IMPROVING THE QUALITY OF INLAND CREW, SHIPS AND INLAND WATERWAYS

***Pero Vidan*[1], *Josip Kasum*[2] & *Frane Mitrović*[3]**

UDC / UDK: 351.813.23:331.46
JEL classification / JEL klasifikacija: L91
Review / Pregledni rad
Received / Primljeno: February 9, 2011 / 09. veljače 2011.
Accepted for publishing /Prihvaćeno za tisak: May 29, 2012 / 29. svibnja 2012.

Summary

Quality level of inland waterway crew and inland waterways is closely related to traffic safety on these waterways. High quality inland crew, ships and inland waterways are important factors of safety and of minimizing losses. Damage to water transport occurs as a result of collisions, spills of oily water and low levels of protection at work. According to the statistics of the American Waterway Organization (AWO), most damage during voyage on inland waterways is caused by human error. The author analyzes the occurrence of accidents on inland waterways and their possible causes. In order to reduce the damage and the number of accidents, measures have been proposed in order to reduce the possibility of occurrence of human error by implementing safety management systems and increasing the quality of crews.

***Key words**: inland waterways, loss, safety, quality, crew.*

1. INTRODUCTION

Inland waterways are all navigable waterways on rivers, lakes and canals which are arranged, marked and opened for safe navigation [5].

An increased level of safety of navigation in inland waterways worldwide is achieved among other things through both international agreements and conven-

[1] Pero Vidan, Ph.D., University of Split, Faculty of Maritime Studies, Split, E-mail: pvidan@pfst.hr
[2] Josip Kasum, Ph.D., University of Split, Faculty of Maritime Studies, Split, E-mail: jkasum@pfst.hr
[3] Frane Mitrović, Ph.D., University of Split, Professor, Faculty of Maritime Studies, Split, E-mail: frane.mitrovic@pfst.hr

tions. The result of such agreements worldwide is the improvement of existing infrastructure and superstructure, development of new waterways, introduction of new regulations on safety of navigation and environmental protection, implementation of existing regulations, standards and customs, survey etc.

Inland waterway traffic records an ever increasing traffic density. Consequently, new channels are being built and new solutions are being found in order to enlarge inland waterways, etc. The development plan of inland waterways in Europe has been summarized in the Programme for inland waterways (*Navigation and Inland Waterway Action and Development in Europe - NAIADES*) [4].

The technology of water traffic is considered not to be developing in a satisfactory manner, when compared to the increase in traffic. The advantage of water traffic in relation to other branches of transport becomes apparent when observing the following facts:

- Transport cost are relatively low
- Pollution is relatively low, and
- Navigation is safe.

The interests of inland waterway crew are not appropriately valued. Working hours and tasks related to various professions are determined by the rules and regulations and agreements of *the International Labour Organization (ILO)* signed by *the International Transport Workers' Federation (ITF).*

An international agreement on the education of inland waterway crew does not exist. In most cases it depends on national legislation. In this sense, such regulations refer to the rules and regulations laid down in the STCW Convention. However, according to the statistics of the American Waterway Organization (AWO) [9], most damage during voyage on inland waterways is caused by human error.

2. DANGERS AND DAMAGES IN NAVIGATION ON INLAND WATERWAYS

The quality of inland waterway crew and waterways is closely connected to traffic safety on those waterways. The quality coefficient of crew, vessel and waterways (KV) can be expressed as a factor defined by the ratio of the number of damage occurrences (N_{st}) and the ship's and navigation safety (S_{bp}) (1):

$$KV = \frac{S_{bp}}{N_{st}} \quad (1).$$

Dangers are accidents which can cause the loss of human life and partial or total loss of objects. The level of danger is evaluated on the basis of damage statistics in individual areas.

Damages are usually expressed as loss of human lives, number of injuries, quantity or value of damaged or lost cargo or vessel or similar objects [19].

Ship's safety in navigation can be expressed as a function (2):

$$S_{bp} = f\left(b, pp, \rho_p, ost\right) \quad (2),$$

Where:

b - ship and cargo safety,

pp - waterways safety,

ρ_p- traffic density,

ost – other factors.

According to function (2) it is obvious that the quality of inland navigation is considered good if the following hypotheses are satisfied:

- Waterways through which the vessel navigates have a satisfactory level of safety;
- Both the ship and crew have a satisfactory level of safety;
- Cargos are considered not dangerous for transport;
- Other factors are considered favourable.

