded 2 000 vehicles / 24 hours and it was not a motorway or an expressway. Variable x_{11} equals 1 if there was an exit from a motorway or an expressway in the unit's area or in its immediate proximity. In case a motorway exit is situated in an area between units, it is added to the closer one.

The specification of the region is represented by the artificial variable x_{12} The region Středočeský surrounds the capital city of Prague and Prague is also the real regional centre despite its location outside the region. All transport to Prague goes through the region and these connections go also through the area of district of Kladno. The variable equals 1 for units situated on a main road from a city in region Středočeský with population exceeding 15 000 to Prague. In case of Kladno district, the affected cities are Kladno and Slaný, and furthermore the city of Rakovník (in its own district of Rakovník), out of which a road to Prague is placed through the area of Kladno district.

After a software calculation was made, based on data for 162 units that create the area of Kladno district, following regression function was determined:

$$y=44{,}422\,019+0{,}021\,741\cdot x\_1+1{,}415\,214\cdot x\_2-1{,}485\,283\cdot x\_3+16{,}375\,680\cdot x\_4+7{,}531\,673\cdot x\_5+20{,}473\,253\cdot x\_6+8{,}219\,191\cdot x\_7+30{,}650\,374\cdot x\_8+12{,}125\,150\cdot x\_9+63{,}128\,034\cdot x\_10+25{,}928\,550\cdot x\_11+75{,}469\,785\cdot x\_12$$

where:

y - estimate of the amount of connections creating the transport service in the observed unit on a working day [-],

x_1 - population of the unit [-],

x_2 - distance to a municipality with an extended authority the unit belong to [km],

x_3 - sum of distances to the two largest municipalities in the region [km],

x_4 - amount of units with population of more than 4 000 in distance up to 5 km from a unit except for units observed in factor x_3 [-],

x_5 - amount of units with population of more than 2 000 and less than 4 000 in distance up to 5 km from the unit [-],

x_6 - artificial variable representing the existence of a railway station or a stop on a railway line with regular service [-],

x_7 - artificial variable representing the existence of at least one primary school in the unit [-],

x_8 - artificial variable representing the existence of a road with intensity exceeding 10 000 vehicles / 24 hours going through the unit [-],

x_9 - artificial variable representing the existence of a road with intensity from 5 000 to 9 999 vehicles / 24 hours going through the unit [-],

x_{10} - artificial variable representing the existence of an intersection of main roads in the unit [-],

x_{11} - artificial variable representing the existence of a motorway exit or an expressway exit in the area of the unit [-],

x_{12} - artificial variable representing the location of the unit on a radial road heading out of Prague serving as a connection of a city with population exceeding 15 000 and Prague [-].

Confidence of the model appears to be sufficient; regression function describes the reality very well; confidence value R^2 equals 94,628 %.

Several factors, that were supposed to have a significant influence on the amount of public transport connections provided in the observed municipality, were put under the test. The original set included more variables, but only 12 of them proved their statistically important influence on the transport service level.

At all of the parameters of the final regression function, it is reached such t-test criterion values that in the confidence level of 95 %, their influence on y variable is proven. Critical value of student distribution for 95% level of confidence and number of observation higher than 120 is $t_{0,975;>120} = 1{,}96$. Parameters b_0 to b_{12} equal the values of the t-test testing criterion presented in the table No. 1.

The confidence of the model is proven by the Fishers complete F-test, too. The critical value gained from the Fisher distribution tables for the 95% level of confidence is as following: $F_{0,95\,(12;>120)} = 2{,}185$. Testing criterion equals 218,702 902.

Parameter values of artificial variables clearly show that the level of transport service of a unit is higher if they are located in more densely populated area near to larger municipalities. Even more important is their location in relation to the transport infrastructure, place at a frequented road or intersection results in an important increase of amount of connections serving in the unit. Equally, the location at a railway station or a stop results in an increase of 20 connections on a working day in comparison to similar municipalities without location at a railway line.

