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Transactions on Maritime Science (ToMS) is a scientific journal with international peer review which publishes scientific papers in the following areas:

~ Marine Engineering,
~ Navigation,
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ToMS aims at presenting major maritime research all over the world, particularly focusing on the Mediterranean area. Articles will be double-blind reviewed by three reviewers. ToMS also promotes scientific collaboration with talented students at a beginning of their scientific careers. These papers also undergo strict peer reviews. Furthermore, the Journal publishes short reviews on significant papers, book reviews and workshops in the fields of maritime science.

The views and opinions expressed in the papers are those of individual authors, and not necessarily those of the ToMS editors. Therefore, each author will take responsibility for his or her contribution as presented in the paper.

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Contents

From Editor-in-Chief

Ivica Kuzmanić

Dear Readers,

You have before you the twelfth issue of the internationally double-blind peer-reviewed scientific journal *Transactions on Maritime Science*. It is published by the Faculty of Maritime Studies of the University of Split. As always, the Journal is published in the printed and electronic, open access form. Our desire is for our readers to have an easy access at a minimum expense.

We are exceptionally pleased, and we take great pride in the fact that we have been admitted to the prestigious Web of Science (Emerging Sources Citation Index) list of journals. Our year-long effort has finally paid off! This is a great step forward for our journal, as well as for the authors who publish their papers in it.

This issue brings seven papers from several scientific areas. The number of authors who have contributed with their papers is fifteen. We are exceptionally pleased because this issue contains four articles written by foreign scholars.

I would kindly ask you to pay attention to two papers from the area of naval engineering entitled "Diagnostic Model of Fuel Installation of Marine Diesel Engine" (written by Polish scholars) and "Evaluation Methodology for Ship's Planned Maintenance System Database" (written by Croatian scholars). Of course, I highly recommend other papers as well. Readers interested in maritime law will have their expectations fulfilled.

The "Contribution" section brings you the news from the International Maritime Organization in London, reported by our selfless and diligent associate Tatjana Krilić. All the news from the past six months have been brought.

In the "News" section we put forward a few contributions as well. I would very much like to single out the presentation of the book entitled *Brod i more (The Ship and the Sea)*, written by the outstanding Croatian scholar from the field of naval architecture, Igor Belamarić. The report concerning the 65th anniversary of the prestigious "Pomorska večer" (Seamen's Evening) radio programme has also been included.

We have also remained faithful to another area we wish to promote: the Croatian cultural heritage. Two poems written by the poet Dobrila Franetović Kuzmić are thus enclosed here.

She was born in Vela Luka on the island of Korčula, her father originating from Stari Grad (the Island of Hvar), and her mother from Vela Luka (the Island of Korčula). She partly spent her childhood on both islands, thereby mastering their respective native Chakavian idioms. She has been writing poetry since her grammar school days, publishing two highly acclaimed and exceptionally favourably reviewed volumes of poetry: *Škoji moji gredu za menun* (My Islands Follow Me, 2004) and *Holte s puomnjom priko žola* (Tread Carefully across the Pebbled Shore, 2012), the poems hereby translated pertaining to the former book. This contribution is presented in a bilingual form with the striking translation by Mirna Čudić. Readers of the electronic edition can listen to an impressive rendition of one of the two poems by the author herself.

We always remain in the hope that the papers we publish will encourage your cooperation.

Diagnostic Model of Fuel Installation of Marine Diesel Engine

Andrzej Grządziela, Agata Załęska–Fornal, Marcin Kluczyk

The paper presents the results of simulation of marine diesel engine fuel injector malfunction and its effects on engine vibration. The work includes the analysis of the engine internal forces and their mathematical models. Simplifications are proposed to allow analyzing the system in one degree of freedom. The results of vibration simulations for the model with efficient fuel system and improperly adjusted injector are also presented. The comparison of simulation results with vibration measurements on the engine was also performed, the diagnostic model was identified and simulation errors were calculated. The complexity of other internal and external interactions is the subject of other studies by the authors. The paper analyzes only the effects of energy dissipation - vibration as a symptom of changes in the technical condition.

KEY WORDS
~ Simulation
~ Diagnostic model
~ Fuel installation
~ Diesel engine

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1. INTRODUCTION

At present, the diagnostics of the marine propulsion engines and generators is a standard procedure on-line, offered by all engine manufacturers. The diagnostic systems are part of a wider management and monitoring platform called IPMS. Such arrangements have become widely available since the 21st century. Due to the lifetime of the ship of up to 50 years and its equipment, it is reasonable to consider the diagnostic tools for marine diesel engines manufactured before the implementation of the modern monitoring systems. Lots of existing marine engines do not have a microprocessor diagnostic system, while the low power engines do not have even the indication valves. Due to the common problem concerning the fuel quality in naval craft, the necessity of assessment of proper operation of the engine fuel system and, above all, the injectors' condition becomes apparent. With regard to the low power engines the vibration diagnostics seems to be one of the more useful and effective methods. Now, the literature is focused mainly on the modelling and diagnostics of fuel installations of the common rail type (Armstrong, 1996; Kiijarvi, 2003; Lalić et al., 2017). In those works, the development of diagnostics of the fuel installations with accustomed injectors and united injectors which are still widely used on ships is presented. The work presents modelling of the dynamic processes on Sulzer 8AL 25/30 engine with properly working fuel injectors and with reduced pressure injection on one cylinder. The object of the study is presented in Figure 1. The obtained results are related to the rotational speed of the engine n = 750 rpm with the moment loads from T = 20 % T_{max} up to T = 75 % T_{max}.

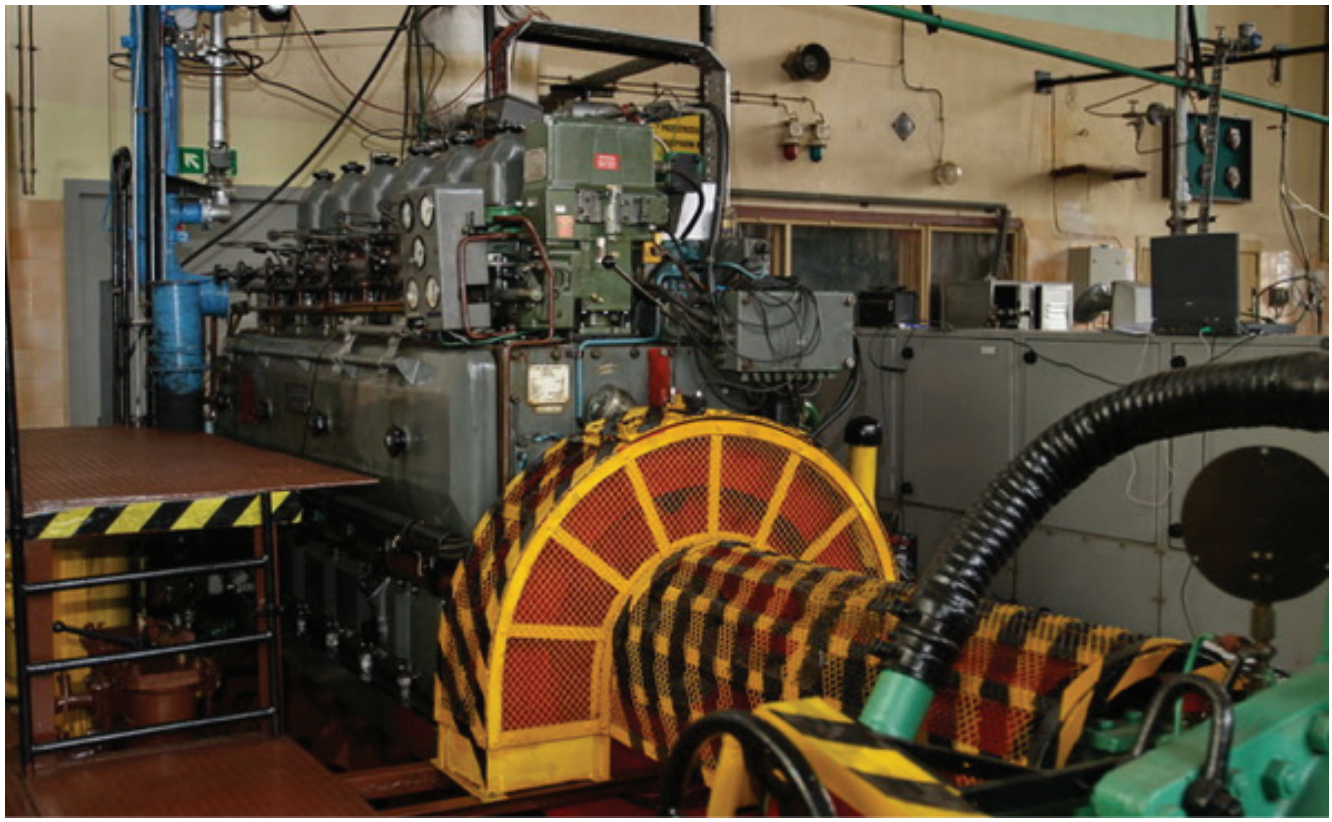

Figure 1.
Sulzer 8AL 25/30 type engine test stand in the Laboratory of the Faculty of Mechanical & Electrical Engineering of the Polish Naval Academy.

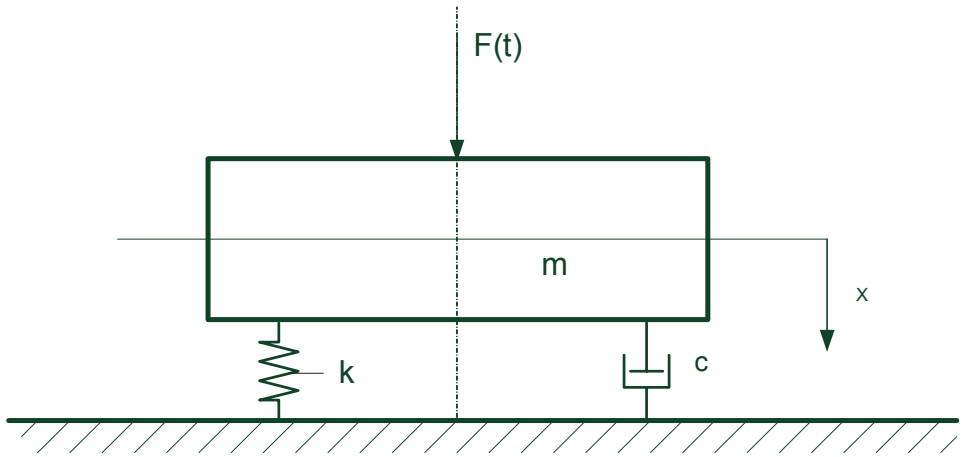

Figure 2.
Simplified model of internal forces excitation on marine diesel engine, where m - mass of engine, c – coefficient of damping, k – coefficient of stiffness.

2. MODEL OF INTERNAL FORCES EXCITATION

Preliminarily, the simplified system with constant force F with the force frequency ω was analyzed – Figure 2. The following notations are assumed:

- single degree of freedom system with viscous damping,
- additivity internal forces,
- no effect of temperature on stiffness and damping,
- the impact of concentrated forces in the center of gravity,
- equivalent stiffness and damping pads,
- identity of vibration measured in join, and modeled in links.

We assume that the external force is cosinusoidal and it is defined by the equation:

$$F(t) = F_0 \cos\omega t \tag{1}$$

The general equation of the engine damped vibration motion is of the form:

$$m\frac{d^2x}{dt^2} + c\frac{dx}{dt} + kx = F_0 \cos\omega t \tag{2}$$

The solution of the general equation of vibration motion is the sum the general solution of the homogeneous equation and the particular solution of the inhomogeneous equation. The first part of the solution is an equation with extinguished amplitude, which after some period of time does not have any impact on the solution of the general equation. There is an additive model admitted, relying on summing the particular solutions which are nothing else but the impacts of the internal forces and moments existing in the object studied.

Dividing the equation (2) by m and denoting:

$$\frac{c}{m} = 2\beta; \quad \frac{k}{m} = \omega^2_0; \quad \frac{F_0}{m} = f_0 \tag{3}$$

The following is obtained:

$$\frac{d^2x}{dt^2} + 2\beta\frac{dx}{dt} + \omega^2_0 x = f_0 \cos\omega t \tag{4}$$

The equation (4) is inhomogeneous second order differential equation with constant coefficients. The general solution of that equation $x(t)$ is the sum of a particular solution $x_s(t)$ and the general solution of the complementary equation $x_0(t)$, i.e.:

$$x(t) = x_0(t) + x_s(t), \tag{5}$$

$$x_0(t) = A \cdot e^{-\beta t} \cos(\omega t + \gamma) \tag{6}$$

where: $\omega = \sqrt{(\omega^2_0 - \beta^2}$, ω_0 – natural frequency of the system.

Finding the particular solution of the inhomogeneous equation - $x_s(t)$ is the next step. To the right side of (4) there is temporarily added: $i \cdot f_0 \sin(\omega t)$, and there the exponential form of the complex number $e^{i\omega} = \cos\omega + i \cdot \sin\omega$ is applied. After the operation, the following form of the equation

$$\frac{d^2x}{dt^2} + 2\beta\frac{dx}{dt} + \omega^2_0 x = f_0 e^{i\omega t} \tag{7}$$

is obtained.

The particular solution is as follows:

$$x_s = a \cdot f_0 e^{i\omega t} \tag{8}$$

Therefore, the differentials of (8) have the form:

$$\frac{dx_s}{dt} = i\omega a e^{i\omega t} \tag{9}$$

$$\frac{d^2x_s}{dt^2} = -\omega^2 a e^{i\omega t} \tag{10}$$

After substituting (9) and (10) into (7), we get:

$$-\omega^2 a + 2i\beta\omega a + a\omega^2_0 = f_0 \tag{11}$$

We obtain the solution when we find the complex amplitude after determining it from:

$$a = \frac{f_0}{(\omega^2_0 - \omega^2) - 2i\beta\omega} \tag{12}$$

The numerator of (12) can be rewritten as:

$$(\omega^2_0 - \omega^2) + 2i\beta\omega = \theta \cdot e^{i\varphi} \tag{13}$$

where:

$$\theta = \sqrt{(\omega^2_0 - \omega^2)^2 + 4\beta^2\omega^2}\,;\ \varphi = arctg\left(\frac{2\beta\omega}{(\omega^2_0 - \omega^2)}\right) \tag{14}$$

Therefore the amplitude is:

$$a = \frac{f_0}{\theta} e^{-i\varphi} \tag{15}$$

Taking under consideration the real part of the complex number we get the particular solution:

$$x_s = Re\left[\frac{f_0}{\theta} e^{-i\varphi} e^{i\omega t}\right] = Re\left[\frac{f_0}{\theta} e^{i(\omega t - \varphi)}\right] = \frac{f_0}{\theta} cos\,(\omega t - \varphi) \tag{16}$$

The following equation is the general solution of (7):

$$x(t) = -A \cdot \beta e^{-\beta t} cos\,(\omega t + \gamma) \frac{f_0}{\theta} \quad cos\,(\omega t - \varphi) \tag{17}$$

while its derivatives are as follows:

$$\dot{x}(t) = A \cdot e^{-\beta t} cos\,(\omega t + \gamma) - A \cdot e^{-\beta t}\omega \cdot sin\,(\omega t + \gamma) - \omega \frac{f_0}{\theta} sin\,(\omega t - \varphi) \tag{18}$$

$$\ddot{x}(t) = A\beta^2 e^{-\beta t} cos\,(\omega t + \gamma) + A \cdot \beta e^{-\beta t} sin\,(\omega t + \gamma) + A \cdot \beta e^{-\beta t}\omega \cdot sin\,(\omega t + \gamma) - A \cdot e^{-\beta t}\omega^2 cos\,(\omega t + \gamma) \tag{19}$$

3. INERTIA AND GAS FORCES SIMULATION

Inertial forces are produced by non-zero translational and angular acceleration. For the identified mass centers for each element of the piston-crank mechanism, the equations of motion will take the form:

$$\Sigma F_{ext} + \Sigma M_{ext} - m\ddot{r} - I\ddot{q} = 0 \tag{20}$$

where: F_{ext}, M_{ext} - the external forces and moments,
I – moment of inertia,
r - the position vector of the mass center of link,
m – mass,

The first task is to find the unknown constraint forces in a moving mechanism that is reduced to a problem of static equilibrium - D'Alembert principle. The diesel engine piston-conrod-crank mechanism scheme is presented in the Figure 3.

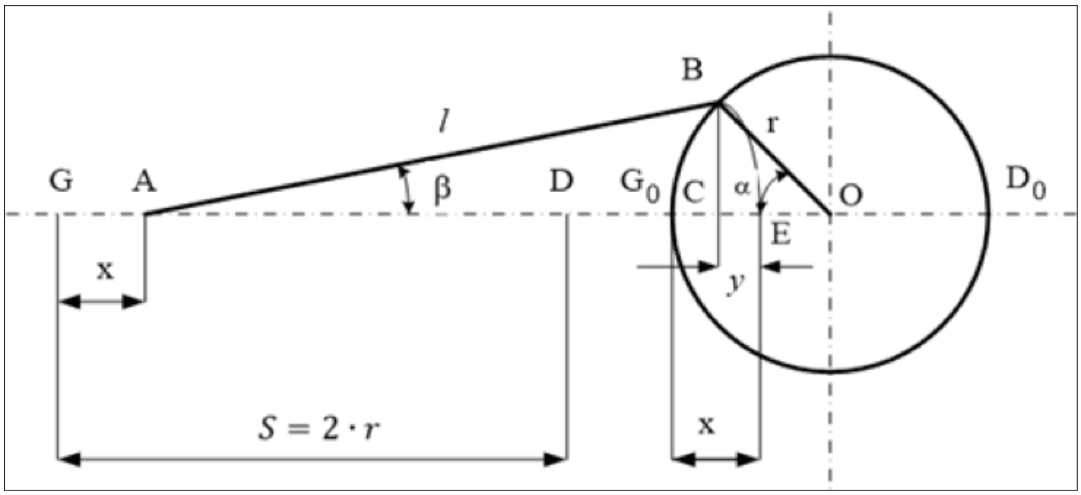

Figure 3.
Diesel engine piston-conrod-crank mechanism schema for inertia forces calculation (Batrak, 2017).

Small 4-stroke diesel engine is a complex mechanism so that the changes in the moment of inertia as crankshaft rotation function may also be shown as (Batrak, 2017):

$$I(\alpha) = I_C + m_C h^2 r^2 + I_R \lambda^2 \frac{\cos\alpha}{\cos(180^0 - \beta)} + m_P r^2 (\cos\alpha \cdot tg(180^0 - \beta) - \sin\alpha)^2 + m_R r^2 [(1 - j)^2 \cos^2\alpha + (j \cdot \cos\alpha \cdot tg(180^0 - \beta) - \sin\alpha)^2] \quad (21)$$

where:

$$\lambda = \frac{r}{l}, h = \frac{oc}{r}, i = \frac{Ac}{l} \quad (22)$$

Knowledge of the course of the first and second-order acceleration in the crank-piston system makes it possible to present changes in the inertia forces as a function of the crankshaft rotation angle, and thus also the changes in the acceleration of the piston and the connecting rod, as a consequence of the inertia and torque of the crankshaft system – Figure 4.

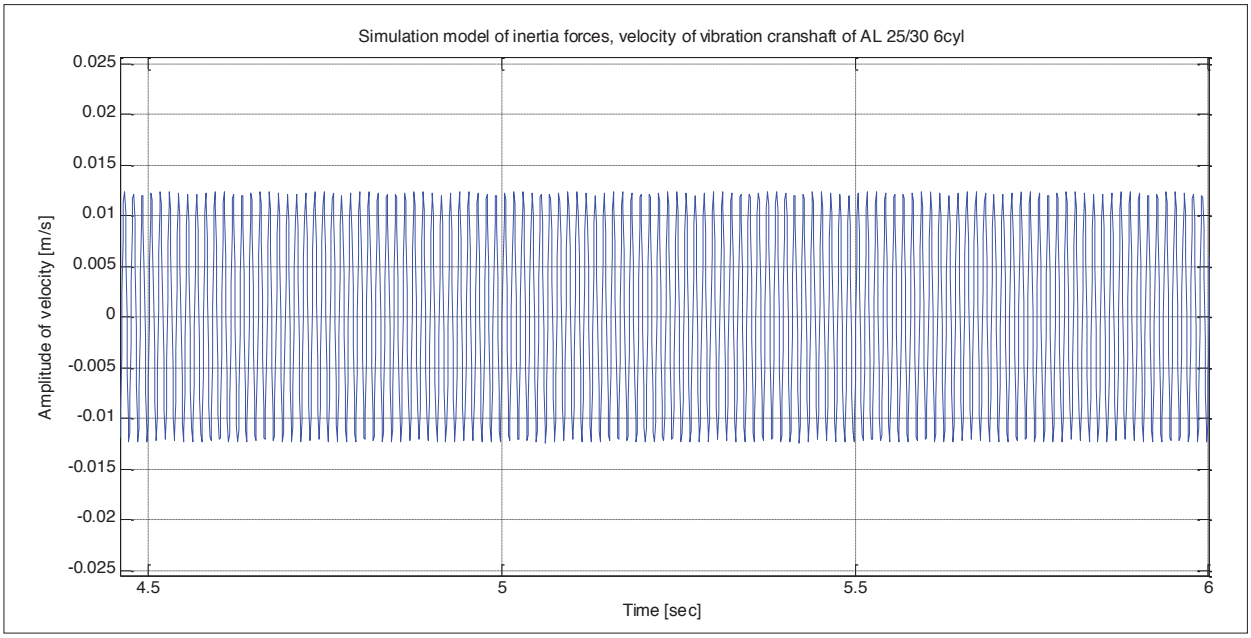

Figure 4.
Result of inertia forces simulation of the crankshaft mechanism of AL 25/30 engine type.

However, these results are often dismissed as unimportant in engines' dynamic calculation, but the authors believe that for the proper model all high energetic forces have to be analyzed.

The next simulations are gas forces excitations of efficient working fuel installation and malfunction of one fuel injector (Jianmin et al., 2011). Figure 5 presents the models of individual, fully efficient injection of fuel installation at the pressure of 17 MPa (blue line), and the simulation of failure of injector at the pressure of 14 MPa (red line) in the domain of crankshaft angle.

The most energetic internal forces are gas pressure pulsation in the cylinders coming from the working process (Carlucci et al., 2006; Sabau, 2012; Yipeng et al., 2014). The important simplification is the assumption of harmonic excitation of gas forces as a time function. Such a simplification is not physically precise because of the relation of gas forces to the rotational speed of the crankshaft, which is not constant in the time domain of a real engine. The simplest model of gas force excitations uses harmonic coefficients A_K and phase ψ_K were calculated from the measured data and inserted into the excitation model of gas forces – Figure 6. The following equation was used to simulate the working process:

$$p_{gas}(t) = \sum_{(i=1)}^{K} A_K \cdot \sin(\omega t + \psi_K) \quad (23)$$

The model describes excitation of the gas forces as a function of time. Then, acceleration of the model was calculated. The vibration velocity was numerically calculated as the integral of the acceleration function in the time domain. The results of the simulations of gas forces excitations with properly working injectors and with the malfunctioning one injector are presented in Figures 6 and 7.