The safety of waterways is considered satisfactory if they are regularly maintained, if they possess accurate necessary signs, if they possess the means to facilitate navigation such as, for example, River Information System - RIS, Vessel Tracing System - VTS, Electronic Charts Display Information System - ECDIS, Automatic Information System – AIS etc. Apart from the abovementioned factors, the accident statistics done for waterways with satisfactory level of safety and observed through a longer time period should provide data on accidents that occur rarely.

The level of vessel and crew safety is considered satisfactory if all international safety regulations concerning construction, maintenance, classification, equipment, crew, quality systems and others are met. Safety regulations are prescribed in legislation and by international organizations and are ratified by member countries. They are prescribed by conventions of which the most important are: *Safety of Life at Sea* - SOLAS, *Standards of Training, Certification and Watch keeping* - STCW and others [9]. They may be supplemented by special requirements of a ship's register, internal shipowner's regulation books and others.

Cargo danger is measured by the extent of damage to crew's health, cargo, vessel and environment.

Other factors include unexpected and rare causes created by force majeure which can jeopardise people, ships and cargo. These are, for example, difficult navigation weather conditions, unexpected dangers on the waterways and similar.

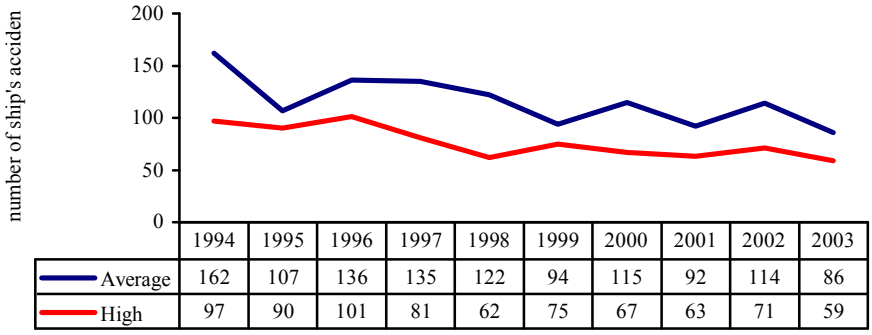
Loss of life and injuries (table 1), as well as damage to vessels and to cargo (graph 1), have tended to decrease over the past several years.

Table 1: Statistics of accidents on inland waterways in USA in 2007

USA inland waterways	Deaths		Work injuries	Lost time due to injuries	Over-boards
	Working hours	Number			
	69,079,233.83	3	858	443	66

Source: AWO Report 4th quarter 2007, available on: *www.americanwaterways.com*

Graph 1: Statistical overview of injuries and damages in the USA between 1994 and 2003 on inland waterways



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Average	162	107	136	135	122	94	115	92	114	86
High	97	90	101	81	62	75	67	63	71	59

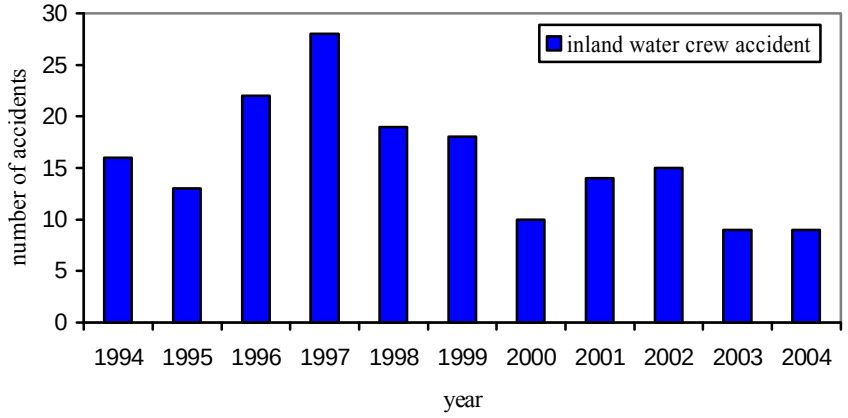
Note: Average damages are considered those in the range between USD 50,000 – 250,000, without human injuries and with a low level of pollution (0.04-4 t)

High damages are considered those in the range from USD 250,001 and higher, with at least one human injury (wounding, death), and where the level of pollution surpasses 4 tons.