The highest parameter values are at variable x_{12}. Connections to the capital city of Prague are in the observed district very intense and the location of a municipality on a way from an important centre to Prague results in an increase of 75 connections on a working day.

Factors resulting out of distribution of transport infrastructure can have a higher influence on the final transport service than factors resulting out of transport service definition

[2] Railway lines 095 and 121 are not regarded as railway lines with regular passenger service in the area of Kladno district. Operation on the line 095 in section Zlonice – Straškov is muted on a long term basis and its near cease is expected; nowadays, there are only 2 pairs of trains in operation during the working days. Railway line 121 serves for Cyclotrain „Cyklohráček" operation in range of 2 pairs of trains on Saturdays, Sundays and national holidays from the end of March to the end of October.

Table 2. Model applications for 40 chosen units
Tabela 2 Primjena modela za 40 odabranih jedinica

The name of the unit Naziv jedinice	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	y	***Real amount of connections Stvarni iznos veza***
Bakov	00 104	5	23	0	0	0	0	0	0	0	0	0	019,632	026
Blahotice	23	3	18	0	0	0	0	0	1	0	0	0	34,565	21
Budihostice	118	15	39	0	1	0	0	0	0	0	0	0	17,821	3
Buštěhrad	02 863	7	21	0	0	0	1	1	0	0	0	1	199,743	175
Byseň	50	4	20	0	0	0	0	0	0	0	0	0	21,443	24
Čabárna	43	5	17	0	1	0	0	0	0	0	0	0	34,701	27
Čeradice	64	11	33	0	0	0	0	0	0	0	0	0	12,366	17
Drnov	88	6	19	0	0	0	0	0	0	0	0	0	26,627	15
Horní Kamenice	46	13	38	0	0	0	0	0	0	0	0	0	7,379	19
Hospozín	00 503	12	35	0	0	0	0	0	0	0	0	0	020,355	027
Hospozínek	34	16	29	0	0	0	0	0	0	0	0	0	24,731	0
Kačice	01 244	11	23	1	1	1	1	0	1	0	0	0	117,599	109
Kamenné Žehrovice	01 729	7	24	0	1	1	1	0	1	1	0	1	243,212	232
Kokovice	112	14	39	0	0	0	0	0	0	0	0	0	8,744	9
Kováry	104	13	29	0	0	0	0	0	0	0	0	0	22,008	26
Křovice	66	9	30	0	0	0	0	0	0	0	0	0	14,035	6
Kutrovice	106	8	27	0	0	0	0	1	0	0	0	0	48,596	52
Kvílice	80	9	29	0	0	0	1	0	0	0	0	0	24,030	27
Lány	01 765	13	30	1	1	0	1	0	0	0	0	0	088,761	088
Libochovičky	58	11	26	0	1	0	0	0	0	0	0	0	30,165	32
Libušín-u dolu	70	7	18	0	1	0	0	0	1	0	0	0	48,765	69
Lísky	85	14	38	0	0	0	0	0	0	0	0	0	9,642	10
Lisovice	83	8	29	0	0	0	0	0	0	0	0	0	14,468	9
Lotouš	46	6	23	0	0	0	0	1	0	0	0	0	50,416	37
Luníkov	57	7	24	0	0	0	0	0	1	0	0	0	32,081	21
Makotřasy	00 373	9	25	0	1	0	0	1	0	0	1	1	167,752	167
Nabdín	78	11	33	0	1	0	0	0	0	0	0	0	20,203	15
Netovice	39	3	14	0	0	0	0	0	0	0	0	0	28,701	12
Netřeby	38	5	23	0	1	0	0	0	0	0	0	0	25,680	14
Nová Studnice	92	12	24	0	0	0	0	0	0	0	0	0	27,758	21
Nové Uhy	89	15	38	0	1	0	0	0	0	0	0	0	18,676	13
Osluchov	74	8	24	0	0	0	0	0	0	0	0	0	21,706	17
Otruby	90	3	19	0	0	0	0	0	0	0	0	0	22,432	9
Otvovice	00 793	17	34	1	0	1	1	0	0	0	0	0	080,290	030
Skůry	87	9	29	0	0	0	0	0	0	0	0	0	15,977	20
Slaný[4]	13 986	0	13	0	0	1	1	0	1	1	0	1	508,600	511
Stradonice	119	10	33	0	0	0	0	0	0	0	0	0	12,168	9
Tmáň	100	8	29	0	0	0	0	0	0	0	0	0	14,859	18
Vítov	77	5	21	0	0	0	0	0	1	0	0	0	34,113	21
Želevčice	115	4	21	0	0	0	0	0	0	0	0	0	21,399	43