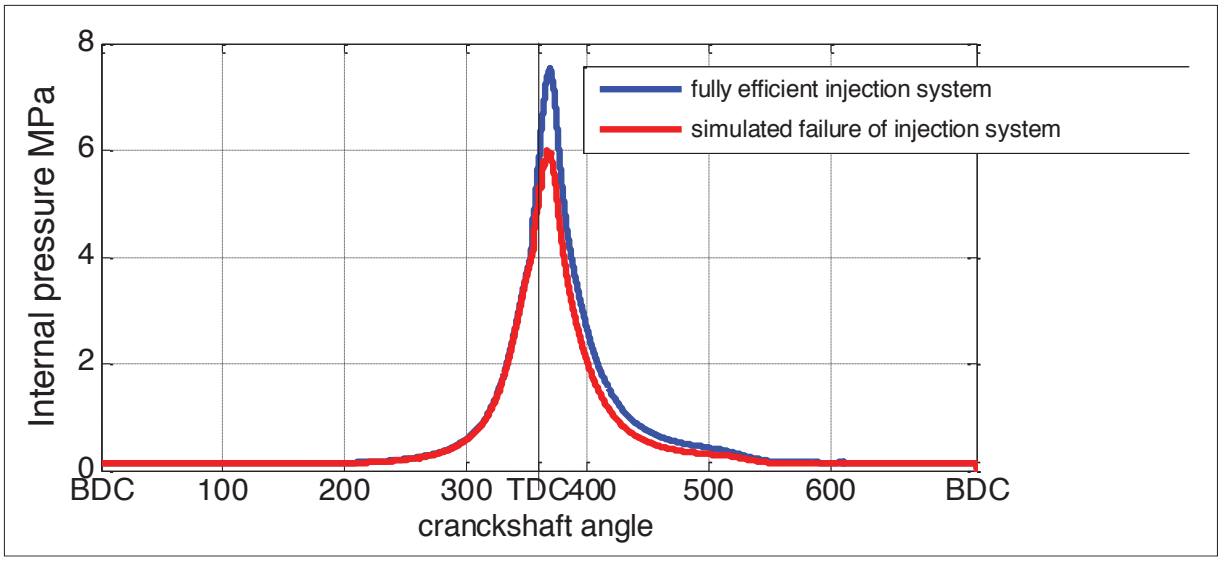

Figure 5.
Result of models of internal cylinder pressure simulation, two cases: properly working injector and malfunctioning one.

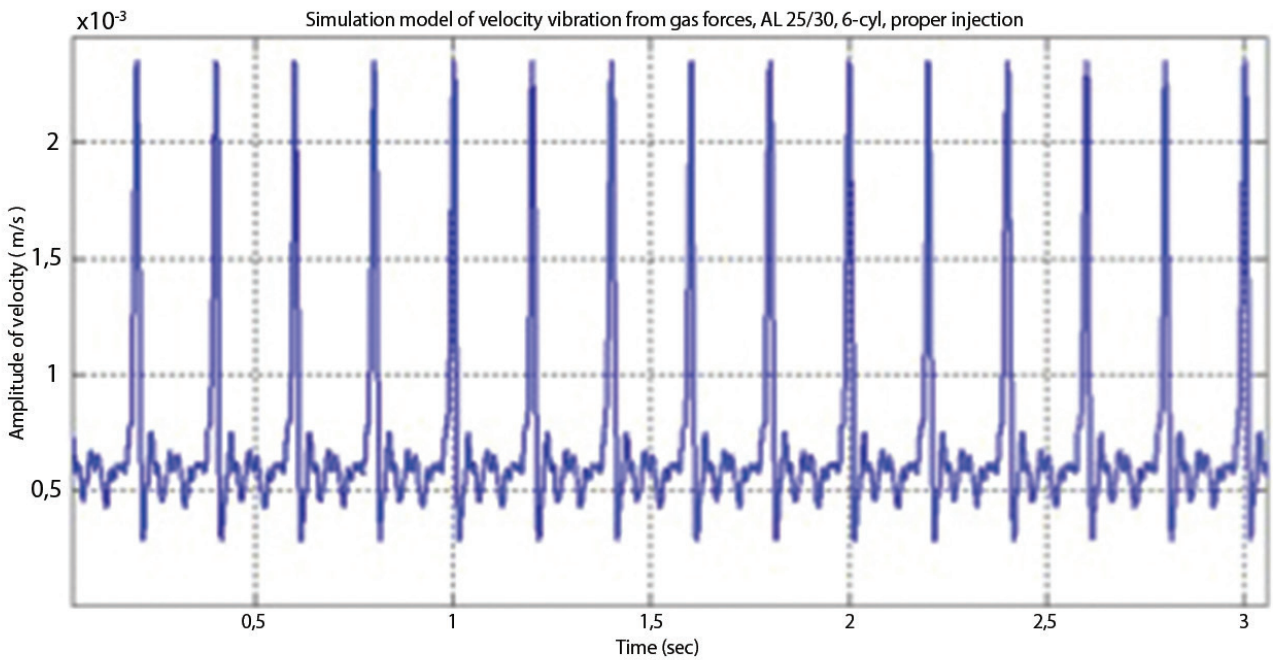

Figure 6.
Result of model of gas pulses excitation as a velocity of vibration, load 20 %, efficient working fuel.

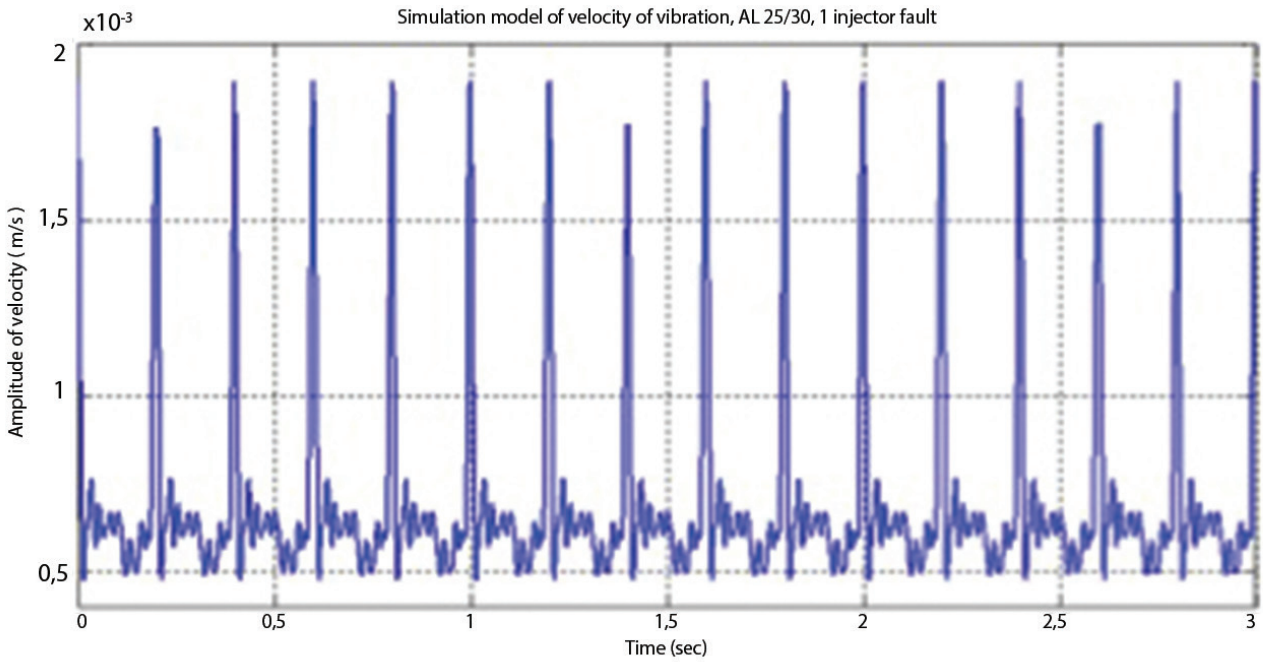

Figure 7.
Result of gas pulses excitation simulation as velocity of vibration, load 20 %, malfunction of 1 injector.

The second model of fuel combustion gas forces excitation is based on the harmonically excited step function. The step value of the function was determined by the gas pressure indicator diagram recorded on the 8AL 25/30 engine. The forces excited on the engine crankshaft were calculated from the combustion pressure values. The differential equation of excitation has the following form due to the scheme in Figure 2:

$$m\ddot{x} + c\dot{x} + kx = F \cdot \sigma(t) \tag{24}$$

or

$$\ddot{x} + 2n\dot{x} + \alpha^2 x = \frac{F}{m} \cdot \sigma(t) \tag{25}$$

with the initial values: $x(0) = \dot{x}(0) = 0$.

Transformations of both sides of the equation (25) are as follows:

$$(s^2 + 2ns + \alpha^2) = \frac{F}{m} \cdot \frac{1}{s} \tag{26}$$

thus:

$$x(s) = \frac{F}{m} \cdot \frac{1}{s(s^2 + 2ns + \alpha^2)} \tag{27}$$

To find the function in the time domain, the expression on the right side of equation (27) is split into simple fractions:

$$\frac{1}{s(s^2 + 2ns + \alpha^2)} = \frac{A}{s} + \frac{Bs + C}{s^2 + 2ns + \alpha^2} \tag{28}$$

thus:

$$1 = A(s^2 + 2ns + \alpha^2) + (Bs + C)s \tag{29}$$

Equation (29) allows the determination of constants as follows:

$$A = \frac{1}{a^2}, B = -\frac{1}{a^2}, C = -\frac{2n}{a^2} \quad (30)$$

Thus, the equation can be written as:

$$X(s) = x_{ST}\left(\frac{1}{s} - \frac{s+n}{(s+n)^2+\gamma^2} - \frac{n}{\gamma}\cdot\frac{\gamma}{(s+n)^2+\gamma^2}\right) \quad (31)$$

where:

$$x_{ST} = \frac{1}{s}; \quad \gamma = \sqrt{(a^2 - n^2)} \quad (32)$$

Using Laplace's transform tables, x is written as a function in the time domain as follows:

$$x(t) = x_{ST}\left[1 - e^{-nt}\left(\cos(\gamma t) + \frac{n}{\gamma}\sin(\gamma t)\right)\right] \quad (33)$$

Finally, the function takes the form for each of the cylinders of the 4-stroke engine as follows:

$$x(t) = x_{ST}\left[1 - e^{-nt}\left(\cos(\gamma t) + \frac{n}{\gamma}\sin(\gamma t)\right)\right] \sin(\pi\omega t + \delta_i) \quad (34)$$

The results of the simulation of gas forces velocity vibration using step function are shown in Figures 8 - 9.

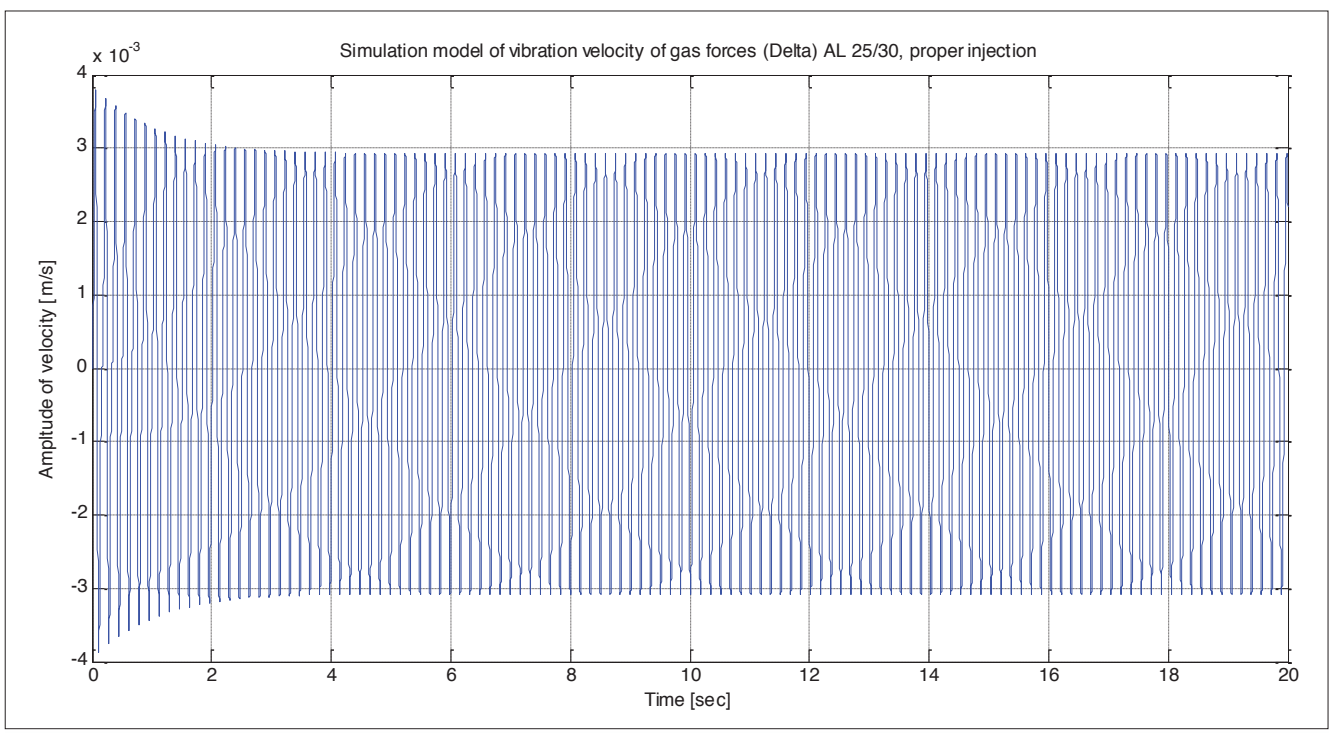

Figure 8.
Result of efficiently working fuel installation simulation, engine 8AL 25/30, 6-cylinder, load T = 20 % T_{max}.

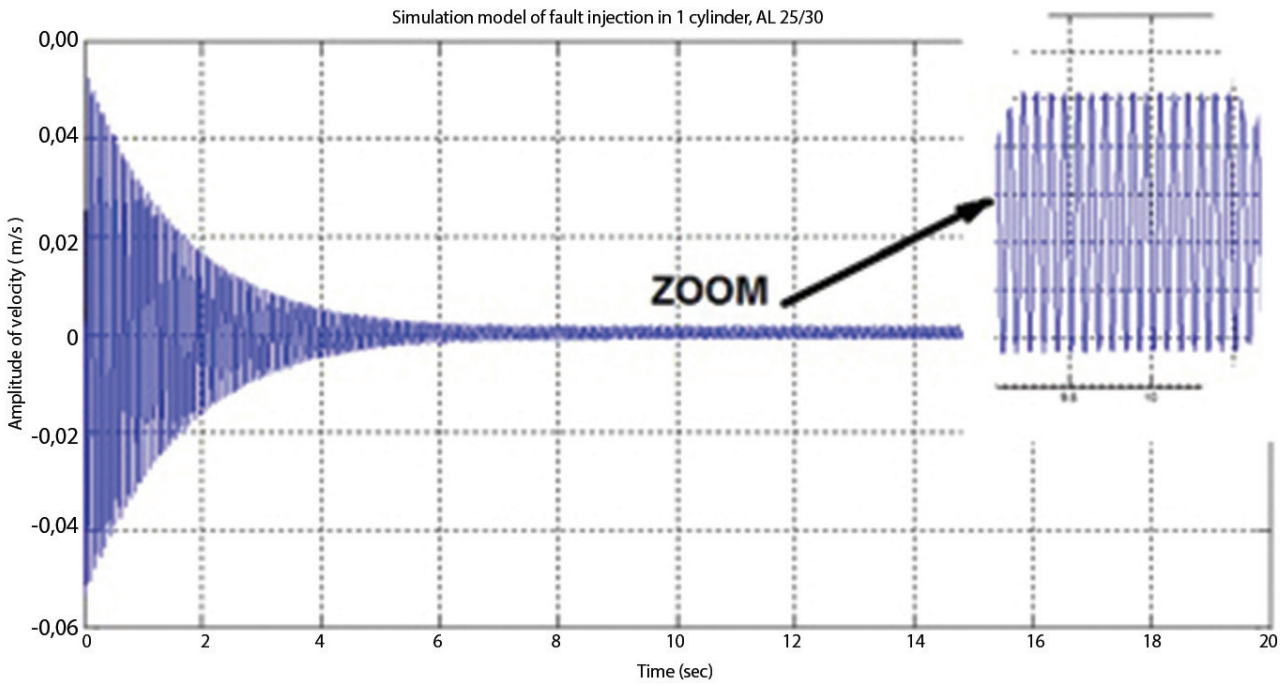

Figure 9.
Result of malfunctioning one injector of the fuel installation simulation, engine 8AL 25/30, 6-cylinder, load T = 20 % T_{max}.

4. AUXILIARY MACHINES' EXCITATIONS

Vibration measurements on the diesel engine head show strong interference with the auxiliary equipment and coupled mechanisms. The basic dynamic forces come from the camshaft mechanism and turbocharger. The other coupled devices such as pumps, fans, etc. have little effect on the dynamics of the engine and are not functionally related to the quality of fuel injection.

The camshaft installation model assumes a poly-harmonic step function whose acceleration is directly proportional to the stiffness of the valve springs and inversely proportional to the mass of the valves. The camshaft speed is 1/2 the crankshaft rotational speed. The vibration velocity model from the installation camshaft operation is shown in Figure 11.

Reduced pressure injection greatly influences the operation of the turbocharger by fluctuating the enthalpy values of the exhaust gas supplied to the turbine (Costall, 2007; Dziubak and Karczewski, 2016). The model of properly working fuel system involves only the residual impact of the rotor unbalance. The injector fault introduces the gas-dynamic unbalance expressed by the mass flow modulation (Korczewski and Zacharewicz, 2009; Podevin et al., 1999). Experimental studies have allowed the development of an empirical formula describing the effect of gasless unbalance in the form:

$$\begin{aligned} F = m_{gas} & \left(\sum_{(i=1)}^{n} \left(\bar{A}_i \right) \cdot \sin 0{,}5\,\omega t \right. \\ & + \sum_{(i=1)}^{n} \left(\bar{A}_i \right) \cdot \sin \omega t + 0{,}25 \sum_{(i=1)}^{n} \left(\bar{A}_i \right) \cdot \sin 2\,\omega t \\ & + 0{,}5 \sum_{(i=1)}^{n} \left(\bar{A}_i \right) \cdot \sin 3\,\omega t \\ & + 0{,}15 \sum_{(i=1)}^{n} \left(\bar{A}_i \right) \cdot \sin 4\,\omega t \\ & \left. + 0{,}2 \sum_{(i=1)}^{n} \left(\bar{A}_i \right) \cdot \sin 5\,\omega t \right) \end{aligned} \tag{35}$$

where m_{gas} – mass of gas,
i – number of cylinders,
Ai – individual coefficient for engine type,
ω – rotational speed of the rotor.

The vibration simulation of the turbocharger supplied by modulated gas flow is presented in Figure 11.

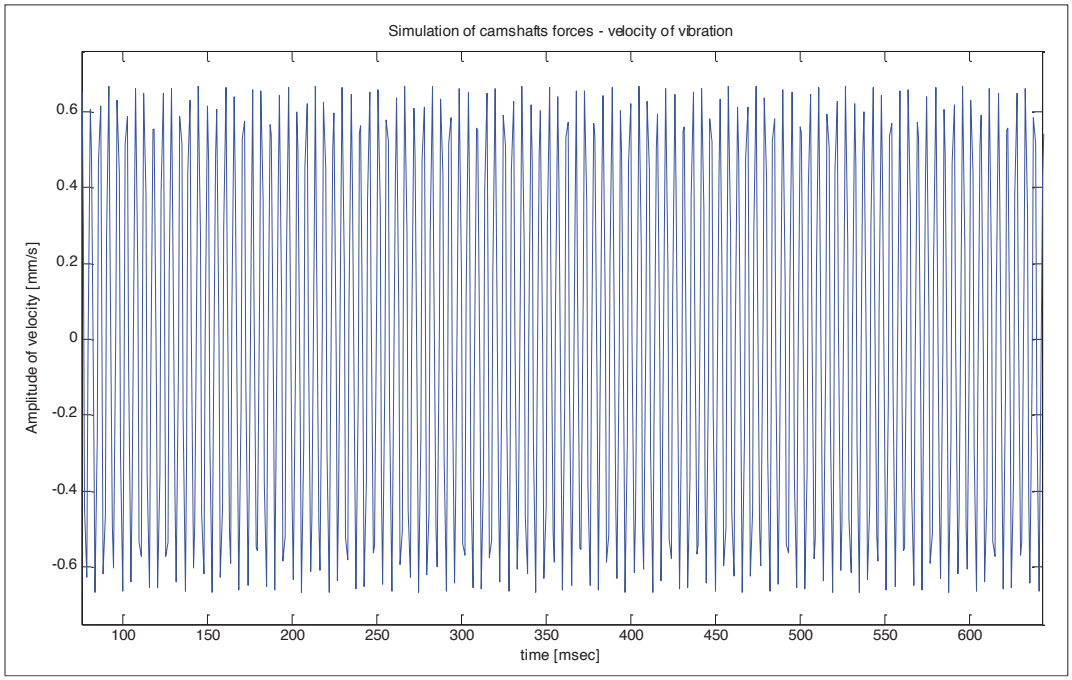

Figure 10.
Result of vibration velocity of camshaft installation simulation, engine type 8AL 25/30, n_{DE} = 900 rpm, load T = 20 % T_{max}.

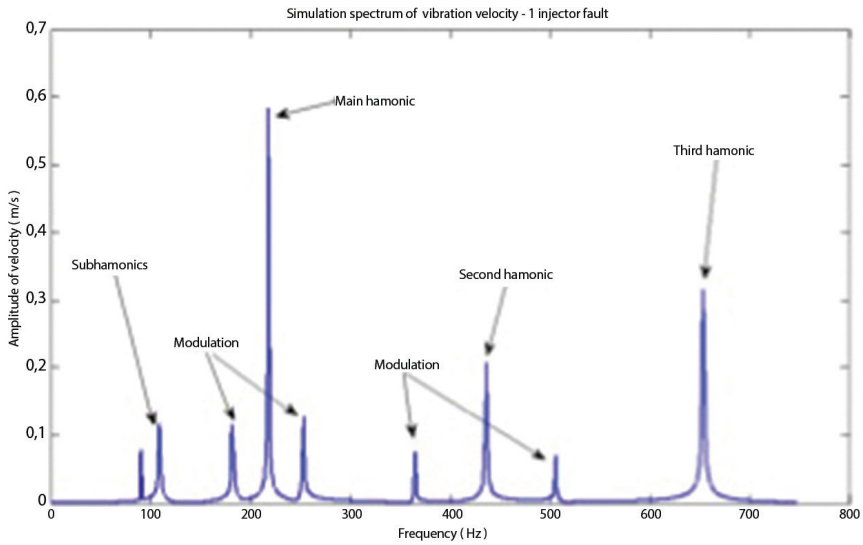

Figure 11.
Result of the spectrum of turbocharger excitation by modulation of gas flow (simulation model).