Source: US Coast Guard, US Army Corp of Engineer

Judging from the statistics, a decrease is evident in the number of shipowners' accidents on inland waterways (graph 2). It is important to aim at keeping accidents to a minimum and raising the safety level.

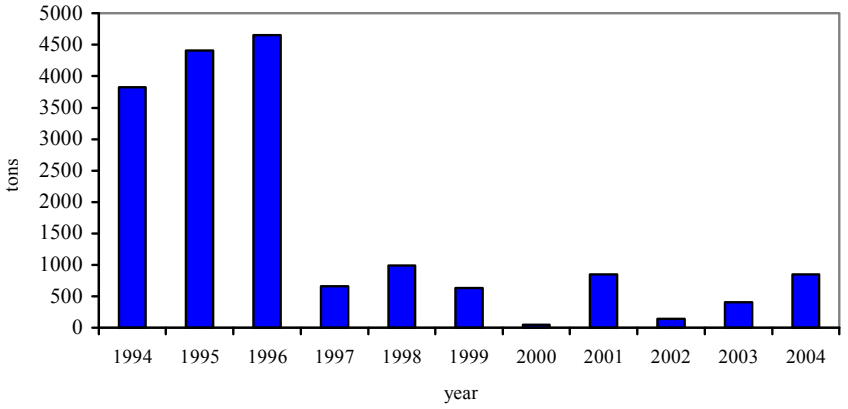
Graph 2: Number of inland water crew accidents on inland waterways



Source: US Coast Guard -AWO Safety Partnership

Insurance companies do not pay for damage claims for shipowners' accidents [14], but damage to cargos, to a vessel's hull and the environment can be extensive. Therefore we endeavour to reduce these types of accidents (graph 3).

Graph 3: Quantity of fuel and fuel products released by barges between 1994 and 2004, expressed in tons



Source: US Coast Guard and US Army Corp of Engineer

According to the AWO, a considerable increase is expected in traffic on inland waterways. Waterways could represent a great danger in the case of a terrorist threat, largely due to their vulnerability and their paths passing through large cities [3].

3. PROPOSALS FOR IMPROVING THE LEVEL OF SAFETY MANAGEMENT IN WATER TRAFFIC

In order to reduce possible accidents caused by human factor on vessels in the maritime commercial fleet, the International Safety Management – ISM code has been introduced [10].

The aims of the ISM code are:

- Developing safety measures
- Reducing injuries and human casualties
- Reducing environmental pollution
- Reducing property damage [2].

For now, the ISM is used as obligatory by the SOLAS convention for maritime ships on international journeys. A state can announce the obligatory use of the ISM in its national waters. The ISM is considered partially harmonised with the standardisation requirements for achieving the 9002 standard [20].

The application of the ISM reduces the chance of possible human error. Human error most commonly occurs as the result of oversight, tiredness, forgetfulness, negligence, handling errors, clumsiness, insufficient knowledge of equipment, misuse of equipment, non-use of occupational safety equipment, abuse of alcohol and drugs, lack of information on operations etc. [2].

The ISM regulation book prescribes the rules of behaviour for many situations on board. Apart from the abovementioned, its obligatory requirement is the use of a check-list. It is considered important to help prevent oversight as well as incorrect procedures in critical situations. It prohibits the abuse of alcohol, narcotics and similar substances on-board. It requires obligatory documentation of data related to the crew, activities on board, safety equipment and other. It gives an insight on the company's and ship's hierarchy, responsible persons, crew duties, communications, archives, ship's documentation and other.

Full application has been suggested of an adapted ISM code to ships on inland navigation under the name ISMIW *(International Safety Management Code Inland Waterways)* according to the algorithm from image 1, ISMIW would have the same purpose, but different safety procedures due to the difference in the type of transport through sea routes and inland waterways. Just like the ISM regulation book for sea traffic, it would be used for all ships on international journeys. Table 2 presents the effects of introducing the ISM code for sea traffic. An analysis was carried out for the Greek commercial fleet which is considered to be one of the biggest in the world.

Table 2: Review of accidents prior to and following application in sea navigation

Time of accident	Vessel type	Reason for accident	
		Human (%)	Other (%)
Prior to ISM	Others	49.3	50.7
	Tankers and RO-Pax ships	84.0	16.0
Following ISM	Others	48.7	51.3
	Tankers and RO-Pax ships	54.8	45.2

Source: Tzannatos, E., Kokotos, D., *Analysis of accidents in Greek shipping during the pre- and post-ISM period*, ScienceDirect, Marine Policy, Journal homepage: www.elsevier.com/locate/marpol

Application of the ISM code succeeded in reducing the number of accidents caused by human error. Similar results are expected as regards traffic on inland waterways because of the affinity of these two traffic branches.