Source: author

by law. Many municipalities can exploit their advantageous location in relation to transport infrastructure that ensures a lot higher transport service level for them than what they would have reached if there would only had applied the transport service by the definition of law.

The model confidently predicts the amount of transport service connections in the evaluated unit after the input of

[3] The unit of Slaný is understood as the sum of the amounts of inhabitants in two city parts of Slaný – the main part Slaný (Czech Statistical Office code 40207 9) and the city part of Kvíček (Czech Statistical Office code 30416 5).

necessary variables, determines the amount of transport service connections for 139 out of 162 evaluated units with deviation ± 20 connections, for 97 out of them with deviation ± 10 connections. I show the demonstration of use of the model for randomly selected 40 units in the table no. 2.

The model works for the above mentioned units with different rate of reliability, for most of them it works very reliable. The biggest difference between the real situation and the situation predicted in the model in the whole set of analysed units appears in the information to the unit of Otvovice, which is also described in the Table no. 2. This unit is located on the eastern border of the district of Kladno. Otvovice is served only by the railway transport on the regional line no. 093 that provides the connection between Kladno and Kralupy nad Vltavou[4]. Although the amount of inhabitants in Otvovice reaches almost 800 and the village is located less than 5 kilometres from Kralupy nad Vltavou with the population of 18.472 inhabitant, the village is served only by 30 trains per weekday. The model expects about 80 public transport connections for this kind of village. The assumption for so significant difference is the location of the unit on the edge of the district of Kladno, the northern-east end of the unit forms the border with the district of Mělník. Another reason is the strong link to the mentioned city of Kralupy nad Vltavou, which is local centre of that area. The cross border interregional transport is unfortunately common problem. Otvovice is located in the valley of Zákolanský stream, this valley creates the natural corridor for the railroad no. 093 as well as for the road no. II/101. The only other road in the unit is the road no. III/24010 which ended in Otvovice by the main road no. II/101, this road leads outside the district of Kladno in the direction to Holubice (the district of Prague-West). There is no other road connection to the area of district of Kladno because of the rugged terrain. The variable representing the location of the unit on the edge of the district as well as the one representing geographically rugged terrains were put into the original set of variables. The t-testing of statistical influence on *y* variable hasn't been proven.

CONCLUSION / *Zaključak*

The paper has presented the creation of public transportation services model calibrated for the district of Kladno. Although only the first use of that model has been presented in the paper, the model describes the real situation with statistically significant reliability. The differences have been given by the imperfection of the model as well as by the soft factors related to the decisions about the extent of the public transportation services. The model with 100% of reliability is purely hypothetic possibility. The differences are the discussion topics for the future and they may lead to the optimization of the public transport services in the described district of Kladno. Every difference should be analyzed individually and the higher ones have to be discussed with the competent authorities and the explanation which can lead to the development of the model or the remedy of the public transport system should be done.

The next development of the model is possible in précising to describe the real situation more reliable, the proper information about the population density or including of walking distance that shall be the next steps. The model is only descriptive in the present-time form, but next development, calibration and validation could lead to its use as the normative model. The including of economic factors on the level of certain regions can lead to the development of effective tool for benchmarking of public transport services in different regions.

[4]The bus services were stopped on 1st July 2005 when the operation on bus line no. 220006 Kladno – Zákolany – Kralupy nad Vltavou was stopped.

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