The main difference between the turbocharger velocity vibration spectrum of efficiently working fuel installation and the faulty working injector are:

- increased values of main harmonics connected to the rotor speed
- appearance of the primary sidebands and subharmonics (Yipeng et al., 2014).

5. FULL SCALE DIAGNOSTIC MODEL

As mentioned above, additive model of interacting forces was adopted. Analyses of the results of simulation of the engines working with efficient and with malfunctioning fuel systems were carried out 5 seconds after the start of the simulation (Lewińska, 2016; Lus, 2011; Venkateshmohan and Kumar, 2015). For all the analyzed internal forces, it was the time period after which the values of root mean square vibration parameters for the subsequent time periods did not change. Simulation of the time waveform and spectrum for the efficiently working systems is shown in Figures 12 and 13.

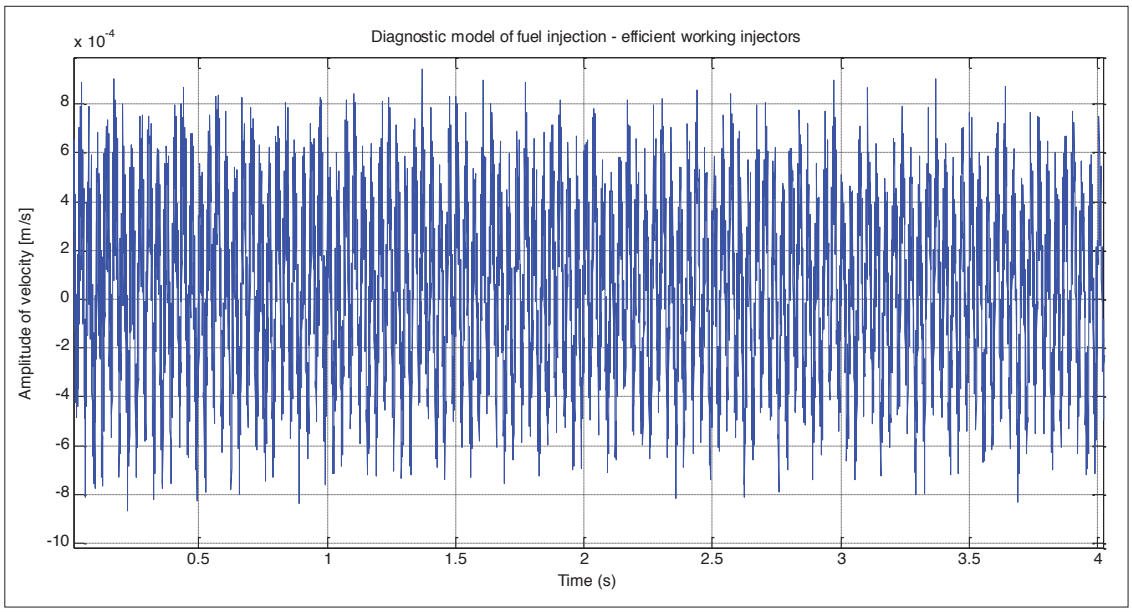

Figure 12
Result of efficiently working fuel injectors simulation – time waveform.

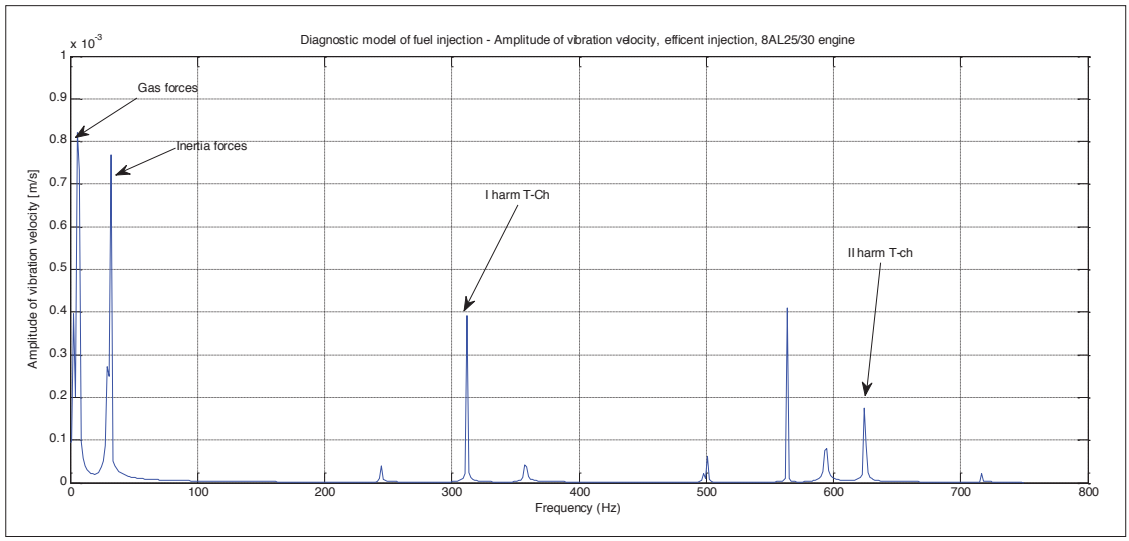

Figure 13.
Result of spectrum of efficiently working fuel injector simulation.

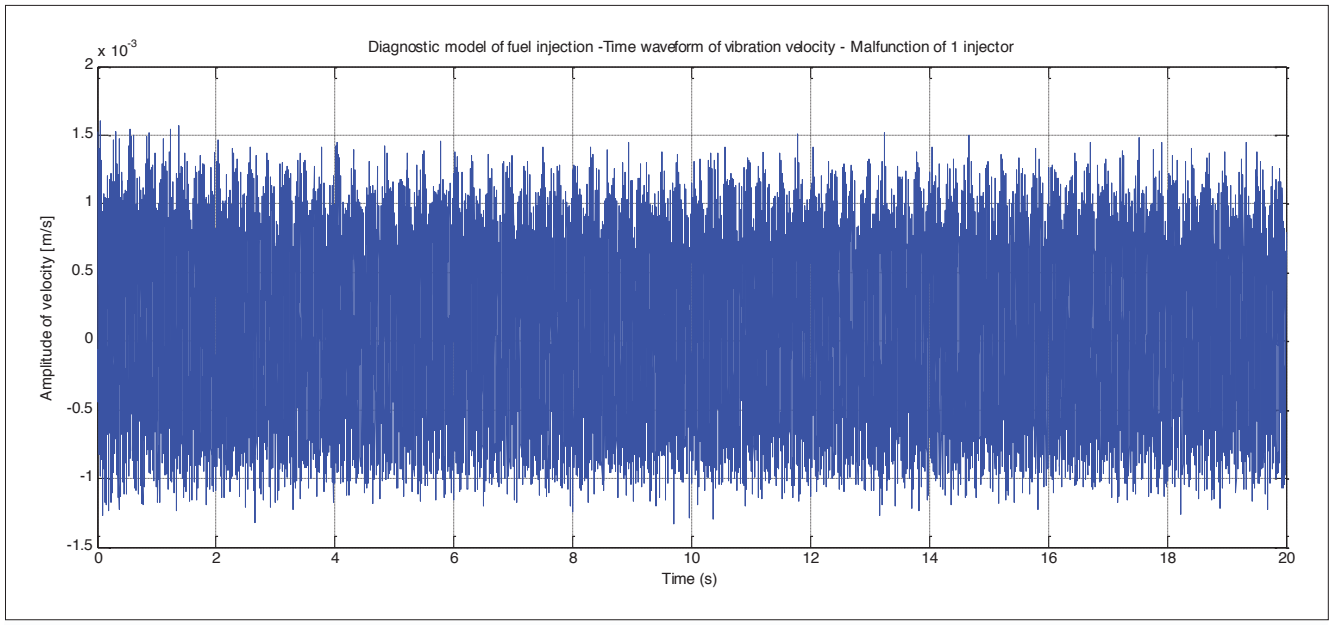

Figure 14.
Result of time waveform model of malfunction of 1 fuel injector (simulation model).

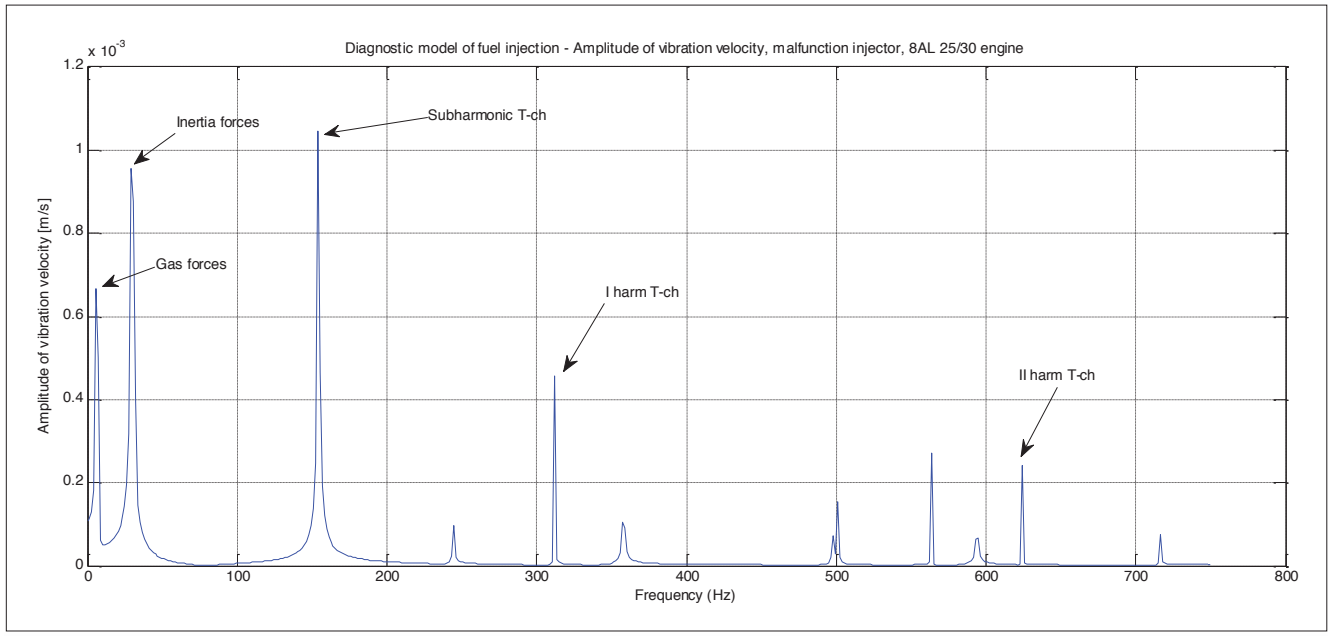

Figure 15.
Result of malfunction of one fuel injector (simulation spectrum).

Introduction of a full-scale diagnostic model of disturbances, such as lowering the combustion pressure in one cylinder, is shown in Figures 14 and 15.

The effect of the change is the decrease in the vibration amplitude value from the combustion process and the increase in the harmonic amplitudes and their sidebands for the operating turbocharger. As a result of the general symptoms of lowering the injection pressure of one or more injectors will reduce the harmonic value from the combustion process and increase the value of root mean square of vibration velocity.

6. MODEL IDENTIFICATION

The identification of the model relies on the analysis of the errors between the parameters of the recorded test on the stand and the model parameters. Due to the lack of simultaneous signals in measurements and in the model, the analysis was done only in the range of frequencies and amplitude values. Compatibility of the frequencies of the forces in the model and in the engine was not a problem because of understanding the kinematics of the object. Finding the fitting function results in readjustment of the the model, and all the forces fit in the range of the amplitude values for the considered operating states. The function of matching the coefficients of successive amplitudes was calculated as follow:

$$C_f = -6^{-4} f_k^2 + 0{,}009 f_k + 0{,}445 \quad (36)$$

where: C_f – value of amplitude matching coefficient for k – frequency, f_k - successive frequencies.

During all the tests, one engine speed n = 750 rpm and 3 loads values i.e. 20 %, 50 %, 75 % were analyzed. The obtained values of the fitting function is monotonic. It means that some tests with different engine speeds are possible. Table 1 shows the mean error values with respect to the model-engine relation.

Table 1.
Example of mean relative error analyses for load 20 % T_{max}.

	Value on engine		Value on model		Mean relative error
	Proper injector	**Malfunction of injector**	**Proper injector**	**Malfunction of injector**	**[%]**
Gas forces harmonic V [mm/s]	0.82	0.68	0.84	0.67	2.4 / 1.4
Inertia forces harmonic V [mm/s]	0.94	0.78	0.93	0.76	1.05 / 2.5
Turbocharger I harmonic V [mm/s]	0.34	0.42	0.39	0.45	14.7 / 7.1
Turbocharger II harmonic V [mm/s]	0.15	0.21	0.17	0.22	13 / 4.7
Turbocharger III * harmonic A [mm2/s]	2.26	2.86	2.38	3.04	5.3 / 6.3
Turbocharger IV * harmonic A [mm2/s]	1.11	1.46	1.24	1.59	11.7 / 8.9
VRMS [mm/s] [2 ÷ 100 Hz]	3.5	3.9	2.9	3.3	17 / 15

* Due to the frequency values of III and IV harmonics of turbocharger (over 1 kHz), the mean relative errors were analyzed as the vibration acceleration.

The mean relative errors of model harmonics of inertia and gas forces for all the analyzed loads are less than 5 %. Due to the natural external forces, the mean relative errors of root mean square of vibration velocity from sideband 2 – 100 Hz are less than 20 %. Such results confirm the effectively calculated matching function and the correct frequency structure of the model. The results of the vibration sample measured on the heads of engine cylinders are seen of Figure 16-19.

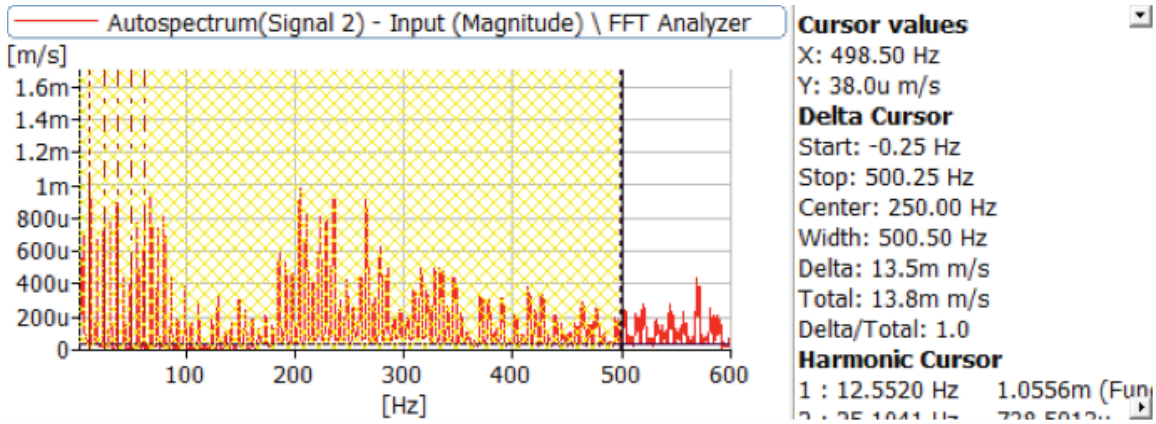

Figure 16.
Spectrum of vibration velocity, 8AL25/30 type engine, n = 750 rpm, T = 20 % T_{max}, efficient fuel installation.

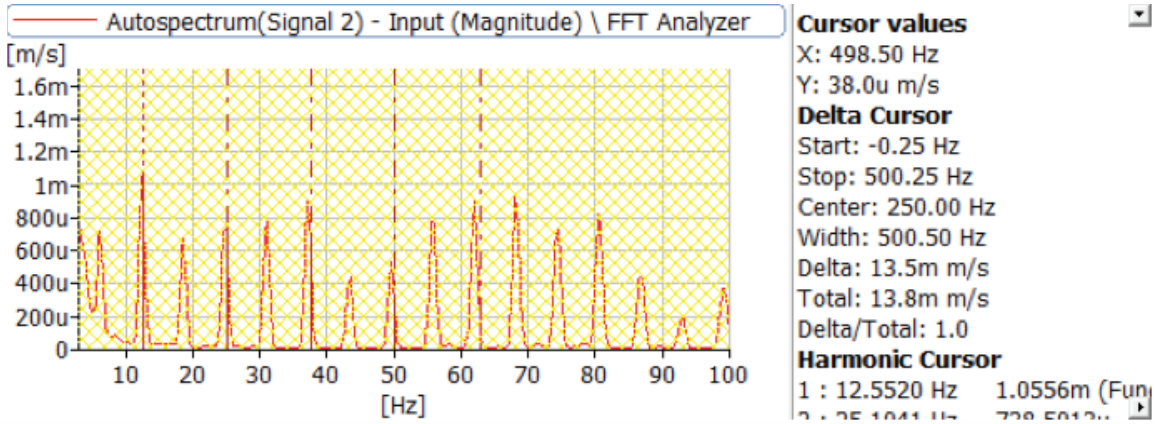

Figure 17.
Spectrum of vibration velocity, 8AL25/30 type engine, n = 750 rpm, T = 20 % T_{max}, efficient fuel installation.

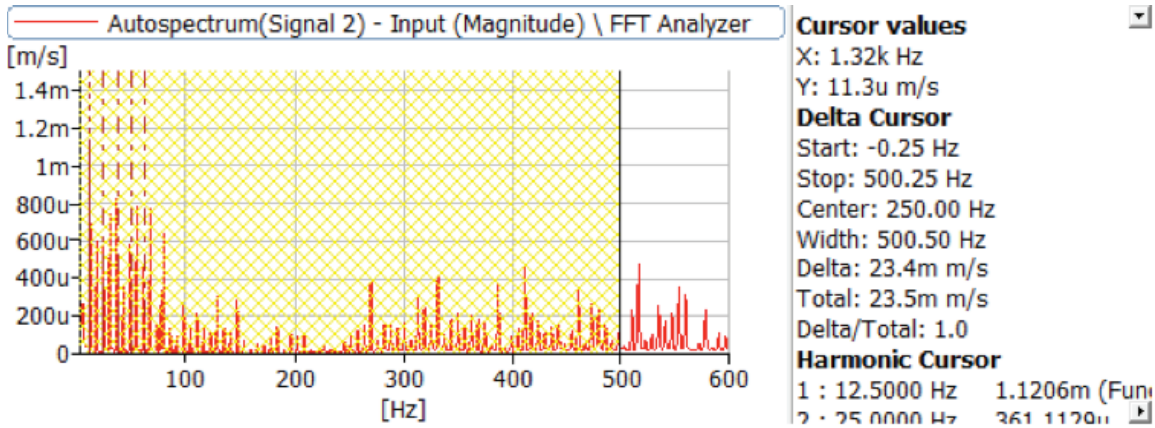

Figure 18.
Spectrum of vibration velocity, 8AL25/30 type engine, n = 750 rpm, T = 20 % T_{max}, malfunction 1 injector.

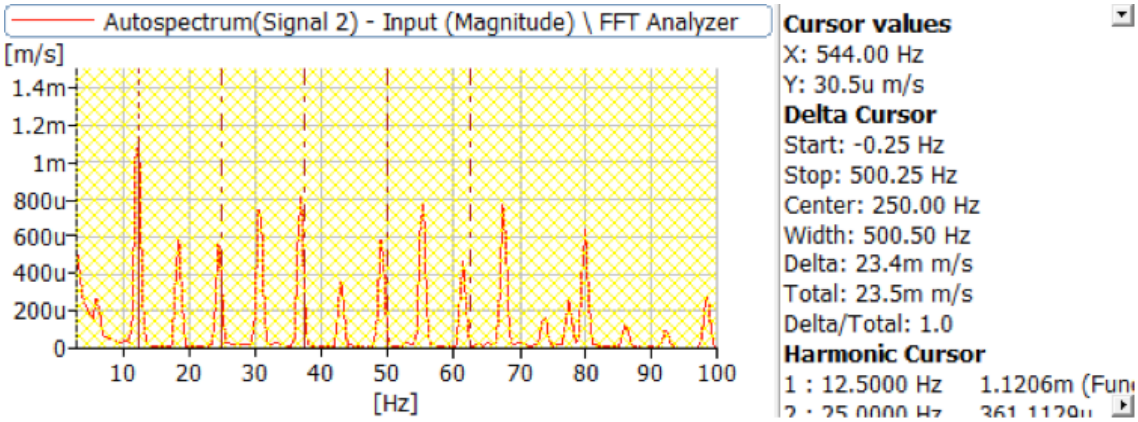

Figure 19.
Spectrum of vibration velocity, 8AL25/30 type engine, n = 750 rpm, T = 20 % T_{max}, malfunction 1 injector.

Further work on subsequent engine speeds and loads will focus on finding statistical relationships of ratios of amplitude values, which represent vibrational symptoms of a change in the technical condition of an injector. Currently, the number of measurements and simulations is too low for the results to be representative and unambiguous.

7. CONCLUSIONS

The main goal of the identified diagnostic diesel engine models is to prepare simulations of typical and uncommon malfunctions for the definition and calculation of diagnostic data. Some symptoms do not need to have specific values because the ratios of symptom values are often equally sensitive. This implies the need for predicting and prioritizing the complexity of the diagnostic model. The high sensitivity model requires resignation of many simplifications; consequently, a huge, multi-level, mathematical model is obtained. The presented model was designed to assess only the technical condition of the fuel installation and, in particular, to reduce the injection pressure on only one injector. The complexity of the response to injection pressure distortion in the model confirms that the overall diagnostic model should be prepared as multi-symptom type model.

The aim of the work was to achieve the identified malfunction of fuel pressure injection model. Further work will be carried out to obtain a full model whose sensitivity will be confirmed for all the rotational speeds of the engine and all operating loads.

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Evaluation Methodology for Ship's Planned Maintenance System Database

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The paper describes an evaluation methodology for ship's Planned Maintenance System database based on the application of a newly created questionnaire and the analysis of the evaluation results received by the questionnaire. The evaluation results of several databases and the analysis of evaluation results are also shown in the paper.

The main purpose of the paper is to provide a simple and useful tool for the evaluation of all ships' Planned Maintenance System databases, which will enable users to examine the data in the database and discover the areas where the database and maintenance can and must be improved.

The expected outcome of the described methodology for the evaluation of ship's Planned Maintenance System database can be described as:

- Evaluating ship's Planned Maintenance System database,
- Performing ship's Planned Maintenance System database diagnostics to indicate insufficiencies,
- Determining the area and mode for ship's Planned Maintenance System database quality improvement and, consequently, overall improvement of the maintenance and reliability of ships' systems,
- Setting up a standard for the development and evaluation of computerized database for ship's planned maintenance,
- Determining problems which occur during database development and describing complexity of the development process.