Due to the increase in occupational safety, an annex to the ISM code was introduced: *The Safety Management System - SMS*. Adaptation of the SMS regulations for transport on inland waterways into the *Safety Management System for Inland Waterways – SMSIW* is being proposed. SMSIW would contain:

- A safety and environmental protection policy
- Instructions and procedures for occupational safety and environmental protection in accordance with the laws of the state in which the vessel is located
- A definition of the method of vessel to shore communication
- A definition of the level of authority on-board, method of communication and hierarchy
- Procedures for reporting an accident
- Procedures for preparing for and reacting to an alarm signal.

Increasing the level of quality would result in better operation as a result of greater utilisation of human and material resources. It would be based on the clarity of communication between inland crew concerning the issue of understanding work duties, decision-making etc. Effective organisation of man power is considered to be an important factor with regard to tasks in order to achieve as good a final result as possible. This kind of management has already been used for several years in sea traffic, known as *Bridge Team Management – BTM*, namely the *Bridge Resource Management - BRM*. It should certainly be applied to management and transport on inland waterways. BTM ensures improved team work, communication, hierarchical structure and decision-making, resulting in an improvement in safe navigation. STCW 95, chapter B VIII/2 is recommended.

It is being applied in procedures such as:

- Voyage planning
- Crew work planning
- Emergency procedures
- Bridge Standing Orders
- Taking-over the duties of the captain/pilot.

An international agreement on the minimum norms of education for inland waterways crew is being considered. This kind of agreement for sea transport has been provided for by the STCW convention. The agreement would mean an improvement in the quality of education and training of inland crew. On the other hand, it would contribute to a better understanding of the importance of safety as well as vessel protection on inland waterways. An increase in the level of education for ship officers, captains and ship managers of inland waterway ships transporting dangerous cargo and passengers is being proposed. The proposal would include a passenger transport limit of 100 people.[4]

4. MEASURES FOR EVALUATING THE WORK OF INLAND CREW

As a consequence of the increase in the responsibility for navigation of the inland crew, the introduction of new proposals and increased demands in terms of education and training, measures are being proposed which would describe each rank on inland waterway ships. These kinds of measures would be used to establish rates on inland waterways. The necessity of these kinds of measures arises from a possible increase in the number of inland waterways crews with the arrival of cheap labour from the Far East. It would lead to a reduction in crew costs and a decrease in their quality. Therefore, the application of coefficients that would determine a crew's quality is being proposed:

- Complexity of profession
- Responsibility of profession
- Effort of profession
- Price of object connected to the profession
- Risk of profession.

[4] The number of 100 passengers has been taken as the limit for authorisation for a river raft skipper. Pursuant to the *Regulation on professions and conditions for acquiring the ranks of crew member of commercial ships for inland navigation of the Republic of Croatia*, authorisation for a river raft skipper (Article 31), provides for the handling of a non-propelled river rafts up to a bearing capacity of 50 t or a capacity of 100 passengers.

The complexity of profession F_s can be expressed by the function (3) assisted by the coefficients:

- Responsibility of profession F_o
- Effort of profession F_n
- Price of object F_c
- Risk of profession F_d.

$$F_s = f\left(F_o, F_n, F_c, F_d\right) \tag{3}.$$

The responsibility of profession is the function of the total number of people n for which the rank of a determined profession is responsible:

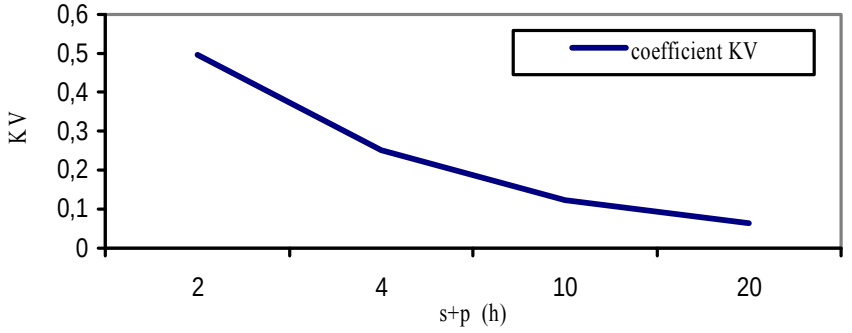
$$F_o = f\left(n\right) \tag{4}.$$

Effort of profession is the function of working hours s and hours of preparedness p which constitute the working hours estimated for position under consideration:

$$F_n = f\left(s+p\right) \tag{5}.$$

The ratio between the coefficients (KV) and the number of working hours onboard is hypothetically shown in graph 4.