KEY WORDS

~ Planned Maintenance System
~ Database
~ Evaluation methodology
~ Questionnaire
~ Quality evaluation

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1. INTRODUCTION

Planned Maintenance Systems (PMS) for ships have been in use for quite a long time. PMS is regulated by ISM code, Chapter 10 (Revised ISM Code, 2015). Computerized programs for Planned Maintenance have been in use for more than thirty years. Despite the relatively long period of their application, the database quality, configuration and content are still open to various interpretations. The database quality depends of several key factors such as: the quality of raw data which must be entered into the database, experience and knowledge of the database factory team, priority given to the computerized PMS and databases, and care assigned to rechecking the data entered into the database (Tayi and Ballou, 1998). Shipping and the shipping industry cause shortcomings of these factors to become more pronounced and visible. Planned Maintenance database construction process is often without a good organization or a serious approach. Determining all the items that a Planned Maintenance database for a ship must have is often left to free interpretation of end users, or in better cases to the database construction team. This makes Planned Maintenance databases for ships very sensitive to shortcomings, especially in cases when the database is not checked and approved by a classification society (Machinery Survey Arrangements, 2003). At this point, a unique criterion or at least the recommendations which the Planned Maintenance database for ships should fulfil, do not exist. Every Planned Maintenance DB (database) for ships must have a certain number of maintenance items to fulfil the condition of quality maintenance. The list of these items does not exist either, and the databases can easily be constructed without one or more important pieces of equipment or machinery.

DQA (Data Quality Assessment) methodology (Batini et al., 2009) was chosen to be used to evaluate the data quality in PMS database. For the methodology, a questionnaire is created with the purpose to evaluate the data in PMS database. The questionnaire must be constructed following several conditions

to meet the requirement of universal usage without any modifications. These conditions are that the evaluation criterion must be the same for all the computerized PMS for ships and all used Database Management Systems (DBMS), and the type of PMS and DBMS must not influence the evaluation grades at all.

The questionnaire shown in this paper is intended as an aid to the qualified personnel to help them evaluate PMS database, either one in use, or one after production. The personnel in this case must be qualified, i.e. they must have extensive knowledge of the computerized PMS system as well as knowledge of the ship's systems and equipment. That is a necessity which must be satisfied to obtain good and realistic evaluation results.

Evaluating the database with the use of the questionnaire will provide answers to the following questions:

- Is the data in PMS database for ships good quality?
- Are there serious deficiencies noted in the data in PMS database?
- Can the quality of the data in PMS database be improved?
- Is it necessary to improve data quality in PMS database?

2. DATABASE EVALUATION

Database evaluation consists of four steps: Preparation of Questionnaire and Database, Evaluation of Database, Analysis of Results, and Conclusion (Figure 1).

The construction of the questionnaire was determined by five criteria which define data quality: timeliness, integrity, validity, reliability, and precision (fletchers.atwebpages.com).

The first database evaluation was performed on 20 July 2017 by the author in the office of Jadroplov d.d., shipping company from Split, on their office PMS database. Evaluation with the use of the questionnaire was performed on four ships' databases installed on the following vessels:

- Database 1 on M/V Split,
- Database 2 on M/V Trogir,
- Database 3 on M/V Sveti Dujam, and M/V Peristil,
- Database 4 on M/V Split.

Additional evaluation was performed on office PMS database (Database 5) in the office of Brodospas d.d., another

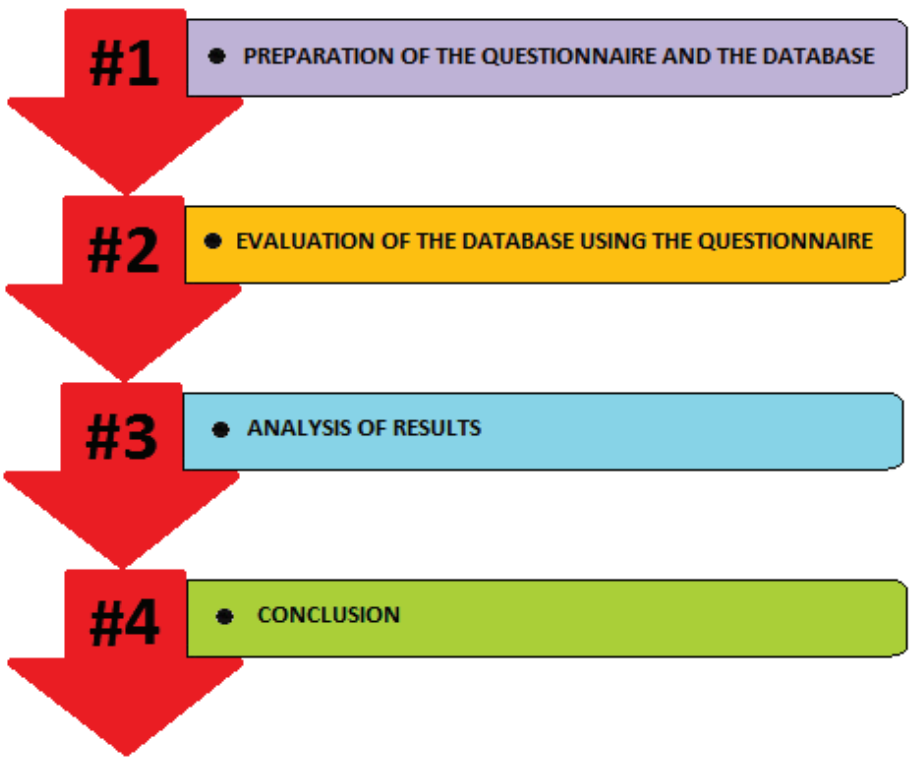

Figure 1.
PMS database evaluation process sequence diagram.

shipping company from Split. The main purpose of the evaluation was testing of the questionnaire by a third person, real person in the real environment, not connected with the questionnaire author. The company has computerized PMS installed only on two sister vessels, and initially the databases were identical. PMS database evaluation was performed on M/V Brodospas Alpha database. The evaluation was performed on 25 July 2017 by the technical superintendent of the company, who fulfils the condition of good knowledge of computerized PMS program and good knowledge of the ship and ship's systems.

Both companies (Jadroplov d.d. and Brodospas d.d.) use the same computerized PMS program and the same DBMS. Their PMS databases for ships were developed in the same database factory.

Note: The data about the computerized PMS program, the DBMS and the data factory are withheld, and are known to the authors of this paper.

3. QUESTIONS AND GRADES IN THE QUESTIONNAIRE

Evaluation questionnaire consists of thirty questions arranged in six thematic groups: Machinery and equipment, Jobs inside DB, Special jobs and rules, DB jobs general, Spare parts, and Miscellaneous (Table 1). There is a field in front of every question indicating the importance of the question for the database quality. The quality of the data in the database "can directly influence all the activities linked to ship's systems" (Jurjević and Bilić, 2009). "Traffic-light principle" is used to determine the colors used in the field and to describe the importance of the question.

The questions with the red field in front have the highest importance, and the deficiencies discovered with these questions have considerable impact on the maintenance quality. All the deficiencies discovered by these questions are serious and should be rectified to improve the database and the maintenance quality.

The questions with yellow field in front have medium importance. This group of questions has also a lower impact on the database quality; the deficiencies discovered with these questions mostly influence the user's workload (unnecessary workload due to inadequate data optimization), while the influence on the maintenance quality and reliability is negligible. The deficiencies discovered with these questions should be rectified because they create unwanted consequences, i.e. unnecessary work often causes ''various stresses and strains on the staff, particularly in situation where the usefulness of these reports is questionable or the staff perceives that these reports are just filed in back room drawer" (Tipgos and Trebby, 1987), and sometimes causing the complete abandonment of the computerized PMS.

The questions with the green field in front have the lowest importance, and the deficiencies discovered with these questions do not have an impact on the maintenance quality. Their impact is restricted to the overall DB appearance, and the evaluation grades to these questions are just an indicator of the attention DB construction team was paying to smaller issues. Therefore, the deficiencies discovered with these questions do not need to be rectified.

The evaluation of the data in the database is performed by a series of questions; each should be answered with a grade from 1 to 5.

The grades should have the following meanings:

Grade 1 – Fully negative evaluation result, very few positive findings

Grade 2 – Mostly negative evaluation with a minor number of positive findings

Grade 3 – Mostly positive evaluation with a significant number of irregularities

Grade 4 – Mostly positive evaluation with a minor number of irregularities

Grade 5 – Fully positive evaluation with a negligible number of irregularities

The questions evaluated with the grade 5 are considered satisfactory and do not require any modifications to be performed in the database. The questions evaluated with the grade 4 are also considered satisfactory, and although the area for an improvement exists, DB changes are not recommended (there will be no significant quality improvement). The questions with the grades 3, 2, or 1 are considered unsatisfactory and an improvement of the data should be performed there. The schedule of the data changes in the database should be performed according to the priority of the question, red first, yellow second.

The deficiencies discovered with the green colored questions do not require rectifying. However, discovery of a significant number of deficiencies using these questions is an indication of the general negligence of DB construction team and can be an indication of a serious deficiency. In this case, a complete DB inspection is recommended.

4. DATABASE EVALUATION

Several factors influence computerized PMS DB evaluation listed according to their importance:

- DB purchaser,
- DB development team,
- DB evaluator.

As DB purchaser and DB development team create DB specification prior to its development, they determine DB content and, therefore, directly influence DB quality and the evaluation results. The DB evaluator will always be subjective, and the grades given will vary from a person to a person. Variation of the evaluating grades will be reduced with clear and concise questions, and with precise defining of the evaluation grades.

Table 1.
Computerized PMS database evaluation questionnaire.

Area	Question	Grade				
		1	2	3	4	5
Machinery and equipment	01. Is all machinery and equipment included in the database?					
	02. Is all included equipment marked properly and uniquely, according to its shipboard location and markings?					
	03. Is all necessary machinery divided into subcomponents (into smaller subsystems) in logical manner?					
	04. Does machinery or equipment have larger number of subcomponents than necessary?					
	05. Is there equipment or machinery listed in the database more than once, or do they have same markings or names?					
	06. Is data about manufacturer, type and serial number entered into all relevant items?					
	07. Do all equipment and machinery entries have same style, abbreviations, and markings?					
Jobs inside DB	08. Do all devices in DB have linked maintenance plan according to manufacturer's recommendation?					
	09. Are manufacturer's recommendations grouped according to devices, periods and company maintenance rules?					
	10. Are all jobs required by company policy included in DB? (e.g. SSM – Safety Management System)?					
	11. Are all jobs based on manufacturer's recommendation changed due to company policy (if exists)?					
	12. Are all jobs required by flag state rules and regulations included in DB?					
	13. Are all jobs required by class society included in DB?					
	14. Is there a number of minor jobs which can be grouped together?					
Special jobs and rules	15. Is fire detection sensor list inserted into DB together with testing plan?					
	16. Is alarm system and its testing program entered in DB?					
	17. Is PMS self-improvement program inserted into DB, and is there control mechanism for PMS DB self-improvement program?					
	18. Is critical equipment marked according to company SMS?					
DB jobs general	19. Are job descriptions written clearly?					
	20. Are jobs created and grouped according to multiplier principle?					
	21. Are all same type jobs coming from different sources synchronized?					
	22. Are all same jobs resulting from different requirements (sources) merged?					
Spare parts	23. Are all required spare parts included in DB?					
	24. Are spare parts distributed to proper equipment and machinery?					
	25. Are all spare parts properly marked, do they have sufficient data for ordering?					
	26. Is company critical spare parts list inserted in DB?					
	27. Do all spare parts have same style, abbreviations, markings…?					
	28. Are there spare parts entered several times?					
Miscellaneous	29. Are all users inserted in DB, all access rights defined in order?					
	30. Is there any other deficiency noted in computerized PMS database?					

As all the three factors are the same for the first four evaluated databases, it is expected that the quality of the databases should be similar as well as the evaluation grades. The expected similarity of the Database 5 compared to others should be a little lower, considering that the two influence factors are different, DB purchaser and evaluator. If questions' and grades' descriptions are created properly, the evaluation grades of Database 5 should not differ significantly.

Database evaluation grades are shown in Table 2.

Table 2.
Evaluation results of computerized PMS databasest.

Question	Database 1					Database 2					Database 3					Database 4					Database 5				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
01.					x				x						x					x				x	
02.				x					x					x					x					x	
03.					x					x					x					x					x
04.					x					x					x					x					x
05.					x					x					x					x					x
06.				x					x				x						x					x	
07.				x					x					x					x					x	
08.					x					x					x					x					x
09.					x					x					x					x					x
10.	x					x					x					x						x			
11.	x					x					x					x						x			
12.			x					x					x					x				x			
13.					x					x					x					x					x
14.				x					x					x					x				x		
15.					x					x		x					x								x
16.					x					x					x					x				x	
17.				x					x					x					x					x	
18.					x					x					x					x					x
19.				x					x					x					x					x	
20.				x					x					x					x						x
21.	x					x					x					x						x			
22.					x					x					x					x					x
23.				x					x					x					x				x		
24.				x					x					x					x					x	
25.				x					x					x					x					x	
26.	x					x					x					x							x		
27.					x				x						x					x				x	
28.					x					x					x					x					x
29.					x					x					x					x					x
30.					x					x					x					x					x

5. EVALUATION RESULTS

The summation of grades given to each database, and the **average grade value** of each database are values which should be considered with reservations; the importance of the questions in DB is not the same. Therefore, the values calculated for these purposes are just an indication of the general condition of the data in DB. The summation of grades and the average grade values are shown in Table 3.

The assessment of major deficiencies serves to separate the questions where data in the DB was not in order. Questions which received lower evaluation grades (excerpt from Table 2) are in Table 4.

Table 3.
Summation of grades and average grade value.
Average grade value: summation of grades divided by the number of questions.

	Database 1	Database 2	Database 3	Database 4	Database 5
Summation of all grades	122	120	118	119	122
Average grade value	4.067	4.000	3.933	3.967	4.067

Table 4.
Questions with lower evaluation grades.

Question	Database 1					Database 2					Database 3					Database 4					Database 5				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
10.	x					x					x					x						x			
11.	x					x					x					x						x			
12.			x					x					x					x			x				
14.				x					x					x					x				x		
15.					x					x		X					x								x
21.	x					x					x					x						x			
26.	x					x					x					x					x				

The majority of the deficiencies in Table 4 are evaluated with Grade 1, indicating that the answer to the question was fully negative. The deficiencies discovered with the questions 10, 11, 12, 21, 26 appear with all evaluated databases, and their evaluating grades are the same, or very similar. The deficiency discovered with the question 14 appears with only one database (Brodospas d.d. database), and the deficiency discovered with the question 15 with two databases. All the questions belong to the red and yellow groups of questions, while in the green group no deficiencies were found.

The deficiencies detected with the questions 11 and 21 are directly linked with the deficiencies detected with the questions 10 and 12, i.e. resulting from them.

The resemblance analysis of the evaluation grades is made to verify the expectations that the evaluation grades will mostly look alike across all the evaluated PMS databases, with a slightly different behavior of the DB 5. The resemblance analysis of the evaluation grades is made according to Equation 1:

$$S = 100 - \frac{100}{nQ} \sum \left| Ri_{bj} - Ri_{bk} \right| \cdot \frac{1}{nG-1} \, [\%] \qquad (1)$$

where:
S – resemblance of grades of two databases
nQ – total number of questions
Ri–answer to i^{th} question (i = 1, 2 ... n)
bj – j^{th} evaluated database,
bk – k^{th} evaluated database; (j, k = 1, 2 ... m, j ≠ k)
nG – total number of grades

The resemblance analysis is shown in Table 5.

Table 5.
Comparison of resemblance of database evaluation results.

	Database 1	Database 2	Database 3	Database 4	Database 5
Database 1	X	98.33 %	96.66 %	97.50 %	90.00 %
Database 2	98.33 %	X	95.00 %	95.83 %	90.83 %
Database 3	96.66 %	95.00 %	X	99.17 %	86.66 %
Database 4	97.50 %	95.83 %	99.17 %	X	87.50 %
Database 5	90.00 %	90.83 %	86.66 %	87.50 %	X

The resemblance analysis of database evaluation results showed great resemblance of all Jadroplov d.d. databases, while the results of Brodospas d.d. database resemblance analysis are slightly lower. The comparison of resemblance confirmed the expected evaluation results, as it is written in the heading "Database evaluation".

6. DISCUSSION

The evaluation results analysis showed several results:

A – The summation of all the grades, as the first criterion, gave quite an equalized result; variations among the databases are very small.

B – The average grade value of every single tested database is satisfactory. If we compare the average grade value with the system of grades given above, every single database was awarded with "Mostly positive evaluation with smaller amount of irregularities" (Grade 4).

C – The resemblance of the evaluated databases is very high.

The analysis of the deficiencies showed that most of them are the same on all the databases, and are connected with the jobs related to the company experience, ISM or SMS Code, and flag state rules and regulations. This fact indicates a potential shortcoming during the process of creating the description of the DB (the list is created for DB specification and agreed by the purchaser and the development team) and to an insufficient control of the inserted data and an insufficient evaluation of the data after the DB was developed. The repetition of the same deficiencies across all the evaluated databases indicates the possibility of DB development team as the key factor which caused the repetition of the deficiencies. This claim is dubious because the evaluated sample is too small.

The deficiencies discovered with the questions 14 and 15 appear with only two evaluated databases. The reason for them seems to be the absence of instruction books (information) during DB construction.

The third database evaluation stage, analysis of the evaluation (Pipino et al., 2002), presented the following results:

- An improvement of the evaluated databases should be performed to rectify the discovered deficiencies (see Table 4). After finishing with the improvement of the data, a new evaluation should be performed with the use of the questionnaire.
- Database specification and contraction process between the purchaser and the construction team should be improved for better data quality in DB.
- Data checking during the construction and DB evaluation process before DB delivery should be improved to prevent the use of databases with deficiencies.

7. CONCLUSION

Good data quality in PMS DB is the basic condition for a normal operation of the Planned Maintenance System and, consequently, for the quality of maintenance. The evaluation of the data quality is a process which requires knowledge and competence from the DB evaluator and a well-defined evaluation system to achieve a relevant and reliable evaluation result. The absence of a unique and well-defined process of DB contracting, supervision, and evaluation leads to a major problem described in this paper, which is the repetition of the same mistake from DB to DB.

The data quality checking system described in the paper is based on the evaluation of database using a specifically designed questionnaire. The questionnaire fulfilled its purpose, first during the test period, and later in use by the end user. The evaluation grades of all the databases showed high resemblance, and that fact shows that the questions in the questionnaire and the description of grades are formulated well, with clarity and precision. This caused a decrease in variation of the grades and DB evaluator's potential subjectivity.

The evaluation of the database with the use of the questionnaire determined the areas where the data in DB can

be improved and pinpointed some potentially weak spots in DB development process. The average grade value and the noted deficiencies during the data evaluation are a good indicator of the complete database condition.

It has been proved that the questionnaire is a useful tool for the evaluation of the data in PMS DB and as help for all the persons involved in DB contraction and construction process. The use of the questionnaire has proven to be simple and the results obtained are reliable.

During the evaluation and the analysis of the results a possible new claim appeared. It appears that DB development team is the key factor for the repetition of the deficiencies; therefore, the key factor in the whole process of database construction. This claim can redefine the order of importance factors that influence computerized PMS DB quality. This claim is still not confirmed and requires a completely new research.

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Analysis of Available Vessels and Storage Capacities in Case of Large Oil Spill in European Union with Particular Reference to Republic of Croatia

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Considering the constant growth of maritime transport and the role of the European Union in the international seaborne trade, it is important to determine the readiness of the EU in case of marine pollution. This paper summarizes the data regarding the number of the vessels ready for the response, and immediate and long-term storage facilities for the oily waste collected after an operation on the European Union territory. The aim of the study is to show the current available operational capacities in each Member State, as well as to determine the strength and capacity of five European regions for a prompt and efficient response to an oil spill. This paper seeks to highlight the importance of practical details that should be accessible and well prepared when an oil spill occurs. Based on the analysis of secondary data, it was found out that the Mediterranean area has the largest number of vessels ready for response in case of oil pollution, while the largest storage capacity for oily waste on shore is in the Baltic region. Particular reference is given to the Republic of Croatia which currently has nine available response vessels with the total storage capacity on board of 49.7 m^3.

KEY WORDS
~ Marine pollution
~ Oil spill
~ Oil response vessels
~ Storage facilities

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1. INTRODUCTION

The UN defines marine pollution as: "*The introduction by man, directly, or indirectly, of substances or energy to the marine environment resulting in deleterious effects such as hazards to human health, hindrance to marine activities, impairment of the quality of seawater for various uses and reduction of amenities*" (United Nations Convention on the Law of the Sea, 1982).

There are various sources of pollution such as sewage, sedimentation, solid waste, biological, chemicals, radioactive substances, oil, etc. One of the major pollutants worldwide besides sewage and solid waste is oil. Every year, millions of tons of oil end up in the marine environment which has devastating consequences on marine ecosystems. When an oil spill occurs, the influence which will affect the environment can be determined by the type and amount of toxic constituents which are present in a petroleum product (Stoyanov et al., 2017).

Oil spills can be caused by operational and accidental discharges during shipping activities. Most incidents of oil spills were the result of a combination of different actions and circumstances. Most of the oil spills are caused by tankers, and a recently increased amount of oil gets into the marine environment due to daily operations. Operational causes are classified as loading/unloading and other operations. Accidental causes often cause major spills of oil, and are classified as collision, grounding, fire or explosion. The residue discharge is caused by routine operations. Even though statistics show that the number of large oil spills has decreased, we should not neglect smaller spills which occur on daily basis, especially in the areas of increased traffic, such as China and some parts of the European coasts (e.g. Barents and North Seas) (Kirby and Law, 2010; Woolgar, 2008).

As International Maritime Organization underlines, the response to marine pollution incidents requires special knowledge and expertise, as well as dedicated equipment and tools (International Maritime Organization, 2017). The key to each response to oil pollution is to reduce damage to the environment and socio-economic resources. Since the oil is identified as contaminant, the ultimate goal is to reduce the time for recovery from oil. The best way to achieve this is the process of Net Environmental Benefit Analysis. Important steps for the implementation of this process are collection of information on physical characteristics, ecology, checking previous spills and the methods that were used, predicting the consequences for the environment, and checking the advantages and disadvantages of different methods of cleaning the oil (IPIECA, Response Strategy Development Using Net Environmental Benefit Analysis (NEBA), 2015).

The subject of this paper is to analyze the capacity and equipment of the EU Member States in case of marine pollution by oil and to identify the location for the reception of oily wastes after cleaning and rehabilitation. The analysis was carried out by using the available sources of primary and secondary data: Inventory of EU member states' oil pollution response vessels in 2016, and Study on discharge facilities for oil recovered at sea in 2012 (Inventory of EU Member States Oil Pollution Response Vessels in 2016, 2016; Study on Discharge Facilities for Oil Recovered at Sea in 2012, 2012).

Upon analysis, the summary of the total capacity that EU has on disposal will be provided. As official EU statistics differentiate between five European sea areas (the Baltic Sea, North Sea, Black Sea, Atlantic, and Mediterranean regions), the overview of capacities including vessels, equipment, and on-shore-based capacities for the reception of waste will be analyzed through these regions. Results are provided for the European countries, EFTA countries, and candidate countries. The latest available data for the Republic of Croatia were collected, and the analysis of the current state of the vessels and equipment is given.

2. AVAILABLE VESSELS, STORAGE CAPACITIES ON VESSELS AND OIL-DISCHARGING FACILITIES IN THE EUROPEAN UNION

Oil spills at sea are unpredictable and interventions in major accidents require the involvement of several countries. The methods which will be used during oil spill incident in a specific area depend on the characteristics of the oil spill and the characteristics of the area where the spill occurred, such as climate, oceanographic or geographical features of the biological and economic potential. They also depend on the available equipment, logistic support and staff teamwork. The key points for an optimal response regarding waste generation after oil spills are the knowledge of the best available techniques and the awareness of logistical constraints.

When an oil spill occurs, the most important part is the quick and timely response, and the big problem may arise if the wrong mode of action is taken. For this reason, the majority of countries have made plans in case of accidental marine oil pollution, i.e. Contingency Plans, which represent a guide for the action in case of accidental pollution.

In case of an oil spill in the European seas, a network of 16 fully equipped stand-by ships for the response is established (European Maritime Safety Agency, 2017). The primary objective of the Stand-by Oil Spill Response Vessel service is to "top-up" the marine oil recovery capacity of Member States, thus minimizing the potential impact on the European coastline. The Stand-by Oil Spill Response Vessels will, under normal circumstances, carry out their usual commercial activities. However, in the event of an oil spill, and following a request for assistance from a Member State, the nominated vessel will cease its normal activities and, at short notice, be mobilized and operate as a certified oil recovery vessel (European Maritime Safety Agency, 2017).

Each response method, chemical or mechanical, brings a different kind of waste that should be temporary stored and disposed of in a long term. The efficient and rapid discharge of the at-sea recovered oil is essential in order to allow these specialized vessels to maximize their time spent in oil spill recovery operations (Study on Discharge Facilities for Oil Recovered at Sea in 2012, 2012).

Besides storages on shore, if the vessel has storage capacities on board ship, a better planning of complete logistics for the response operation is possible.

In addition to an established network of standby ships, systems for monitoring Clean Sea Net and MAR-ICE, and other preventive or operational measures for the prevention of pollution, it is of great importance to determine the capacity of individual states, private and governance mechanisms that are used in the response to a marine pollution.

According to the available data (Inventory of EU Member States Oil Pollution Response Vessels in 2016, 2016; Study on Discharge Facilities for Oil Recovered at Sea in 2012, 2012), in Tables 1 and 2, the overview of available vessels and equipment, on board storages, and possible facilities for discharge (m^3) on shore is presented.

It is also important to underline some facts about the methods of analyzing the secondary data which are presented in the tables. The comparison of two different studies is provided.

The Oil Spill Response Vessel Inventory for 2016 provides information on the pollution preparedness and response mechanisms and capabilities of the EU, EFTA coastal States and Turkey, long-time candidate for EU (Inventory of EU Member States Oil Pollution Response Vessels in 2016, 2016). The data given throughout this document include complete specifications and details about vessels, equipment, and anti-pollution equipment. All the vessels that are processed during the study are defined in the same way. For this comparison, we decided to

extract data about the number of vessels for each country and their storage capacity on board. Within the table, the following abbreviations for the types of vessels will be used: Emergency Towing Vessel - ETV, Search and Rescue Boat - SAR, and Oil Recovery Vessels - ORV. Besides them, multipurpose vessels and other categories of ships are also included.

The second study, Discharge facilities for oil recovered at sea (2012), presents all the available on-shore facilities (immediate and long-term) for the reception of oil recovered at sea which is collected by the specialized oil spill response vessels. During this research, there were some restrictions that were taken into consideration. Each facility had to been suitable to accommodate EMSA's vessels and receive recovered oil, and the relative capacity had to be at least 1,000 m^3. The total of 35 facilities (495 of them were contacted, 67 replied) were marked as suitable for this kind of operations (Study on Discharge Facilities for Oil Recovered at Sea in 2012, 2012). Therefore, the data that will be presented do not refer to the total state of possible storage capacity for the

Table 1.

Overview of available vessels, storage capacities on vessels and oil discharging facilities in European Union by country.
Source: Made by authors according to data extracted from Oil Spill Response Inventory (2016) and Discharge facilities for oil recovered at sea (2012) (Inventory of EU Member States Oil Pollution Response Vessels in 2016, 2016; Study on Discharge Facilities for Oil Recovered at Sea in 2012, 2012).

Country	No. of vessels (ETV, ORV, SAR, Multipurpose)	Total storage capacity on vessels (m^3)	Potential oil discharging facilities (capacities in m^3)	
			Immediate	Long term
Belgium	7	n/a	1,600.00	1,000.00
Bulgaria	8	895.60	n/a	n/a
Croatia	21	n/a	n/a	n/a
Cyprus	3	n/a	2,000.00	2,500.00
Denmark	10	1,672.20	7,000.00	25,000.00
Estonia	4	459.00	n/a	n/a
Finland	18	5,898.10	17,900.00	20,800.00
France	9	1,971.50	3,000.00	8,500.00
Germany	30	15,565.00	1,000.00	3,000.00
Greece	10	290.00	9,500.00	44,500.00
Iceland	1	640.00	n/a	n/a
Ireland	1	n/a	57,000.00	57,000.00
Italy	39	4,435.06	7,950.00	37,000.00
Latvia	6	286.00	10,000.00	20,000.00
Lithuania	3	353.00	7,000.00	5,000.00
Malta	9	264.20	3,500.00	6,500.00
Norway	23	8,376.20	n/a	n/a
Poland	10	844.00	n/a	n/a
Portugal	22	360.70	27,500.00	45,000.00
Romania	18	230.00	2,500.00	5,000.00
Slovenia	3	n/a	n/a	n/a
Spain	14	4,442.00	10,400.00	14,700.00
Sweden	15	6,478.00	131,000.00	143,000.00
Turkey	n/a	n/a	60,000.00	60,000.00
Netherlands	19	48,991.00	10,000.00	25,000.00
United Kingdom	n/a	n/a	2,000.00	1,600.00

Table 2.

Available vessel storage capacities and oil discharging facilities in European Union by areas.

Source: Made by authors according to data extracted from Oil Spill Response Inventory (2016) and Discharge facilities for oil recovered at sea (2012) (Inventory of EU Member States Oil Pollution Response Vessels in 2016, 2016; Study on Discharge Facilities for Oil Recovered at Sea in 2012, 2012).

Area	Country	No. of vessels	Total storage capacity on vessel (m^3)	Potential oil discharging facilities (capacities in m^3)
Baltic Sea	Denmark	10	1,672.20	32,000.00
	Estonia	4	459.00	0.00
	Finland	18	5,898.10	38,700.00
	Latvia	6	286.00	30,000.00
	Lithuania	3	353.00	12,000.00
	Poland	10	844.00	0.00
	Sweden	15	6,478.00	274,000.00
	Total	**66**	**15,990.30**	**386,700.00**
North Sea	Belgium	7	0.00	2,600.00
	Germany	30	15,565.00	4,000.00
	Iceland	1	640.00	0.00
	Norway	23	8,376.20	0.00
	The Netherlands	19	48,991.00	35,000.00
	UK	0	0.00	36,000.00
	Total	**80**	**73,572.20**	**77,600.00**
Atlantic Region	Ireland	1	0.00	114,000.00
	Portugal	22	360.70	72,500.00
	Total	**23**	**360.70**	**186,500.00**
Mediterranean Sea	Croatia	21	0.00	0.00
	Cyprus	3	0.00	4,500.00
	France	9	1,971.50	11,500.00
	Greece	10	290.00	54,000.00
	Italy	39	4,435.06	44,950.00
	Malta	9	264.20	10,000.00
	Slovenia	3	0.00	0.00
	Spain	14	4,442.00	25,100.00
	Turkey	0	0.00	120,000.00
	Total	**108**	**11,402.76**	**270,050.00**
Black Sea	Bulgaria	8	895.60	0.00
	Romania	18	230.00	7,500.00
	Total	**26**	**1,125.60**	**7,500.00**

reception of oily waste across the European seas. For the purpose of this paper, only the data regarding possible location of storage facility and capacity in m^3 will be shown.

According to Table 1, Italy and Germany are the countries with the highest number of vessels for response to oil pollution. There are 39 vessels in Italy and all of them had class ORV, which is not the case with other countries. For example, Germany is in the second place according to the number of vessels, but as a difference from Italy has 18 oil response vessels, and also has an emergency towing vessel, and ice breakers. Regarding the storage capacity on board, it should be noted that the Netherlands has a significant fleet with the largest storage capacity on ships, with the total of 48,991.00 m^3. For some of the countries, such as Turkey or Ireland, there are no available data regarding storages on board, but e.g. they have available huge storage capacities on shore (immediate and long-term). Turkey ranks second and Ireland ranks third regarding storage facilities on shore.

Sweden has the largest storage capacity on shore, 131,000.00 m^3 for immediate storage, and 143,000.00 m^3 for long term storage of oily waste.

Although it appears that the Republic of Croatia is within the top five countries in terms of the number of vessels, it is important to note that 10 of them are ORV and 11 of them are SAR.

Except for the capacity analysis per country, it is essential to link a particular country to the European seas to which it belongs and thus to determine the strength and ability of each of the European regions for a prompt and proper response to a potential oil spill.

Table 2 analyzes vessels, their capacity, and total storage capacities available on shore through regions. Some of the EU Member States border more than one sea, but in the comparison one country will be taken into consideration only once. The criterion for the selection was the area of the country which has access or is bordering a particular sea. If the area is greater for a specific region, then the state was affiliated to this region or sea, e.g. in the case of Spain, which can be related to the Atlantic and Mediterranean regions, where the significance of the Mediterranean region is greater.

According to the data, 90 % of the European Union's external freight and 40 % of its internal freight is carried by sea (Transport, Connecting Europe's Citizens and Businesses, 2014), and the busiest routes are those in the Baltic and Mediterranean regions.

As indicated in Table 2, in case of large oil spills countries in the Mediterranean Sea have 108 vessels at their disposal, available for response with the total capacity of 11,402.76 m^3 on board vessels, and 270,050.00 m^3 for storage of oily waste on shore. It can be noted that the Mediterranean region has the largest number of vessels which can be deployed, but after the oil recovery operation the largest on-shore storage capacities for oily waste acceptance are in the Baltic region, with the total of 386,700.00 m^3. The Baltic Sea countries have so far successfully responded to any pollution which was recorded in their waters, and HELCOM had a very important role. The ships that sail the Baltic Sea must adhere to strict regional and global regulations on the prevention of discharges of oil (HELCOM, 2017).

The North Sea data should also be highlighted. This area is one of the most potential threats due to the majority of offshore operations. The table shows that the North Sea area has the largest storage capacity on vessels (73,572.20 m^3) which is almost 7 times higher than the Mediterranean region.

For the European part of the Black Sea (Bulgaria and Romania), there are 26 vessels on disposal and a small storage capacity on vessels and on shore, approximately 8,500.00 m^3 in total.

If there is a potential threat, the above mentioned data could easily lead to a wrong conclusion about the equipment and preparedness of the EU countries for a fast and effective response in case of pollution.

Already in 2013 the European Economic and Social Committee (EESC), through their Opinion about multiannual funding for the action of the European Maritime Safety Agency in the field of response to pollution caused by ships and to marine pollution caused by oil and gas installations (Proposal for a Regulation of the European Parliament and of the Council, 2013), stated that the network of 19 stands by oil response vessels (at this moment there are 16 vessels on disposal) might be insufficient for the entire EU coastal area, and also raised the question whether the Member States and neighboring countries were sufficiently equipped to respond to a larger scale pollution. Similarly, the Committee warned that the planned funds for enhanced oil equipment in the period 2014 - 2020 may become sub-optimal and that an improvement of equipment for offshore spills, additional dispersant capabilities and replacement of oil response pollution equipment was needed (Proposal for Regulation of the European Parliament and of the Council, 2013).

Besides the equipment improvement, the member states should discuss the optimal distribution of storage facilities (short term and long term) on the mainland, and their redevelopment for the acceptance of EMSA's vessels. A lack of storage facilities for oily waste and their remoteness translates into additional costs and could delay a prompt and effective response.

3. AVAILABLE VESSELS AND STORAGE CAPACITIES ON BOARD IN REPUBLIC OF CROATIA

Although the Adriatic Sea is relatively small and well preserved, it is highly threatened by the extensive growth of maritime traffic and dangerous cargo in particular, of which crude oil traffic is the most dangerous (Lušić et al., 2008). The main cargo seaports like Trieste, Venice, Koper, and Rijeka are situated in the

northern Adriatic and they are associated in the North Adriatic Ports Association - NAPA. Every year more than 100 million tons of cargo are handled in NAPA seaports, which is not surprising considering the perfect position of seaports which make the most appropriate gateway to the main European markets (Twrdy and Batista, 2014). The main advantage of NAPA seaports is 2,000 Nm shorter naval route from the Far East via Suez to Europe in comparison with other North-European ports (North Adriatic Port Association, 2017).

The constant annual growth of traffic in NAPA seaports is expected; recent data show 3.3 % increase in the total cargo handled in 2016 compared to 2015 (North Adriatic Port Association, 2017).

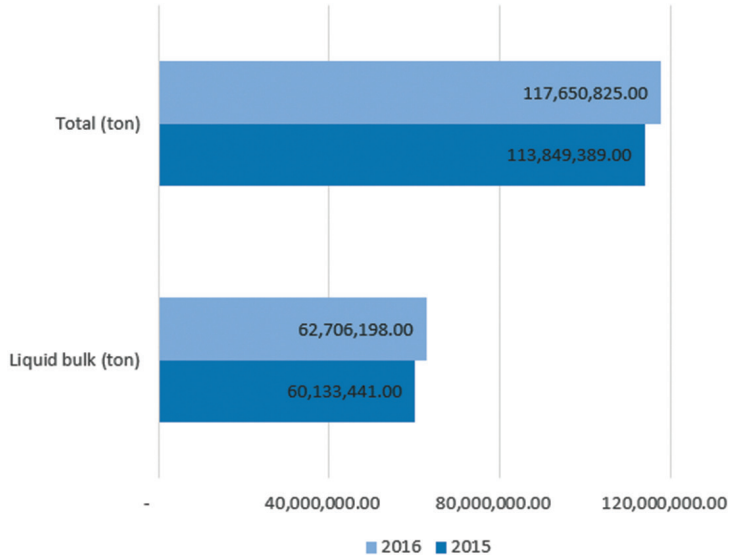

Figure 1.
Overview of total cargo and liquid bulk handled in NAPA seaports for 2015 and 2016.
Source: Made by authors using data of North Adriatic Ports Association (NAPA) (North Adriatic Port Association, 2017).

According to the Figure 1, comparing 2015 and 2016, except the increase in total cargo handled, the increase of liquid bulk is also recorded in NAPA seaports. It is evident that the majority of the total cargo handled in these ports (approximately 50 %) is liquid bulk. Also, the new transportation route for the Caspian oil, and One Belt One Road initiative will foster the growth of not only NAPA seaports, but the eastern Adriatic ports as well.

The presented facts and figures indicate an increased risk of potential pollution of the Adriatic, wherein the greatest threat is certainly oil pollution. From the foregoing, the importance of the prevention activities and response planning should be emphasized. There are six countries that have access to the Adriatic Sea, three of which are EU member countries, and the other three countries are candidates or potential candidates. Each country has its own contingency plans for response to pollution, but in case of a major pollution Croatia, Slovenia and Italy have the Sub-regional Contingency Plan for the prevention of, preparedness for and response to major marine pollution incidents that shall be activated.

The first step in the protection is an identification of the subject and equipment which are capable of intervention in the case of marine pollution. If there is an oil spill, and the Contingency plan is activated, the identified equipment must be available and the response teams must be trained to handle the equipment correctly. During the inventory of equipment by EMSA, the relative data for Croatia were not complete. There were no detailed data on the amount of storage capacity, operation of the vessel and pollution equipment on board the vessel.

Although Table 1 indicates that the Republic of Croatia had 21 available vessels along the coast in 2016, the analysis of the relative data reveals that only 10 of them were oil response vessels of which one was in the past for a few months indicated as "not available" due to the technical limitations (Nacrt Zaključka o prihvaćanju Godišnjeg programa rada Županijskog operativnog centra za provedbu Plana intervencija kod iznenadnih onečišćenja mora u Dubrovačko- neretvanskoj županiji za 2017. godinu, 2017). According to the available data of the Ministry of Sea, Transport and Infrastructure of the Republic of Croatia, besides the above mentioned ORV vessels there are two ETV

Table 3.

Overview of available oil recovery vessels and appropriate equipment in case of oil spill .

Source: Made by authors according to the data provided by the Ministry of Sea, Transport and Infrastructure of the Republic of Croatia (2017) (Zaštita Jadrana, Ministry of Sea, Transport and Infrastructure of Republic of Croatia, 2017).

Category	Vessel Name	Place of storage (longitude and latitude)	Purpose and technical specification of equipment on board vessel	Storage capacity (m^3)
ORV	INKOCLEAN EKO C1	Split, Croatia (43.506 N 16.441 E)	Specialized vessel for collecting hydrocarbons and solid waste from the sea surface. Equipment: portable submersible turbine pump for collection of oily water, dispersants, brush skimmer, hydraulic platforms for the collection of floating waste.	n/a
ORV	ECO 13/5	Split, Croatia (43.506 N 16.438 E)	Equipment: brush skimmer, dispersants, booms	4.8
ORV	ECO I	Pula, Croatia (44.871 N 13.839 E)	Collection of solid and liquid waste from the sea surface, encircling contamination by protective curtains, application of dispersants, aeration undersea	10
ORV	ECO II	Rijeka, Croatia (45.323 N 14.444 E)	Collection of solid and liquid waste from the sea surface, encircling contamination by protective curtains, application of dispersants, aeration undersea	10
ORV	ECO III	Rijeka, Croatia (45.322N 14.437 E)	Collection of solid and liquid waste from the sea surface, encircling contamination by protective curtains, application of dispersants, aeration undersea	10
ORV	ECO 13/4	Rijeka, Croatia (45.321N 14.448 E)	Collection of solid and liquid waste from the sea surface, encircling contamination by protective curtains. Equipment: Foilex micro skimmer, firefighting pump, pump for dispersant application, crane	5
ORV	ECO 13/3	Zadar, Croatia (44.119 N 15.226 E)	Emergency response vessel (transportation of the equipment), collection of solid and liquid waste from the sea surface, encircling contamination by protective curtains. Equipment: skimmers, booms, dispersants and two cranes.	4.6
ORV	ECO 13/2	Šibenik, Croatia (43.737 N 15.884 E)	Equipment: booms, dispersants, skimmer, firefighting equipement, crane	0.3
ORV	ECO 13/1	Port of Ploče, Croatia (43.061 N 17.424 E)	Not on disposal from March 2017 due to technical and mechanical deficiencies.	n/a
ORV	INKOCLEAN EKO C2	Dubrovnik, Croatia (42.644 N 18.095 E)	Specialized vessel for collecting hydrocarbons and solid waste from the sea surface. Equipment: brush skimmer, front crane basket for collection of floating waste, dispersants (dispersant capacity 1000 l) , booms	5

vessels (storage capacities not available), three barges (6,200 m^3 total storage capacity) and one tanker for the transport and manipulation of oil and other fluids (1,054 m^3 storage capacity on board).

Table 3 gives the summarized data of the available storage capacities and equipment on board each response vessel. Also, where the data was available the purpose of the ships is indicated.

Regarding the distribution of the vessels, they are well positioned and the Primorsko-Goranska County, where the main cargo port Rijeka is located, has the largest number of vessels and available equipment. A possible problem may arise in the port of Ploče, Croatia's second biggest cargo port, where from this year there are no available response vessels. For planning effective response, the information about available storage capacity on response vessels is also important. From the data above, it is evident that some of the ORV vessels have very low capacities. The total available capacities for these available 10 ships is 49.7 m^3.

Due to the uneven data, we were not able to properly display the available storage facilities on shore.

4. CONCLUSIONS/RECOMMENDATIONS

For the purpose of effective and timely response, and in terms of available equipment and storage capacity, the following recommendations should be followed:

- Regular and, if applicable, annual update of information about available vessels and equipment for pollution response.
- Review the information on storage capacities on the mainland, and invite all Member States (the competent authorities) to collect and maintain the unified database of possible storage capacities.
- Accurate and updated data will help identification of provision of additional equipment, ships and storage capacities, and thus enable the adoption of support measures for an increase of storage capacities as well as initialization of sustainable management for collected oily waste.
- Plan the location of equipment and storage capacities according to the estimated risk.
- The Republic of Croatia should improve the database of active equipment and storage capacities through legislative measures or with the help of EU funds encourage the purchase of additional equipment for the response.

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Theoretical and Practical Significance of the Issue of Maritime Delimitation in the Law of the Sea

Bojana Lakićević-Đuranović

This paper aims to show the significance of maritime delimitation in the Law of the Sea, as well as the contribution of international jurisprudence to the creation of the rules of maritime delimitation. The decisions of the International Court of Justice (ICJ) and the awards of arbitration tribunals are especially significant in the part of the Law of the Sea dealing with maritime delimitation. Based on the analysis of the principle of equity and the method of equidistance, the jurisprudence of the courts is shown to have established precedents and to have an irreplaceable role in the development of the international Law of the Sea, particularly in the segment of maritime delimitations.

KEY WORDS
~ Delimitation
~ Equidistance
~ Principle of Equity

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1. INTRODUCTION

The international Law of the Sea has been striving to develop an equitable regime for delimitation of maritime zones for over half a century. Due to the relative ambiguity of the Geneva Convention on the Law of the Sea (1958) and of the Convention on the Law of the Sea (1982) on the issue of delimitation of maritime zones, case law of international courts, arbitration and ad hoc tribunals has a significant role in the formulation of general principles applicable to the delimitation of maritime boundaries.

In the age when states have, for the most part, stabilized their territorial sovereignty on land, the determination of the limits of their maritime rights and delimitation became major issues in the Law of the Sea in the second half of the 20th century, as seen in the sheer number of bilateral agreements on the delimitation of maritime boundaries signed between states worldwide.

More than 30 % of oceans in the world today fall under some sort of state jurisdiction, creating the need for as many as 430 international maritime boundaries and delimitations. Less than a half are partially aligned and regulated by an agreement.

Although the need to define the rules of maritime delimitation arose at the time of gradual expansion of territorial sovereignty of coastal states from land and inland waters to territorial sea, old maritime regulations establishing state sovereignty over 3-12 nautical miles of territorial sea (Limits in the Seas, 1999), by their very nature, caused overlapping and disputes to a much lesser extent.

Maritime spaces in the international Law of the Sea are defined with respect to the jurisdiction of the respective coastal

state over such spaces. The distinction between maritime boundaries of a state and maritime delimitation must therefore be explained. The establishment of maritime boundaries consists of drawing lines that define maritime spaces under the jurisdiction of a country, i.e. spaces which are not in contact with the maritime spaces of another country. It is a unilateral act by means of which a state separates maritime zones from open sea. Maritime delimitation is an operation conducted by and between two or more states with the objective of separating overlapping areas in which the rights of such coastal states conflict, with each state aspiring to obtain spatial jurisdiction over the same maritime space (Caflish, 1991). One of the basic characteristics of maritime delimitation is emphasized here, i.e. that *it is conducted by and between two or more states*. The delimitation of maritime zones concerns the division of the spatial reach of state jurisdictions. The aforementioned jurisdiction may be considered spatial, given that it refers to a certain space and may be exercised only within that space.