Graph 4: Graphical overview of the KV coefficient depending on the sum of working hours and hours of preparedness



The coefficient of the price of the object related to the profession is the function of value of the object which is being managed:

$$F_c = f(C) \tag{6}.$$

The risk coefficient F_d is the function of the probability of injury or loss of life which describe each rank, that is, the working environment. The D value is obtained based on the statistical data of the sum of injuries in the work place for each rank:

$$F_d = f(D) \tag{7}.$$

Each rank can be described on market basis by the coefficient of availability $K_{A..}$ The coefficient of availability is the proportion of actual supply n_o and demand n_n on the labour market.

$$K_A = \frac{n_o}{n_n} \tag{10}.$$

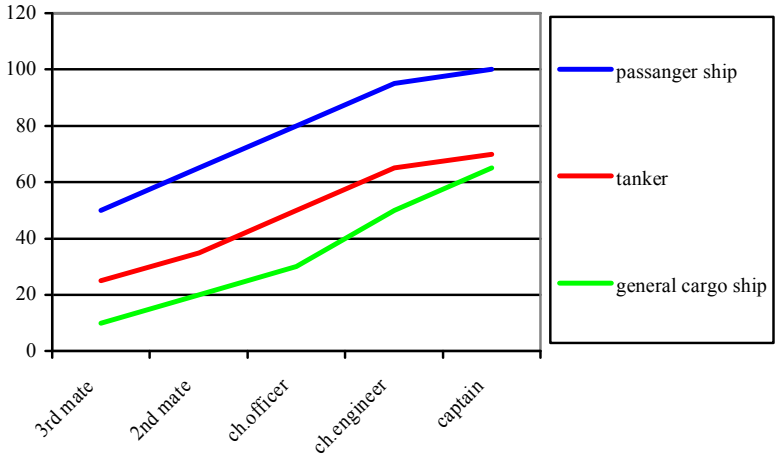
The value of the inland waterways crew work V_b can be expressed in the following way:

$$V_b = \frac{f(F_s)}{f(K_A)} \tag{11}.$$

The application of factors of complexity and the coefficient of availability as parameters for determining the quality of inland crew, that is, determining the personal income, is proposed.

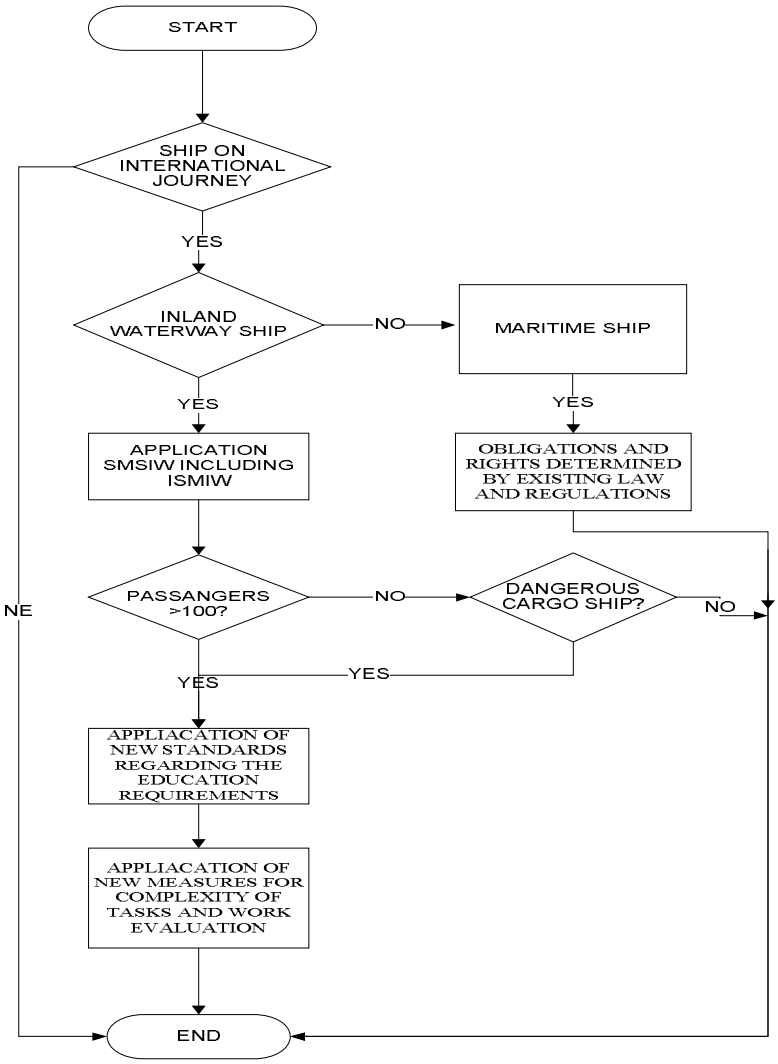
By elaborating on the measures for each type of vessel and professions on vessels, some hypothetical data can be obtained (graph 5).