The issue of the source of the part of the Law of the Sea regulating maritime delimitation is specific in many aspects. When the Commission for International Law started to study the issue of maritime delimitation, there were practically no legal rules regulating this area. The onset of formation of legal rules and norms of maritime delimitation was simultaneous with the appearance of the institute of continental shelf in the middle of the last century. As early as 1958, only thirteen (13) years after the first proclamation of continental shelf by American president Truman, the Geneva Conventions codifying continental shelf issues, along with the issues of territorial sea, outer limits and open sea, was signed. Most of the papers on the history of maritime delimitation begin with Truman's Declaration from 1945 or with the discussions of the Commission for International Law in the first half of the last century.

The relevance of common law in the delimitation of maritime boundaries is considerable. However, customary legal principles gradually developed until World War II (WWII) were mainly ignored in the theory of the international Law of the Sea in the segment pertaining to maritime delimitation. Nevertheless, common law remains a significant source of the law of maritime delimitation, as stated in Article 83 of the Convention on the Law of the Sea stipulating that the delimitation of maritime zones needs to be performed *based on international law, as described in Article 38 of the Statute of the International Court of Justice (ICJ), with the aim of reaching an equitable solution* (Convention on the Law of the Sea, 1986). Therefore, the practice of international courts in this field is much more than a subsidiary source. States negotiating an agreement almost invariably strive to base their argumentation on the wording and the spirit of international agreements, as well as on customs and court precedents. Case law also has great weight when used as argumentation in negotiations. The decisions of the International Court of Justice (ICJ) concerning the limits of fishing zones in the disputes between Great Britain and Norway, as well as between Great Britain and Iceland, are important for the segment of the Law of the Sea relating to maritime delimitation (Fisheries (United Kingdom v. Norway), 1951; Fisheries Jurisdiction (United Kingdom of Great Britain and Northern Ireland v. Iceland), 1974). Although these disputes do not concern maritime delimitation directly, some of the Court's positions from these judgments are very significant for defining the limits of certain maritime zones. Territorial delimitation dispute between Honduras and El Salvador, which partially revolved around the issue of historical maritime boundaries in the Gulf of Fonseca should be mentioned here (Land, Island and Maritime Frontier Dispute (El Salvador/ Honduras: Nicaragua intervening, 1992).

The International Tribunal for the Law of the Sea is also of great importance for maritime delimitation. The Tribunal was established by the 1982 Convention on the Law of the Sea as a court of specialized jurisdiction based in Hamburg. In accordance with Article 293 of the Convention, the Tribunal "shall apply this Convention and other rules of international law not incompatible with this Convention". Thus, the Convention is the main and other rules of international law secondary sources. The Tribunal may also decide on the basis of equity with the agreement of parties to the dispute.

Presently, and especially with respect to disputes concerning maritime boundaries, once considerable differences between court and arbitration methods of dispute resolution became negligible. There are, of course, special characteristics of these two processes that make them clearly distinct. Having emerged as an alternative in the diplomatic resolution of disputes, arbitration primarily started gaining importance as a manner of quasi-legal resolution of disputes. Starting from the 20th century, arbitration began assuming the characteristics of a real legal process and approximating court proceedings of dispute resolution at a faster pace. The role of equity as a principle, the rules of delimitation and the role of equidistance as a method of delimitation proved to be the most disputable issues in case law of international courts and tribunals among legal issues of relevance for the Law of the Sea.

2. EQUITY AS A PRINCIPLE AND RULE IN THE LAW OF MARITIME DELIMITATION

Aristotle was the first great philosopher to explain the functioning of the process of equity in law. Equity is not better than law, it is simply better law and goes beyond the text of the regulations only to the extent necessary for the rectification of some imperfection, the root of which lies in the generality of the regulations – which is almost always inevitable, since it is practically impossible to formulate a text to encompass and predict all situations occurring in real life (Aristotle, 2017).

Aristotle's influence on European legal tradition is significant. Equity in international law is not the same as the concept of equity in domestic law and can be defined and identified in various forms and in many societies. Equity which is the subject of study in international law is mostly related to western legal traditions. The principles of equity developed over time both in Roman law and English common law due to the need to improve the corpus of legal rules. In Roman law, equity was contained in *jus honorarium* by means of which praetors, based on the advice of judges, issued edicts in order to complement or rectify *jus civile*. Resorting to equity is particularly characteristic for early phases of development of branches of law, when practice is not sufficiently developed and enables the full expression and formulation of legal rules. Two great 17th century theoreticians, who had an impact on the creation and development of international law, Grotius and Pufendorf, assigned a significant role to equity. These theoreticians held that a judge who needed to use his/her right of discretion as opposed to the word of law, demonstrated certain tension.

The texts of important decisions and the Conventions on the Law of the Sea state and stipulate that maritime boundaries need to be established and delimited by applying the principle of equity, simultaneously taking into account all the relevant circumstances so as to arrive at a fair result. To acknowledge the great importance of equity in the process of delimitation of maritime zones, the legal function of equity in the fulfillment of such role needs to be defined. Two positions were formulated in the international Law of the Sea. The first position is that the application of equity would result in the change of the general legal rule if required by special case-related circumstances. The second approach gives greater autonomy to equity, treating it as an integral part of the Law of the Sea on its own. The starting point, that the uniqueness of every maritime boundary dispute prevents the establishment and application of general rules of delimitation, is in favor of the notion of autonomous equity, leading us to conclude that equity has a key role in the process of delimitation. The role of equity is to supplement the rules in a particular case and these rules should differ on a case to case basis. A judge of the International Court of Justice (ICJ) and professor of international law Jiménez de Aréchaga, in the continental shelf dispute between Tunis and Lybia (Continental Shelf (Tunis/Libyan Arab Jamahiriya), 1982), defined the principle of equity as follows: *„... to resort to equity means, in fact, to assess and to balance the relevant circumstances of a case, with the aim of enforcing justice, not through a rigid application of general rules and principles, but through adjustment and adaptation of such principles, rules and concepts to the facts, realities and circumstances of each case ...*" According to the Court's reasoning in the case of Tunis/Libya, equity applicable to maritime delimitations is primarily the equity of results, instead of equity of principles and rules. In this case, the International Court of Justice (ICJ) indicated that the Court „is obliged to observe the principles of equity as a part of the international law and to weigh various considerations that the Court deems relevant with the purpose of achieving a fair result (Continental Shelf (Tunis/Libyan Arab Jamahiriya), 1982).The generality of the norm prescribed by the Convention on the Law of the Sea for maritime delimitations leaves a lot of space for the discretionary role of a judge, while to the same extent, reinforcing the role of the courts and tribunals dealing with the issues of delimitation.

3. APPROACH TO DELIMITATION BASED ON THE METHOD OF EQUIDISTANCE

In the beginning, states applied the rules for the delimitation of rivers and lakes to maritime boundaries. Therefore, delimitation sometimes relied on *thalweg*, although the method of equidistance was also used. The word equidistance denotes an equal distance, i.e. equal remoteness and spacing between the coasts of two states. It originates from the Latin word *equi* which means equal, even and Latin word *distantia* which means distance.

When we discuss delimitation at sea, Article 15 of the Convention on the Law of the Sea (1982) needs to be mentioned. It provides for three integral elements: agreement, equidistance and special circumstances, due to which it is often referred to in literature as a combined rule: *Where the coasts of two States are opposite or adjacent to each other, neither of the two States is entitled, failing agreement between them to the contrary, to extend its territorial sea beyond the median line every point of which is equidistant from the nearest points on the baselines from which the breadth of the territorial seas of each of the two States is measured. The above provision does not apply, however, where it is necessary by reason of historic title or other special circumstances to delimit the territorial seas of the two States in a way which is at variance therewith*. Therefore, agreement remains the first means of delimiting territorial sea in the Convention on the Law of the Sea. Article 15 proves that the rule contained in the first sentence is of dispositive nature and, hence, the states are at liberty to negotiate solutions different from those stipulated by the relevant rules of international law. Sovereign states are always free to conclude or not to conclude agreements and freely determine the contents of the agreement within the limits set by peremptory norms (jus cogens).

In the absence of agreement to the contrary, states are authorized to expand their territorial sea up to the median line. Due to the wide acceptance of the median line, this method of delimitation deserves to be discussed in more detail. This is a line along which every point is equidistant from the nearest points on the baselines from which the breadth of the territorial sea is measured. The theory recognizes three main types of the median line: strict, simplified and modified median line. The simplest

definition of the strict median line is that it is a line created by the strict application of the definition referred to in Article 15 of the Convention on the Law of the Sea from 1982. Strict median line consists of many related flat lines (segments) (Hodgson and Cooper, 1976). With the aim of avoiding such a complex line of delimitation between two states, they often simplify the median life by reducing the number of points at which the boundary line changes direction. Finally, the modified median line is also based on equidistance, but consists of segments that connect the points which are not strictly equidistant from the starting points, having in mind that certain forms have been only partially taken into account. The states are at liberty to select the method of boundary establishment. The analysis of the practice of states indicates that the application of the median line as the method of delimitation was dominant in the last 70 years. Out of 45 concluded agreements, equidistance was used in 33 agreements, among which 15 were concluded between states whose coasts are opposite to each other, and 18 between states with adjacent coasts. From the point of view of the states' practice in the process of delimitation of territorial sea, median line may be concluded to be the most commonly used method of delimitation. The popularity of the rule of equidistance, a special circumstance in early contractual law, may be explained by the fact that this formula managed to balance predictability and flexibility, objectivity and discretion.

While the Commission for International Law and Geneva Conventions proclaimed equidistance a desirable solution in the process of delimitation of continental shelves, the conclusion of the International Court of Justice (ICJ), for instance, in the case of the Northern Sea, was complete rejection of equidistance as the legally necessary first step or a desirable method of delimitation. In the case of the Northern Sea, the International Court of Justice (ICJ) rejected two arguments that spoke in favor of the rule of equidistance, one based on practical advantages and another on the principle. The Court pointed out that the advantages of a certain method did not represent a sufficient basis to make it mandatory, given that its application may lead to unfair results (North Sea Continental Shelf (Federal Republic of Germany v. Denmark), 1969; North Sea Continental Shelf (Federal Republic of Germany v. Netherlands), 1969). The International Court of Justice (ICJ) devoted a lot of attention to proving that equidistance was not a mandatory common law method and its argumentation was the following. At the time of Geneva Conventions, equidistance was certainly not a part of international common law (instead, it represented the rule *de lege ferenda*) (North Sea Continental Shelf (Federal Republic of Germany v. Denmark), 1969; North Sea Continental Shelf (Federal Republic of Germany v. Netherlands), 1969).

Given that, in the case of the Northern Sea, the International Court of Justice (ICJ) presented the principles of common international law governing the delimitation of continental shelfs, the following opportunity for the verification and expression of the mentioned principles was the decision of the Arbitration Tribunal established by United Kingdom and France for purposes of delimitation of the continental shelf in the English Channel (La Manche) (Delimitation of the Continental Shelf (United Kingdom of Great Britain and Northern Ireland and the French Republic), 1977). In this case, the Tribunal reaffirmed the position that the method of delimitation was subjected to the fair aim of the entire operation, strengthening the link between the fairness of the solution and concrete geographical and other circumstances, taking into account that geography became the key factor. The application of the rule of equidistance, in the opinion of the Tribunal, depends on the concrete geographical context and must be viewed in that light. According to the Tribunal, the equity of delimitation is not the result of their categorizations as adjacent or opposite, but of actual geographical circumstances that characterize the overall relation between the coasts and, therefore, the selection must be for the purpose of the concrete geographical circumstances (Bowett, 1978). However, the Tribunal started from the line of equidistance as a temporary line for each sector and adjusted it depending on geographical circumstances.

4. CONCLUSION

As a result of the development of the Law of the Sea, it is clearly established today that the starting point of every delimitation is the right of states to expand their maritime zones. International justice has great importance in the resolution of border and other maritime disputes submitted to international courts and arbitration tribunals. The decisions of the International Court of Justice (ICJ) and arbitration tribunal awards have special significance in the part of the Law of the Sea dealing with maritime delimitations. The international law of maritime delimitation is pretty imprecise as defined in the Convention on the Law of the Sea. In support of this claim, it suffices to quote the provision of the Convention on the Law of the Sea which stipulates that coastal states are legally merely required to delimit their boundaries "by an agreement on the basis of the international law". It was perhaps due to this imprecision that coastal states mainly adopted the position that court or arbitration dispute resolution proceedings may, in principle, resolve disputes related to the delimitation of maritime zones. The aforementioned indicates considerable confidence in international judiciary. Consequently, there are currently more decisions on maritime delimitation disputes than in any other area of international law.

The rules of international law on delimitation at sea and on the seashore lack clarity and are insufficient for the successful resolution of disputes between states. In court case law during

the resolution of such disputes, the intention was to find the best solutions based on the most extensive geographical, historical, political, commercial-economic and other arguments, similarly as in Anglo-Saxon law based on *precedents*. Although insufficiently precise, the principle of equity is of great significance, since in the course of its application, a number of criteria were elaborated that should be considered relevant for the selection of the most adequate and appropriate method of delimitation.

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North Sea Continental Shelf (Federal Republic of Germany v. Netherlands), (1969), International Court of Justice, report, available at: http://www.icj-cij.org/en/case/52, [accessed 13 March 2017.].

Improving Safety at Sea Through Compliance with International Maritime Safety Codes

Jelena Nikčević Grdinić

There is a number of international instruments that contribute to the improvement and advancement of safety at sea. The primary task of all international instruments is to make sea navigation less dangerous and to reduce, to the maximum extent possible, the risks associated with maritime navigation, and hence the occurrence of maritime accidents and marine pollution. In addition to international conventions as basic international instruments, codes adopted by various international organizations are of particular importance for improving the safety of navigation. The IMO, as the main organization responsible for improving maritime safety, certainly occupies a special place. Since its inception, the IMO has convened many international conferences and developed many regulations, recommendations and codes of practice concerning the carriage of dangerous cargoes by sea. Thirty conventions and protocols, as well as a number of codes and recommendations concerning maritime safety, the prevention of marine pollution and other related matters have been adopted by the IMO. In this paper we have tried to point out the most important international codes the observance of which is imperative for improving safety at sea. Attention is paid to the role of a number of international organizations in the safety of navigation, with special emphasis on the IMO.

KEY WORDS

~ Safety of navigation
~ Safety
~ International instruments
~ Codes

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1. THE NECESSITY OF ACCEPTANCE OF INTERNATIONAL INSTRUMENTS ON MARITIME SAFETY

The entire maritime law is more or less codified by a number of international conventions intended to be ratified and incorporated by the states into their national legal systems. Pursuant to Article 26 ("Pacta sunt servanda") of the Vienna Convention on the 1969 Law of Treaties "… *every treaty in force is binding upon the parties to it and must be performed by them in good faith*." This means that the contracting states are required to incorporate convention provisions into their national legislation and ensure the proper observance of standards in line with the actions of other states. In fact, international conventions are integrated into domestic law or, as professor Grabovac points out the "nationalization of international regulations" is carried out.[1] International norms integrated into the legal systems of national states form a distinct legal system of regulations distinguishable both from the Continental and the Anglo-Saxon legal systems, and may thus be considered to be the third legal system in the world.[2] Why do international maritime regulations need to be nationalized with respect to other branches of the law? The answer lies in three facts. First, it is clear that navigation is virtually the same everywhere and international regulations help prevent the co-existence of disparate legal regulations capable of potentially jeopardizing the safety of shipping. International regulations liberate the international shipping industry from having to cope with contradictory national safety regulations on

1. *Grabovac I. (2009) International contracts as the basis for harmonizing maritime law – in relation to the Act on Amendments to the Maritime Code, 2008, Collection of Works of the Faculty of Law in Split, Vol. 46 (2), pp. 261 - 269.*
2. *Bolanča, D. (2002) Maritime Law In the Era of Globalisation-Universal Law or A Mixed Legal System? Zbornik radova Pravnog fakulteta u Splitu, 67(3-4), pp. 333-338.*

the construction and operation of vessels. And last but not least, international conventions proscribe minimum standards for the regulation of competition between states.

Regulations on maritime safety, by nature, regulate maritime navigation identically in all countries. This issue is regulated by international instruments each country is required to strictly observe and consistently apply. Many international instruments, like international conventions, resolutions, codes, guidelines and regulations have been issued in this respect. The provisions of paragraph 3, Article 94 of the UNCLOS Convention of 1982, indicating the general obligations of the flag state[3] regarding the safety of navigation, clearly state that "*… every state shall take such measures for ships flying its flag as are necessary to ensure safety at sea with regard, inter alia, to: (a) the construction, equipment and seaworthiness of ships; (b) the manning of ships, labour conditions and the training of crews, taking into account the applicable international instruments; (c) the use of signals, the maintenance of communications and the prevention of collisions.*" Paragraph 4 states that "*…such measures shall include those necessary to ensure: (a) that each ship, before registration and thereafter at appropriate intervals, is surveyed by a qualified surveyor of ships, and has on board such charts, nautical publications and navigational equipment and instruments as are appropriate for the safe navigation of the ship; (b) that each ship is in the charge of a master and officers who possess appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship; (c) that the master, officers and, to the extent appropriate, the crew are fully conversant with and required to observe the applicable international regulations concerning the safety of life at sea, the prevention of collisions, the prevention, reduction and control of marine pollution, and the maintenance of communications by radio…*" Paragraph 5 of the same Article states that in taking the measures called for in the preceding paragraphs "*… each State is required to conform to generally accepted international regulations, procedures and practices and to take any steps which may be necessary to secure their observance.*"

Consequently, no state has the discretion to independently decide on these issues. In fact states, as a rule, adopt international regulations in this field. However, this is not to say that the states are prohibited from bringing their national legislations, merely that they are required to do so in strict compliance with international regulations.[4]

2. THE ROLE OF INTERNATIONAL ORGANIZATIONS IN THE SAFETY OF NAVIGATION

Although a number of international organizations contribute to maritime safety by preparing international conventions, the IMO (*International Maritime Organization*) stands out as the most important, followed by the ILO (*International Labour Organization*) and the UNCTAD (*United Nations Conference on Trade and Development*), and from regional organizations, the EMSA (*European Maritime Safety Agency*). There are also other non-governmental organizations, institutions and associations whose members perform navigational activities and various other activities directly or indirectly related to maritime safety.[5]

The ILO is a specialized UN agency, founded in 1919, which adopted a large number of conventions and recommendations, inter alia, relating to the working and living conditions of sailors. *The Maritime Labour Convention, MLC* from 2006, laying down the minimum requirements for work onboard, conditions of employment, wages, hours of work and rest and medical care, is certainly worth a mention.

Established in 1964 with seat in Geneva, the UNCTAD is a permanent body of the United Nations General Assembly for trade and development. The primary objective of UNCTAD is to define the rules that apply to all aspects of development, including transportation. The UNCTAD Committee on Shipping is specifically responsible for the commercial and economic aspects of maritime affairs. Magazine *Review of Maritime Transport*, published annually from 1968, significantly contributed to

3. *Flag state is the state the flag of which the ship is flying, or the state of ship's registration. The flag of the vessel is the element of individualization of the vessel which indicates her nationality. Each state independently determines the requirements a vessel must meet to receive its nationality or earn the right to fly its flag. The requirements should establish the genuine link between the ship and the flag. The flag state has legislative and executive authority over the vessel flying its flag. However, when the vessel arrives in the coastal belt, which is under the sovereignty of another state, it comes under the jurisdiction of that coastal state.*

4. *Each country has its own national regulations (acts and bylaws) on the safety of navigation which must fully comply with international regulations. In Montenegro, the main piece of legislation governing this subject matter is the Act on Safety of Maritime Navigation of 2013 ("Official Gazette of Montenegro", No. 62/2013).*

5. *These are different organizations: Ship-owners Associations – ICS (International Chamber of Shipping International Chamber of Shipping), INTERTANKO (International Association of Independent Tanker Owners), INTERCARGO (International Association of Dry Cargo Shipowners), BIMCO (Baltic and International Maritime Council), ISMA (International Security Management Association); Seafarers Associations – ITF (International Transport Workers' Federation), IFSMA (International Federation of Shipmasters' Associations), IMPA (International Maritime Pilots' Association); Shippers and Cargo Owners Associations – OCIMF (Oil Companies International Marine Forum), CEFIC (European Chemical Industry Council); Insurers Associations – IUMI (International Union of Marine Insurance), IG P&I Clubs (International Group of P&I); Regulatory Organizations and Classification Societies – IACS (International Association of Classification Societies), ISO (International Organization for Standardization), IEC (International Electrotechnical Commission); Ports,Terminals and Port Services Associations - IAPH (International Association of Ports and Harbors), SIGTTO (Society of International Gas Tanker & Terminal Operators) and Navigational Services Associations different organizations that provide navigation services – IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities).*

maritime safety. The publication analyzes the changes in the maritime trade and port sector, and presents them through corresponding statistical information.

The EMSA, based in Lisbon, was established in 2002 following a major maritime accident of tanker *Erica*, to contribute to the safety of maritime navigation in the European Union by introducing a number of measures and actions aimed at reducing the risk of maritime accidents, preventing pollution caused by ships and safeguarding human lives at sea. The EMSA has an important role in assisting EU candidate countries (with the implementation of regulations into their national legislations) with issues relating to maritime safety and marine pollution prevention.

2.1. IMO and Safety of Navigation

The role of the IMO was defined in Article 2 of the *Convention on the International Maritime Organization (IMO Convention)* adopted in Geneva, Switzerland, on 6 March 1948, which entered into force on 17 March 1958[6]. Article 1 of the IMO Convention sets out the purposes of the Organization and establishes the global scope of IMO's safety and antipollution activities. It also refers to other tasks, such as the promotion of efficiency of navigation and the availability of shipping services based on the freedom of shipping of all flags to take part in international trade without discrimination. Article 2 states that the IMO shall: "…*a) consider and make recommendations upon matters"* (within its attributions), "… *b) provide for the drafting of conventions …, and recommend these to governments…and convene such conferences as may be necessary*"…"*c) provide machinery for consultation among Members and the exchange of information among Governments*…"

Almost 50 international conventions and hundreds of guidelines and codes have been adopted under the auspices of the IMO. These instruments are constantly refined and updated, and constitute the regulatory framework of international shipping.

The vast majority of IMO international conventions are in force, and several are widely if not universally accepted. Additionally, they cover almost all the world fleet tonnage to which they apply. Today it is virtually impossible for a ship to sail, unless its flag State is party to the principal IMO conventions.

The IMO governing bodies are the Assembly, which convenes every two years and is open to participation by all Member States, and the Council, which convenes every six months. The Council is the only elected body and has 40 members.[7]

The technical and legal work of the Organization is carried out by committees and sub-committees, which are open to participation by all members. Intergovernmental and non-governmental organizations, with specific competences and know-how, take active part in the work of the Organization. Committees meet at regular intervals, on average every six months.'The main committees are the Maritime Safety Committee (MSC), the Marine Environment Protection Committee (MEPC), the Legal Committee (LC), the Facilitation Committee (FC) and the Technical Co-operation Committee (TCC). In order to be implemented, the international conventions adopted by the IMO must be ratified by the states and incorporated into their national legislations. From the legal perspective, it is then up to the national administrations to make sure that ships flying their flags comply with the requirements contained in the IMO treaties and non-treaty instruments. Nonetheless, the IMO, using various techniques, actively encourages flag States to take the necessary implementing actions.

The IMO international conventions can be broadly divided into three main groups: those concerning the safety of navigation, those dealing with preventing and combating marine pollution, and those regulating liability and compensation issues and other legal matters. In more recent years, security has also been the focus of IMO treaties.

3. SAFETY CONVENTIONS[8]

Some of the most important IMO conventions on the safety and security of navigation are the International Convention for the Safety of Life at Sea (SOLAS 1974), ratified by 163 states with the combined merchant fleet representing 99.14 % of the world tonnage (the International Ship and Port Facilities Security Code (ISPS) was adopted in 2002 as an integral part of the SOLAS); the Load Lines Convention (LL 1966) ratified by 161 countries, with 99.13 % of the world tonnage; the International Regulations for the Prevention of Collisions at Sea (COLREG 1972) ratified by 157 states, with 99.13 % of the world tonnage; the Convention

6. *Article 74 of the IMO Convention reads as follow: "... The present Convention shall enter into force on the date when 21 States, of which seven shall each have total tonnage of not less than 1,000,000 gross tons of shipping, have become parties to the Convention in accordance with Article 71…"*

7. *The following states were Council members on the 2014-2015 biennium. Category a): 10 states with the largest interest in providing international shipping services: China, Greece, Italy, Japan, Norway, Panama, Republic of Korea, Russian Federation, United Kingdom, United States. Category b): 10 other states with the largest interest in international seaborne trade: Argentina, Bangladesh, Brazil, Canada, France, Germany, India, Netherlands, Spain, Sweden. Category c): 20 states not elected under (a) or (b) above which have special interests in maritime transport or navigation, and whose election to the Council will ensure the representation of all major geographic areas of the world: Australia, Bahamas, Belgium, Chile, Cyprus, Denmark, Indonesia, Jamaica, Kenya, Liberia, Malaysia, Malta, Mexico, Morocco, Peru, Philippines, Singapore, South Africa, Thailand, Turkey.*

8. *Nikčević Grdinić, J., (2015) Legal regulations in the function of ensuring ship safety, Pomorstvo: Scientific Journal of Maritime Research, Vol.29 No.1 pp. 34-38.*

on Standards of Training Certification and Watchkeeping for Seafarers (STCW 1978), with 162 member states and 99.18 % of the world tonnage; and the Convention on Maritime Search and Rescue (SAR 1979), ratified by 111 countries with 80.176 % of the world tonnage.[9]

Other important legal treaties from the domain of liability and compensation for damage at sea are the Convention on Limitation of Liability for Maritime Claims (LLMC 1976) and the Athens Convention on the Carriage of Passengers and their Luggage by Sea (PAL 1974). IMO legal treaties also include the International Convention on Salvage (Salvage 1989), the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, (SUA 1988) and the Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf 1988 (SUA PROT 1988). Both SUA and the Protocol were substantially amended by the IMO's Legal Committee following the events of 11 September 2001. The amendments were considered and adopted by an international legal conference convened by IMO 10-14 October 2005.

4. SAFETY CODES

In addition to international conventions, other legal instruments adopted by the IMO are also of importance for maritime safety. Different terminology is adopted for their identification. These are various resolutions, codes, standards, protocols, etc. on a variety of issues such as: design, construction and equipment of ships, ship stability, fire protection, radio communication and transportation of cargo (including dangerous goods), security management and maritime safety. These legal instruments differ from international conventions (containing principles, norms, standards or other statements of expected behaviour) and fall within the domain of soft law.[10]

A large number of codes on maritime safety was adopted under the auspices of the IMO. Codes on the safe transportation of cargo which regulate the safe transportation of cargo in detail are particularly important. In this respect, general codes, such as: the *CSS Code (Code of Safe Practice for Cargo Stowage and Securing)* and the *IMSBC Code (International Maritime Solid Bulk Cargoes Code)* are of special interest, as are the codes relating to the safe carriage of certain types of cargo, primarily the carriage of grain, timber and dangerous goods by sea. Examples of such codes are: the International *Grain Code (International Code for the Safe Carriage of Grain in Bulk)* and the *Code of Safe Practice for Ships Carrying Timber Deck Cargoes*. The most important codes regulating the carriage of dangerous goods by sea are: the *IMDG code (International Maritime Dangerous Goods)*, the *IBC code (International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk)*, the *IGC Code (International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk)* and the *INF Code (The International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High Level Radioactive Wastes on Board Ships)*. The *ISM code (International Management Code for the Safe Operation of Ships and for Pollution Prevention)* adopted by the IMO to reduce the human factor risk, improve maritime safety and avoid maritime accidents is also worth a mention.[11]

4.1. Code of Safe Practice for Cargo Stowage and Securing, the CSS Code

The CSS Code was adopted by the IMO Assembly on 6 November 1991. The 74 CSS Code was adopted by Resolution A.714 (17). The application of CSS Rules, consolidating almost all IMO recommendations on cargo stowage, is mandatory since 1997. The CSS Code consists of 7 chapters and 14 annexes. It applies to ...*"cargoes carried on board ships (other than solid and liquid bulk cargoes and timber stored on deck) and, in particular, to those cargoes whose stowage and securing have proved in practice to create difficulties."* [12]

Considering the specific matter dealt with in the Code, it was amended relatively early. The first significant amendment to the CSS code was made in 1994[13], when Annex 13 on methods to assess the efficiency of securing arrangements for non standardized cargo was introduced.[14] Amendments to Annex 12 on the safe stowage and securing of unit loads, were made by the MSC/Circ.740, in June 1996, followed by amendments to the CSS Code by the MSC in 2010. MSC.1/Circ.1352. These amendments include Annex 14: Guidance on Providing Safe Working Conditions for Securing of Containers on Deck. The objective of Annex 14 is to ensure safe working conditions, and in particular, access to safe and appropriate equipment to persons responsible for taking safety measures on containers transported on the deck of the ship.

9. *As per data as on 5 June 2017.*
10. *The notion of soft law designates rules which are not legally binding, as opposed to hard law denoting legally binding acts. However, this rule can not be applied strictly to codes adopted by the IMO, since special provisions of many international conventions call for their mandatory application.*
11. *Experience shows that the human factor, i.e. human error is one of the main causes of accidents at sea. When it comes to accidents and incidents at sea, except in rare cases of force majeure, human activity is almost always included. Oversights in ship management were the main causes of accidents. The human factor (error of the crew) is believed to have played a role in 75 % to 96 % of maritime accidents. Rothblum, A., Human Error and Maritime Safety, Maritime Human Factors Conference, Linthicum, MD, March 13-14., 2000.*
12. *Chapter 1 Article 1.1. of CSS Coda.*
13. *MSC/Circ.691*
14. *In May 2002 important amendments were made in Annex 13, MSC/Circ 1026. Circular 1026 also includes an extension on the scope of application recommending all lashing assemblies to be fixed to strong or fixed points, a new table on friction coefficients and new texts on an advanced calculation method and an alternative method of balancing forces.*

4.2. International Maritime Solid Bulk Cargoes Code, the IMSBC Code

The IMSBC code is the basic code that regulates the transportation of bulk solids, although it does not apply to grain. It was published several times after its first publication in 1965. The IMSBC Code was originally called the Code of Safe Practice for Solid Bulk Cargoes BC Code.[15] However, on 4 December 2008, the IMO[16] adopted a new code for the carriage of solid bulk cargoes – the IMSBC Code. The primary objective of the IMSBC Code is to ensure the safe stowage and shipment of solid bulk cargoes, provide information on the dangers certain shipments are exposed to and instructions on procedures to be followed during their transportation. All ships are required to comply with the IMSBC Code, regardless of the date of keel laying and gross register tonnage. The IMSBC Code became mandatory on 1 January 2011. The BC Code continued to be applied between 1 January 2009 and 1 January 2011, during which period the IMSBC Code was applied on a voluntary basis.[17] Both the IMSBC Code and the BC Code divide cargoes into three groups A, B, and C. More detailed requirements for each type of cargo are given in some parts of this paper. In June 2013, the IMO, namely the MSC, adopted Resolution 354 (92) laying down amendments to the IMSBC Code. Contracting parties of the SOLAS Convention were free to apply amendments in whole or in part from 1 January 2014 at their discretion, with their mandatory application starting as of 1 January 2015.

4.3. International Code for the Safe Carriage of Grain in Bulk, International Grain Code

The International Grain Code applies to grain. It was adopted in May 1991 and contains detailed regulations on the carriage of grain in bulk. Its application is mandatory. Each cargo ship carrying grain is required to comply with the requirements of the International Grain Code and have the documentation (approval) necessary for such carriage. A ship which does not have such a document can not be loaded with grain until the commander obtains such approval from the competent authorities or until the government of the country of the port of loading confirms that the ship meets the requirements of the International Grain Code. The International Grain Code replaced Chapter VI of SOLAS 1974, which regulated grain carriage in more detail.

4.4. Code of Safe Practice for Ships Carrying Timber Deck Cargoes, TDC Code

The TDC Code was adopted by the IMO in 1972 and amended in 1978. The introduction of new techniques and technologies in the maritime industry and the emergence of sophisticated ships necessitated Code revision. The new code was adopted at the IMO's seventeenth session in November 1991, by Resolution A.715(17), in response to continuous injuries and loss of human life when moving wood and frequent loss of wood transported as cargo. The new Code revised the TDC Code from 1972. During its adoption, special attention was paid to the construction of larger and more sophisticated ships, as well as to the introduction of new cargo handling techniques. The Code contains four chapters. Chapter 1 contains general provisions, Chapter 2 contains data on stability, Chapter 3 provisions on stowage and Chapter 4 provisions regulating the securing of timber deck cargoes. Although the TDC Code was directed primarily at providing recommendations for the safe transportation of wood on the deck, it also contains an appendix consisting of recommendations for the stowage of wood under the deck. The Code was amended by IMO Resolution A.1048-a (27), adopted on 30 November 2011.

4.5. International Maritime Dangerous Goods, the IMDG Code

The participants of the SOLAS conference held in 1960 decided to regulate the carriage of dangerous goods by new international regulations adopted by the IMO. In 1965, the IMO first published the IMDG Code, which became mandatory for all member states of the SOLAS Convention as of 1 January 2004. The IMDG Code is an international act for the carriage of dangerous goods by sea, regulating their packaging, transport in containers and stowage, with particular reference to the segregation of incompatible substances. This is a unique international Code, which comes in addition to the rules of the SOLAS Convention. Although it was adopted primarily for maritime carriage, it has a significant impact on other branches of carriage as well. This Code served as the basis for the adoption of pieces of legislation and recommendations for the carriage of dangerous goods. The IMDG Code was intended to advance the safety of carriage of dangerous goods, protect the marine environment and improve the free unlimited flow of dangerous goods with appropriate supporting documentation.[18]

15. *The BC Code provides guidelines for maritime administration, shipowners, shippers and other parties with respect to standards applied to safe stowage and carriage of solid bulk cargoes, excluding grains which are subject to specific rules. The primary purpose of the BC Code is to improve boarding and lodging of bulk cargoes by pointing out the dangers of loading, providing guidelines on procedures to be followed when loading bulk cargo, as well as the list of cargo regularly carried in bulk, description of testing procedures conducted to determine the properties of cargoes carried in bulk.*
16. *Resolution MSC.268 (85)*
17. *However, shipping companies are aware that the Port State Control and port authorities of many states require proof of compliance with the IMSBC Code, which should be available on board.*
18. *Nikčević Grdinić, J., (2012) Safe Transport of Dangerous Goods by Sea, Import Part of the Maritime Transport, Proc.of the 5th International Conference on Maritime Transport, 27th-29th June, Barcelona, Spain, pp.1038-1056.*

Since the IMDG Code is regularly updated, it is constantly evolving and changing. However, its basic structure remains unchanged.

When it was amended, new dangerous goods were included, as well as new technologies and methods of operation or handling of dangerous goods. Cargoes listed in IMDG regulations are dangerous goods. However, if a particular cargo is not listed, it does not necessarily mean that it is not dangerous cargo. The states may extend the list of dangerous cargoes in their national legislations, including them in the regimen of dangerous goods. In addition, national legislations may proscribe extra requirements to be met by ships carrying dangerous goods when entering their ports. In any case, the existing national regulations must be based on the IMDG Code. Given the fact that certain states prohibit the carriage of certain dangerous goods through their territory or allow such a carriage, but in limited quantities, it is paramount for every shipping company to be familiar with the regulations of transit or destination countries of their ships.[19]

In May 2000, the MSC made amendments to the IMDG Code, which significantly changed its form. The changes came into force on 1 January 2001. Pursuant to the amendments, the IMDG Code now consists of seven parts, two appendices and an index. The parts of IMDG regulations are: Part 1 - General principles, definitions and training; Part 2 - Classification; Part 3 - Dangerous Goods List - DGL exceptions to the limited amounts. The DGL is the core of the IMDG Code and presents information on transport requirements in coded form; Part 4 - Packing and tank provisions; Part 5 - The consignment procedures; Part 6 - Construction and testing of packaging, medium sized bulk containers, large packaging, portable tanks and road cisterns; Part 7 - Requirements relating to transport operations. Appendices to the IMDG Code are: Appendix A - list of generic goods and commodities that are not specified elsewhere and proper shipping names; Appendix B - a brief glossary of terms.

According to the IMDG Code, dangerous goods are divided into nine classes: Class 1- Explosives substances and articles; Class 2- Gases, compressed, liquefied or dissolved under pressure; Class 3- Flammable liquids; Class 4- Flammable solids, liable to spontaneous combustion, or which, in contact with water, emit flammable gases; Class 5- Oxidizing substances (which provoke combustion) and organic peroxides which are subject to violent or explosive decomposition; Class 6- Toxic and infectious substances; Class 7- Radioactive materials; Class 8- Corrosive materials; Class 9- Miscellaneous dangerous substances and articles such as aerosols, some ammonium nitrate fertilizers, asbestos, safety matches and substances designed as marine pollutants. The purpose of the classification given in the IMDG Code is to distinguish cargo potentially dangerous for transporting from that which is not; to identify risks associated with the transportation of dangerous goods; to identify measures necessary to effect the safe transportation of dangerous goods, without risk to people and property (during transportation, as well as during the stay in port and onboard).

In May 2002, amendments to Chapter VII of the SOLAS Convention were adopted, proscribing that the IMDG Code become binding for all member states of the SOLAS Convention as of 1 January 2004. In fact, although the IMDG Code is mandatory for all member states of the SOLAS Convention, from the legal standpoint, some of its provisions are formulated as recommendations. Specifically, the word "must" is quite frequently replaced with "must" in the Code.

4.6. International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk, IBC Code

The IBC Code defines international standards for the safe carriage by sea of dangerous and harmful liquid chemicals in bulk. In order to minimize the risks for the ships, the crew and the marine environment, the IBC Code sets out international requirements for the design and construction of ships, and proscribes the required equipment. The IBC Code is applicable to all tankers carrying chemicals, regardless of size. Risks associated with chemicals are indicated, such as: fire, threat to human health, pollution of the sea, air and the marine environment, reactions with other chemicals and water. The IBC Code requires the ships to be inspected and issued the international certificate for the carriage of dangerous chemicals in bulk. The international certificate contains the information on the type of the ship according to the Code, cargoes that can be carried, additional requirements, exemptions, etc. All dangerous liquids are classified into four categories: Category A - chemical substances that can cause considerable danger to marine resources and human health; Category B - substances that can cause certain dangers; Category C - substances that might cause less risk; Category D - substances that can cause barely noticeable danger.

Ships built after 1986, carrying dangerous chemicals indicated in the IBC Code, must comply with its requirements in terms of design, construction and ship operation.

4.7. International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, IGC Code

The IGC Code was adopted with IMO Resolution MSC.5(48) on 17 June 1983.The IGC code applies to gas carriers constructed on or after 1 July 1986. Gas carriers constructed before that date should comply with the requirements of the Code for the

19. *For example, the Port of Singapore is known for its sensitivity to the passage of ships with dangerous cargo and strict rules contained in its port acts (Port of Singapore Authority Act Code).*

Construction and Equipment of Ships Carrying Liquefied Gases in Bulk or the Code for Existing Ships Carrying Liquefied Gases in Bulk.[20] The purpose of these codes is to establish an international standard for the safe marine transportation of liquefied gases and certain other substances in bulk, by proscribing design and construction standards for ships involved in such transport and the equipment required to minimize risks to the ship, its crew and the environment, having regard to the nature of the products involved.

The underlying philosophy is that of ship types related to the hazards of products covered by these codes, each of which may have one or more dangerous properties. Further hazards are associated with products transported under cryogenic (refrigerated) or pressurized conditions. Severe collisions or strandings may damage the cargo tank, causing an uncontrolled release of the product. Such release could cause the product to evaporate or disperse and, in some cases, cause brittle fracture of the ship's hull. The requirements in the codes are intended to minimize these risks as much as practicable, using our current know-how and technology.

According to section C of Chapter VII of the SOLAS Convention, provisions of the IGC Code are mandatory for all members of the SOLAS Convention. To account for ever evolving techniques and technologies, its amendments are taken into consideration as well. Its amendments were adopted with Resolution MSC.30 (61) on 11 December 1992. The IGC Code published in 1993 included the said amendments.

4.8. International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High Level Radioactive Wastes on Board Ships, INF Code

Ships carrying packaged irradiated nuclear fuel, plutonium and high-level radioactive waste must comply with the requirements of the INF code. The INF code defines the cargo covered, and provides specifications for ships carrying such cargo.[21] The Code was adopted with Resolution MSC.88 (71) on 27 may 1999. Its application became mandatory as of 1 January 2001 based on amendments to Chapter VII of the SOLAS, entitled Carriage of dangerous goods.

The INF code applies to all ships regardless of the date of their construction or size, including cargo ships of less than 500 gross tonnage, engaged in the carriage of INF cargo. The INF Code does not apply to warships, naval auxiliary or other ships used only for governmental non-commercial purposes, although administrations are expected to ensure the compliance of such ships with the Code.

Special provisions of the Code regulate issues like, inter alia: damage stability, fire protection, temperature control of cargo spaces, structural considerations, cargo securing arrangements, electrical supplies, radiological protection equipment and management, training and shipboard emergency plans.

Ships carrying INF cargo are classified into one of three classes, depending on the level of radioactive cargoes carried. The INF Code classifies ships as belonging to Class INF 1, INF 2 or INF 3.[22] Prior to the beginning of the journey, the ships are required to undergo basic inspection, which includes a detailed inspection of their structure, equipment, appliances and built-in materials. Once the competent authority finds that the results of the conducted inspection are satisfactory, it issues the International Certificate of Fitness for the Carriage of INF Cargo.

The INF Code regulates the issue of ship's stability under load. It, also, proscribes that every INF ship is required to have a Shipboard Emergency Plan. The plan must contain: worked out procedure for reporting accidents involving a ship carrying INF cargo, which the master or officer on duty are obligated to comply with; the list of authorized persons to be informed of the accident; a detailed description of activities to be taken by the person on board without delay, in order to prevent, reduce or control the release of hazardous substances; the method of contacting the ship to facilitate the coordination of work between the ship and the local authorities.

4.9. International Management Code for the Safe Operation of Ships and for Pollution Prevention, ISM Code

In October 1989, the IMO adopted, with Resolution A.647(16), Guidelines on Management for the Safe Operation of Ships and for Pollution Prevention. The purpose of the Guidelines is to ensure safety, protect people from harm or loss of life and avoid possible damage to the maximum extent possible. The Guidelines are based on general principles intended to support

20. *Gas carriers constructed before that date should comply with the requirements of the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk or the Code for Existing Ships Carrying Liquefied Gases in Bulk.*

21. *According to the Code, INF cargoes are packaged irradiated nuclear fuel, plutonium, high-level radioactive wastes in accordance with class 7 of the IMDG Code. Irradiated nuclear fuel - material containing uranium, thorium and/or plutonium isotopes used to maintain a self-sustaining nuclear chain reaction. Plutonium - the resultant mixture of isotopes of that material extracted from irradiated nuclear fuel from reprocessing. High-level radioactive wastes - liquid wastes resulting from the operation of the first stage extraction system or the concentrated wastes from subsequent extraction stages, in a facility for reprocessing irradiated fuel, or solids into which such liquid wastes have been converted.*

22. *Class INF 1 ship - ships certified for the carriage of INF cargo with the aggregate activity under 4,000 TBq (TeraBecquerel = measurement of radioactivity); Class INF 2 ship - ships certified for the carriage of irradiated nuclear fuel or high-level radioactive wastes with the aggregate activity under 2 x 106 TBq and ships certified for the carriage of plutonium with the aggregate activity under 2 x 105 TBq; and Class INF 3 ship - ships certified for the carriage of irradiated nuclear fuel or high-level radioactive wastes and ships certified for the carriage of plutonium with no restriction of the maximum aggregate activity of the materials.*

development and management practices in the industry as a whole. The Guidelines have recognized the importance of the existence of international instruments for the safe operation of ships, as one of the most important factors for the prevention of maritime accidents and marine pollution.

In 1993, following a brief experience with the application of the Guidelines, the IMO adopted the ISM Code with Resolution A741 (18). After several years of practical experience, its importance and the need for it to become mandatory were recognized. It was decided that the best way to effect this was to amend the SOLAS Convention. Consequently, new chapter IX, entitled Management for the Safe Operation of the Ship, which consists of six rules, was added to the SOLAS Convention. Although the ISM Code was not incorporated into Chapter IX, the Chapter provides for its mandatory application.[23] The ISM Code entered into force and became mandatory for ships in 1998. In 1995, striving to ensure uniformity in the application of the ISM Code, the IMO adopted the Guidelines on the Implementation of the International Safety Management (ISM) Code by Administrations with Resolution A. 788 (19). These are the Guidelines for the implementation of the requirements of Chapter IX of the SOLAS and the ISM Code. The Guidelines were first revised in November 2001 with Resolution A.913 (22), and again in December 2009 with Resolution A.1022 (26).[24]

The ISM Code indicates that its requirements may apply to all ships.[25] However, Rule 2 of Chapter IX of the SOLAS Convention states that the ISM Code applies to the following ships: cruise ships, including high speed cruise ships, built before 1 July 1998; tankers, chemical tankers, gas carriers, bulk cargo carriers and high speed carriers of 500 gross tonnage or more, built before 1 July 1998; other cargo ships and mobile offshore drilling units (MODUs) of 500 gross tonnage or more, built before 1 July 2002.

The ISM Code introduced a system for the safe operation (conduct) of ships (Safety Management System), the so called SMS system. Shipping companies are required to implement the system, and use it in all actions relating to planning, organization and execution of the tasks of the shipping company and of the ship on the mainland and at sea. The SMS system covered the ship and the company in accordance with the ISM Code for the first time.

The ISM Code clearly states that the SMS system should ensure the observance and compliance with rules, regulations and guidelines; the applicability of many regulations (the Codes); taking into account the recommended standards of various organizations, administrations, classification societies and the entire maritime industry.