Graph 5: Hypothetical example of evaluation of a crew according to their profession and type of vessel



The application of new measures for evaluating work is proposed, as well as the application of SMSIW and ISMIW according to the algorithms shown in image 1.

Image 1: Application of new measures for a quality system on inland waterways



5. CONCLUSION

Traffic through inland waterways is considered the most cost-effective method of transport. The level of inland crew and waterways quality is closely connected to the traffic safety on those waterways. It is not considered satisfactory. The reason for

that is evident in the example of corridors of the most important waterways which often traverse industrial centres, cities etc. Frequent worldwide terrorist threats make this way of transport vulnerable.

In order to raise the quality of vessels and crews, this paper proposes the introduction of the ISMIW code, the SMSIW code and both BTM and BRM regulation books which are already being applied in sea transport. Their application should be introduced as the condition for obtaining the ISO standards for vessels and companies that operate on inland waterways.

The introduction of new standards of education in the world is considered necessary due to the influx of cheap labour from the east with suspect training skills and levels of education. The proposed prescribed standards would be applied to inland crew officers transporting more than 100 passengers and dangerous cargo.

Due to the noticeable disproportion in incomes of the members of inland crews, the application is proposed of measures which would determine the minimum personal incomes of inland crew members giving due regard to their quality. It would depend on the rank of the member of an inland crew, level of education and training, type of vessel, overtime, and the ship's value. Personal income coefficients would vary according to the coefficients of demand and supply on the market. Personal incomes would entice inland crews and operators to adhere to safety measures, working hours, and it would also increase the level of education and training.

The paper suggests supplementing and applying the abovementioned measures to a quality system for inland waterways.

NOTE:

1. Barsan, E., Social Aspects of the Seafarers'Integration on the Maritime Jobs Market, available at: www.iamu/edu.org/generalassembly/aga4/barsan.phd
2. *International Safety Management (ISM) Code*, North of England P&I Association Limited, 1996
3. Kasum,J., Vidan,P., Baljak, K., *Threats to ship in inland navigation*, POWA, Dubrovnik, 2008
4. Kasum, J, Vidan, P., Baljak, K. , *Threats and New Protection Measures in Inland Navigation*, Promet-Traffic, Vol.22 (2), 2010., p. 143-146
5. Vidan, P., Kasum, J., Jolić, N., *Proposal of Models and Measures of Search and Rescue on Inland Waterways. Transport*, The Journal of Vilnius Gediminas Technical University and Lithuanian Academy of Sciences, 25(2), p. 178–185
6. Loydś Register Fairplay, World Fleet Statistics, 2006
7. *Pravilnik o zvanjima i uvjetima za stjecanje zvanja članova posade trgovačkih brodova unutarnje plovidbe Republike Hrvatske*,NN 171/03, available at: http://narodne-novine.nn.hr/default.aspx

8. *SIRC surveys of crew composition in 1992-93 and 1998-99*, available at: http://ilo-mirror.library.cornell.edu/public/english/dialogue/sector/techmeet/jmc01/jmc-r3.pdf
9. Zec,D.,Sigurnost na moru, Pomorski fakultet Rijeka, Rijeka 2001
10. *International Safety Management (ISM) Code*, North of England P&I Association Limited, 1996
11. www.americanwaterways.com
12. www.dft.gov.uk/pgr/statistics/.../maritime/seafrer/ukseafarerstatistics2007
13. www.ecy.wa.gov/biblio/991302.html
14. www.hok.hr
15. www.imo.org
16. www.itf.org
17. www.jadranbrod.com
18. www.mmtpr.hr
19. www.osiguranje.com.hr/rijecnik.asp
20. www.unols.org/meetings/2001/200110rvt/200110rvtap13.pdf

REFERENCES:

1. Barsan, E., Social Aspects of the Seafarers'Integration on the Maritime Jobs Market, available at: www.iamu/edu.org/generalassembly/aga4/barsan.phd
2. *International Safety Management (ISM) Code*, North of England P&I Association Limited, 1996.
3. Kasum,J., Vidan,P., Baljak, K., *Threats to ship in inland navigation*, POWA, Dubrovnik, 2008.
4. Kasum, J, Vidan, P., Baljak, K. , *Threats and New Protection Measures in Inland Navigation*, Promet-Traffic, Vol.22 (2), 2010., p. 143-146.
5. Loydś Register Fairplay, World Fleet Statistics, 2006.
6. *Pravilnik o zvanjima i uvjetima za stjecanje zvanja članova posade trgovačkih brodova unutarnje plovidbe Republike Hrvatske*,NN 171/03, available at: http://narodne-novine.nn.hr/default.aspx
7. *SIRC surveys of crew composition in 1992-93 and 1998-99*, available at: http://ilo-mirror.library.cornell.edu/public/english/dialogue/sector/techmeet/jmc01/jmc-r3.pdf
8. Vidan, P., Kasum, J., Jolić, N., *Proposal of Models and Measures of Search and Rescue on Inland Waterways. Transport*, The Journal of Vilnius Gediminas Technical University and Lithuanian Academy of Sciences, 25(2), p. 178–185

9. Zec,D.,Sigurnost na moru, Pomorski fakultet Rijeka, Rijeka 2001
10. www.americanwaterways.com
11. www.dft.gov.uk/pgr/statistics/.../maritime/seafrer/ukseafarerstatistics2007
12. www.ecy.wa.gov/biblio/991302.html
13. www.hok.hr
14. www.imo.org
15. www.itf.org
16. www.jadranbrod.com
17. www.mmtpr.hr
18. www.osiguranje.com.hr/rijecnik.asp
19. www.unols.org/meetings/2001/200110rvt/200110rvtap13.pdf

PODIZANJE RAZINE KVALITETE BRODARACA, BRODOVA I UNUTARNJIH PLOVNIH PUTOVA

***Pero Vidan*[5], *Josip Kasum*[6] & *Frane Mitrović*[7]**

Sažetak

Razina kvalitete posade i unutarnjih plovnih putova je usko povezana sa sigurnosti prometa na njima. Kvaliteta posade, broda i unutarnjih plovnih putova bitan je čimbenik sigurnosti plovidbe i sprječavanja nastajanja šteta. Štete u vodnom prometu nastaju kao posljedica sudara, izlijevanja zauljenih voda i slabe razine zaštite na radu. Prema statistikama Američke organizacije za unutarnje plovne putove (American Waterway Organisation-AWO), uzrok većine šteta nastalih u plovidbi unutarnjim plovnim putovima je ljudska nepažnja. U ovom radu autori analiziraju pojavu nezgoda na unutarnjim plovnim putovima i njihove moguće uzroke. S ciljem smanjivanja šteta i broja nezgoda, predlažu se mjere smanjivanja mogućnosti pojave ljudske pogreške uvođenjem sustava upravljanja sigurnošću prilagođenog unutarnjoj plovidbi te podizanju kvalitete brodaraca.

Ključne riječi: *unutarnji plovni putovi, nezgode, sigurnost, kvaliteta, posada.*

JEL klasifikacija: L91

[5] Dr.. sc. Pero Vidan, Sveučilište u Splitu, Pomorski fakultet u Splitu, E-mail: pvidan@pfst.hr

[6] Dr. sc. Josip Kasum, Sveučilište u Splitu, profesor, Pomorski fakultet u Splitu, E-mail: jkasum@hhi.hr

[7] Dr. sc. Frane Mitrović, Sveučilište u Splitu, profesor, Pomorski fakultet u Splitu, Email: frane.mitrovic@pfst.hr