The ISM Code proscribes functional requirements for the SMS system. It points out that every company should develop, implement and enforce the SMS system, together with the following requirements: safety of navigation and environmental protection policy; guidelines and procedures for the ship's safe navigation and environmental protection; determining the levels of authority and means of communication between the coast and the crew on board; procedures for reporting accidents and non-conformities of the established system with the ISM Code; procedures for emergency situations; internal control procedures and inspections of compliance with the established ISM Code; registration system for passenger data.[26]

To ensure the safe operation of each ship and communication between the company and persons onboard, the company should identify a specific person or persons ashore having direct access to the highest levels of management (Designated Persons Ashore-Dpa). This person is responsible for monitoring the safety of each ship, environmental protection and ensuring appropriate supporting resources from the mainland.

The ISM Code stipulates that the company is responsible for the implementation of its requirements. In this case, the term "company" means the shipowner or any other organization or person such as the Manager, or Bareboat Charterer, who took over the responsibility for a ship's operation from the shipowner and agreed to take over all the duties and responsibilities imposed by the Code.[27] In this sense it is pointed out that:

The Company should ensure:

- That the shipmaster is properly qualified for assuming commanding and fully aware of the company's SMS system.

23. *Rule 3.1. of Chapter IX of the SOLAS Convention.*
24. *In order to better understand and implement the ISM Code, certain guidelines have been adopted, such as: Guidelines for the operational implementation of the International Safety Management Code by Companies, MSC-MEPC.7/Circ.5; Guidance on the qualifications, training and experience necessary for undertaking the role of the designated person under the provisions of the International Safety Management Code, MSC-MEPC.7/Circ.6; Guidance on near-miss reporting, MSC-MEPC.7/Circ.7. ISM Code and Guidelines on implementation of ISM Code, IMO, 2010.*
25. *Rule 1.3. of the ISM Code.*
26. *In Montenegro, the provisions on the safety management system for ships are provided in Article 50 of the Act on Safety of Maritime Navigation. The Article clearly states that the shipowner, i.e. the company is obliged to apply and maintain a safety management system, in accordance with the SOLAS Convention (Chapter IX) and the ISM Code, containing the following: a safety of navigation and environmental protection policy; instructions and procedures for the safe navigation of the ship and protection of the environment; define the levels of authorization and methods of communication between the coast and the crew onboard; procedures for reporting incidents and non-conformities of the established system with the ISM Code; procedures for emergency situations; procedures for internal control and inspections of functioning of the established ISM Code; system for registration of passengers. Paragraph 2 of the same Article stipulates that, to ensure the safe navigation of their vessels and communication between the company and persons onboard, the shipowner i.e. the company are obliged to appoint a person on the coast responsible for monitoring the safety of navigation of ships and protection of the environment.*
27. *Article 6, item 14 of the Act on Safety of Maritime Navigation of Montenegro, gives the definition of the term „company". A company means owner of the ship or another physical or legal person (manager, or charterer) who takes over the responsibility for ship navigation in accordance with the International Safety Management Code.*

The company is also required to provide the shipmaster with assistance he requires to safely execute his duties:
- That each ship is managed by a qualified, authorized and medically fit crew, in compliance with national and international requirements;
- That procedures ensuring that any new staff and staff transferred to new duties are familiar with the issue of safety and environmental protection are in place. Basic guidelines must be established and implemented prior to departure and appropriate documentation in this respect issued;
- That any personnel involved in the company's SMS fully understands the rules, regulations, policies and guidelines;
- That procedures are implemented, identify additional training required to improve the SMS system and ensure the implementation of such training and participation of the entire staff;
- The procedures for the receipt of necessary information on the SMS system by the ship's crew are available in their working language or a language they understand;
- That the crew is capable of and efficient in the execution of their duties pertaining to the SMS system.

The ISM Code sets forth the obligations of flag states. Namely, once a shipping company or a ship are established to have met the requirements of the ISM Code, i.e. that they have in place an SMS system compliant with the ISM Code, the competent administration of the flag state or another recognized authority (authority may be delegated to an organization, usually a classification society) issues: DOC (Document of Compliance), verifying that the SMS implemented by the shipping company is compliant with the ISM Code; Certificate of safe operation of the ship, the SMC (Safe Management Certificate) confirming that all ship operations are carried out in accordance with the SMS system.

The ISM regulations were amended in December 2000 with Resolution MSC.104 (73). The amendments came into force on 1 July 2002. In December 2004 with Resolution MSC. 179 (79). The amendments came into force on 1 July 2006. In May 2005 with Resolution MSC. 195 (80). The amendments came into force on 1 January 2009. The ISM Code was amended in December 2008 with Resolution MSC. 273 (85). The Resolution was adopted on January 1, 2010 and the amendments entered into force on 1 July 2010.

5. CONCLUSION

From the legal perspective, safety is a requirement without which navigation is prohibited. As the leader in ensuring safe navigation, ever since its inception, the IMO has been striving to ensure the minimum conditions requisite for safe navigation and safe stay at sea by taking numerous actions and measures. The adoption of international instruments, conventions, i.e. codes, or more precisely, their implementation into national laws, is essential for the promotion of safe navigation. The IMO issued a number of international codes which might be said to supplement the international conventions. General regulations on the safe transportation of cargo, the CSS code and the IMSBC Code are of particular importance, followed by special regulations on the safe transportation of certain types of cargo, the International Grain Code and the TDC Code, as well as regulations relating to the transport of dangerous goods by sea – the IMDG Code, the IBC Code, the IGC Code and the INF Code. Flag states, i.e. shipping companies, are obliged to strictly adhere to the requirements of international instruments, i.e. codes, which actually form the basis of their legislation. To this end, the states should separately regulate a number of issues relating to the safe transportation of certain types of cargo in their national legislation, instead of referring to the application of international codes in principle. Special attention should thus be paid to the adoption of manuals that would regulate in detail the procedures for the safe handling of different types of cargo, followed by the organization of training and issuance of certificates for handling and transportation of various types of cargo, and introduction of restrictive measures into national law.

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Modified Legal Framework and Opening of the Liner Shipping Market in the Republic of Croatia to Shipping Companies from the European Economic Area

Nikola Mandić

Generally speaking, public transport is the transport of persons and cargo available for use to the general public, performed on the basis of a transport contract. Public transport costal liner shipping is the transport of passengers, cargo and vehicles in the internal marine waters and territorial sea of the Republic of Croatia performed on pre-established lines in compliance with the published terms and conditions of the sailing schedule and services pricelist. The *Act on Transport in Liner Shipping and Occasional Costal Maritime Transport* established the public transport system in the Republic of Croatia, ensuring regular connection of inhabited islands with the mainland and other inhabited islands, as well as between coastal towns, with an appropriate number of daily two-way connections, to improve the conditions of island life and stimulate their development. Prior to the accession of the Republic of Croatia to the European Union, the maritime liner shipping market in the Republic of Croatia was reserved primarily for Croatian shipping companies. Now, following the expiry of the transitional period negotiated in pre-accession negotiations with the European Union and the expiry of previously concluded concession contracts, the market is opening up to shipping companies from the European Economic Area. Hence, over the last couple of years, the Republic of Croatia was required to modify its legal framework regulating this subject matter. This paper presents novelties in the legal framework introduced in 2016 and 2017, which directly affect the opening of the maritime liner shipping market in the Republic of Croatia to shipping companies from the European Economic Area, with the critical analysis of the new solutions.

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~ Contracts on public transport services
~ Concession contracts
~ Sailing schedule
~ Public liner shipping without public service obligation

1. INTRODUCTION

The accession of the Republic of Croatia to the European Union on 1 July 2013 marked the beginning of the application of new rules in the performance of maritime cabotage in the Republic of Croatia. While prior to the accession of the Republic of Croatia to the European Union, exclusively national shipping companies had the right to perform the transport of passengers and cargo between Croatian ports (maritime cabotage), the maritime cabotage market has since been opened to all shipping companies from the European Economic Area. The EU maritime cabotage market has been liberalized with the *Regulation (EEC) No. 3577/92 applying the principle of freedom to provide services to maritime transport within Member States (maritime cabotage)* allowing all shipping companies having business establishment in any EU member state, i.e. in the European Economic Area to perform maritime cabotage across the European Union. Inter alia, maritime cabotage rules also apply to the performance of public transport in coastal liner shipping. In pre-accession negotiations with the European Union, the Republic of Croatia negotiated a transitional period for public transport contracts in coastal liner shipping predating the accession of the Republic of Croatia to the European Union, with their validity limited to 31 December 2016, due to which the market on the shipping lines which were the subject of such contracts remained closed

to European shipping companies until the expiry of the said transitional period. Consequently, a comprehensive process of granting concessions for the performance of public transport in costal liner shipping was conducted immediately prior to the accession of the Republic of Croatia to the European Union. Concession contracts for 24 ferry, 15 high-speed and 8 shipping lines were executed.[1] In spite of the transitional period envisaged by the *Treaty Concerning the Accession of the Republic of Croatia to the European Union*, due to the political instability in the Republic of Croatia and slow pace of work in the ministry competent for maritime affairs, in 2016, the Republic of Croatia reached an agreement with the European Commission to extend the validity of all contracts concluded prior to 1 July 2013 by one year, i.e. by 31 December 2017 at the latest. Hence annexes to contracts for transport on lines were concluded with all shipping companies which serviced the lines at the time, with validity period until the selection of a new shipping company, but no later than by the end of 2017.

The period was used to prepare the legal framework for future EU market competition as efficiently as possible.

In the Republic of Croatia, there are a total of 52 state lines on which public transport services in coastal liner shipping are provided by 13 Croatian shipping companies with the combined fleet of over 70 ships. Only eight state lines are profitable[2] on which shipping companies pay compensation under their concession contracts. On other, unprofitable lines, shipping companies providing public transport services are granted public service compensations. The new *Decision on the establishment of state lines in public transport in coastal liner shipping* adopted by the Government of the Republic of Croatia on 22 December 2016, increased both the capacity and frequency of state lines. The *Decision* establish a total of 53 state lines.[3]

Preparatory actions and the procedure for the allocation of the right to provide public transport services in coastal liner shipping to shipping companies are performed by the *Coastal Liner Services Agency* (hereinafter referred to as the *Agency*). The Agency is currently publishing invitations to tender, i.e. carrying out tender procedures for the selection of shipping companies on 48 state lines, using the e-procurement module of the *Electronic Public Procurement Classifieds of the Republic of Croatia*. Since the tender procedures are open to all interested shipping companies from the European Economic Area, invitations to tender and notices on intention to grant concession are published both in the *Electronic Public Procurement Classifieds of the Republic of Croatia* and in the supplement to the Official Journal of the European Union – *Tenders electronic daily (TED)*. The critical preconditions for the implementation of the above procedures are the compilation of schemes for granting state aid in the form of public service compensation on state lines and conducting concession feasibility studies.

2. LEGAL SOURCES

Legal sources regulating public transport in coastal liner shipping may be divided into three basic groups – legal sources, sublegal sources and European legal sources.

Legal sources:

1. *Maritime Code*[4],
2. *Act on Transport in Liner Shipping and Occasional Coastal Maritime Traffic*[5],

Sublegal sources:

1. *Regulation on the conditions and evaluation of criteria for granting concessions and awarding contracts for the provision of the public services of public transport in costal liner shipping*[6],
2. *Ordinance on requirements to be met by the ship and the shipping company to perform public transport services in costal liner shipping*[7],
3. *Ordinance on requirements to be met by the ship and the shipping company to perform international maritime liner transport services*[8],
4. *Ordinance on the conditions and manner of realization of the right to privileged transport on public maritime transport lines*[9],
5. *Decision on the amount of discount on regular passenger ticket prices in the privileged transport of persons and vehicles in public coastal liner maritime transport*[10],
6. *Decision on the establishment of state lines in public transport in costal liner shipping*[11],
7. *Ordinance on the conditions for the performance of maritime cabotage in the Republic of Croatia*[12].

European legal sources:

1. *Regulation (EU) No. 1177/2010 concerning the rights of passengers when travelling by sea and inland waterway and amending Regulation (EC) No. 2006/2004*,

1. The previously signed two contracts on shipping lines and a subsequently executed contract on one ferry line and two shipping lines, ensured the full engagement of all capacities of Croatian shipping companies in the provision of public transport services in costal liner shipping on 52 state lines.
2. According to data published by the Coastal Liner Services Agency, there are a total of eight profitable state lines – seven ferry (Valbiska – Merag and back; Porozina – Brestova and back; Prizna – Žigljen and back; Mišnjak – Stinica and back; Supetar – Split and back; Dominče – Orebić and back; Stari Grad – Split and back) and one shipping line (Trogir – Slatine – Split and back).
3. See more in infra 4. Decision on the establishment of state lines in public transport in costal liner shipping.
4. Official Gazette no. 181/04, 76/07, 146/08, 61/11, 56/13 and 26/15.
5. Official Gazette no. 33/06, 38/09, 87/09, 18/11, 80/13 and 56/16.
6. Official Gazette no. 31/14.
7. Official Gazette no. 26/14.
8. Official Gazette no. 130/06 and 83/13.
9. Official Gazette no. 41/17.
10. Class: 011-01/13-05/15, reg. no.: 530-03-2-2-2-14-10, 25 March 2014
11. Class: 022-03/16-04/363, , reg. No.: 50301-25/14-16-2, 22 December 2016
12. Official Gazette no. 56/14 and 56/17.

2. *Council Regulation (EEC) No. 3577/92 applying the principle of freedom to provide services in maritime transport within Member States (maritime cabotage)*.

In 2016 and 2017, *Act on Transport in Liner Shipping and Occasional Coastal Maritime Traffic* and *Ordinance on the conditions for the performance of maritime cabotage in the Republic of Croatia were amended,* and the new *Ordinance on the conditions and manner of realization of the right to privileged transport on public maritime transport lines* and *Decision on the establishment of state lines in public transport in costal liner shipping* adopted.

3. ACT ON TRANSPORT IN LINER SHIPPING AND OCCASIONAL COASTAL MARITIME TRAFFIC

The activity of provision of public transport services in liner shipping and occasional maritime transport in the Republic of Croatia is regulated by the *Act on Transport in Liner Shipping and Occasional Coastal Maritime Traffic* (hereinafter: *Act*). The *Act* ensures regular traffic connection of inhabited islands with the mainland and other inhabited islands, with an appropriate number of daily two-way connections, intending to meet the needs of islanders, improve living conditions on the islands and stimulate their development. The *Act* was adopted at the session of the Croatian Parliament held on 10 March 2006, and entered into force on 1 April 2006.[13] It was amended on several occasions, in 2006, 2009, 2011, 2013 and 2016. The 2016 amendments to the *Act* entered into force on 25 June 2016.

The *Act* consists of a total of 70 articles divided into seven chapters: General Provisions, Public Transport, Occasional Transport, Administrative Supervision and Inspection, Violations, Penalty Provisions, Transitional and Final Provisions. The *Act* stipulates that transport services on lines on which regular public transport is performed (state lines, county, inter-county and local lines) are services of general economic interest with public service obligation. The *Act* ensures the implementation of all EU enactments regulating the subject-matter and served as the basis for the adoption of several more detailed sublegal regulations.[14]

In 2006, based on the *Act*, the Government of the Republic of Croatia founded the *Agency* as the main regulatory body in the Republic of Croatia for the subject matter of liner passenger transport in the Adriatic. The *Agency* grants rights to provide public transport services in costal liner shipping, sets up the public transport IT system and regulates the realization of the right to privileged transportation. Bodies of the *Agency* are the Governing Council and the Director.

3.1. The 2016 Amendments to the Act on Transport in Liner Shipping and Occasional Coastal Maritime Traffic

In the 2016 amendments to the *Act*, many articles were modified to accommodate for the terminological harmonization of the text. Terminological adjustments may be said to have been belated, since they should have been made in the 2013 amendments to the *Act*. The new terms in the *Act* ensure the full implementation of the package of measures envisaged by the European rules on state aid for services of general economic interest (SGEI package). Following interventions into its content, the *Act* could neither be followed nor understood without having the new terms defined.

State, county, intercounty and local lines are defined as lines on which public coastal liner shipping services are provided with public service obligation, which is a novelty in the *Act*. Moreover, as to the content of the Decision on the establishment of state lines, adopted by the Government of the Republic of Croatia at the proposal of the ministry competent for maritime affairs, it is stipulated, *inter alia*, that the decision must state *ship type and minimum capacity*. The imprecision of the wording *ship type and capacity* contained in the previous version of the Act was remedied exactly by emphasizing that it needed to indicate the *minimum* capacity of ships.

With respect to terminological modifications of the *Act*, the term *aid* is replaced with the term *public service compensation* and the term *concession* with the term *public service contract*. According to its legal definition, public service compensation is aid granted by the public authority to the shipping companies providing public transport services on lines of general economic interest and with public service obligation, on which revenue generated by service provision is insufficient to cover the costs relating to the fulfilment of the public service obligation (non-profitable lines). A public service contract is a contract between the concession-granting authority / contracting authority and a shipping company regulating the provision of a service, concluded in the form of a *concession contract for the provision of public transport services or contract on public transport services*. Concession contract for the provision of public transport services is a contract equivalent to the contract on public services for activities of public transport, stipulating that the selected concessionaire is obligated to pay a concession compensation pursuant to the *Concession Act*. Contract on public transport services is a public procurement contract the subject of which are waterway transport services, concluded in accordance with the *Public Procurement Act*. Furthermore, the term classic shipping line is replaced with the term *shipping line*, i.e. the word classic

13. On the date of entry of the Act into force, the following became null and void: *Act on public transport in costal liner shipping* (Official Gazette no. 131/97), Articles 3 – 6 and Article 19 of the *Act on Jadrolinija*, Rijeka (Official Gazette no. 11/96), Article 10, paragraph 3, Article 10, paragraphs 1, 2, 4 and 6 in the part relating to maritime transport, Article 12, paragraphs 1 – 5, Article 12, paragraph 6 . of the *Act on Islands* in the part relating to maritime transport (Official Gazette no. 34/99 and 32/02).
14. Fore more details see *supra* 1. Legal sources.

was deleted as redundant since that ship category no longer exists.

The amendments to the *Act* likewise expanded the activities of the *Agency*. These are defined in accordance with *Regulation (EU) No. 1177/2010*, which separately specifies *Agency* activities considered to be public powers. The *right to be awarded a concession* is replaced with the new term *granting of the right to provide public transport services* and the scope of *Agency* activities is broadened to include the setting-up of the public transport IT system and activities pertaining to the realization of the right to privileged transport. In addition, yet another novelty in the *Act* is *Agency* obligation to submit a report on its activities to the Government of the Republic of Croatia on an annual basis, by late April of the current year for the previous year, due to the lack of such a provision being identified as a shortcoming of the then applicable text of the *Act*. The activities of the *Agency* have also been expanded. Apart from terminological changes and adjustment of *Agency* activities in compliance with the amendments to the *Act*, *granting of approvals for the provision of public transport services without public service obligation* is also indicated as an *Agency* activity.

Changes to the tasks and activities of the Agency were accompanied by the corresponding modifications of the duties of the *Agency's* Governing Council. However, these amendments to the *Act* failed to rectify the poor solution regarding the composition of the Governing Council, introduced into the *Act* with the 2013 amendments. Namely, the said amendments proscribe a change in the composition of the Governing Council, reducing its membership from the then current seven to five members. The currently applicable provision stipulates that only and exclusively representatives of ministries may be appointed (three from maritime, one from finance and one from island development), which is considered a poor legal solution since it increases the *concentration of political power*. The Croatian Chamber of Commerce, the Croatian Register of Shipping, shipping company associations and the Seafarers' Union of Croatia all lost their representatives in the *Agency's* Governing Council. The non-participation of the shipping company associations and the Seafarers' Union of Croatia in the *Agency's* Governing Council is partly justified since due to the opening of the market to shipping companies from the European Economic Area, Croatian shipping companies and the Seafarers' Union of Croatia having a say in the decision-making process would hardly contribute to the *fair market competition* of European and Croatian shipping companies. However, the Croatian Chamber of Commerce and the Croatian Register of Shipping should most certainly be represented in the *Agency's* Governing Council.

The part of the *Act* which, in the previously applicable text, regulated *concessions*, is now titled the *right to perform public transport services of general economic interest*, which right stems from the *entrustment documents establishing public service obligations*, namely the concession decision and the decision on the selection of the successful tenderer. That part of the *Act* was correspondingly modified to account for the said change. As stated previously, the right to perform public transport services of general economic interest is obtained on the basis of the *enforceable decision to grant a concession* for profitable lines, i.e. *decision on the selection of the successful tenderer* for non-profitable lines, as entrustment documents lending the shipping companies-service providers authority and establishing their public service obligations. *Concession contract* is concluded on the basis of enforceable decision to grant a concession, while *contract on public transport services* is concluded on the basis of the decision on the selection of the successful tenderer. *Concession compensation* (payment made by the shipping company based on the concession contract for the performance of public transport in coastal liner shipping) is paid for the provision of public transport services. When revenue from service provision realized on a line of general economic interest is insufficient to cover the costs of the fulfilment of the public service obligation, *public service compensation* is granted.

The proscribed requirements to be met by a shipping company to obtain the right to provide public transport services in coastal liner shipping were modified in 2013 and 2016 due to the need to harmonize them with the EU Acquis. The right to provide public transport services with public service obligation may be granted to a shipping company from the European Economic Area in accordance with *Regulation (EEC) No. 3577/92*, providing the crew must speak the language proscribed by the regulations on cabotage in the Republic of Croatia, i.e. crew members charged with ensuring passenger safety must understand and give orders and instructions and submit reports in Croatian.

A provision regulating the issue of the need for increased transport capacity was introduced into the *Act*. Namely, if the *Agency* determines that there is a real need to increase transport capacities on a line on which regular public transport is performed or any part thereof, it will send the shipping company which was awarded the public service contract, a request to meet the need for increased capacity. If the shipping company is unable to meet the request, the Agency may give its consent for the performance of such transport to another shipping company and pay that company compensation in accordance with the provisions applicable to public liner shipping without public service obligation. This legal solution is compliant with the *Regulation (EEC) No. 3577/92* envisaging continuous adjustment of transport connections to new situations, i.e. to the actual needs, primarily through the conclusion of public service contracts. The previous legal solution approached the need for increased transport capacity on public transport lines quite differently. Namely, the previous legal solution stipulated that if the transport volume increased by 30 % in the preceding period no shorter than one

year, and the concessionaire was unable to accommodate for such increase with his current capacities, another concession could be granted on the same line. Since this legal solution proved to be defective, the 2016 amendments to the *Act* made a positive breakthrough in the regulation of this issue.

Privileged transport and public passenger transport IT system provisions have also been modified with the latest amendments to the *Act*. Privileged transport includes discount transport of passengers and vehicles and free transport. The provisions on the privileged transport of islanders and their vehicles are now legally elaborated much more clearly. The *Act* provides for the funds for privileged discount transport to be provided from the state budget of the Republic of Croatia, from allocations of the competent central state administration bodies. In case of free transportation, funds are compensated to the shipping companies in the framework of compensation for the fulfilment of public service obligation (SGEI package), and for emergency interventions in accordance with regulations on the protection against natural disasters and catastrophes. The technical requirements for the realization of the right to privileged transport are the establishment of an IT system and issuance of island passes for passengers and vehicles and vehicle vignette. The manner and procedure of the realization of the right to privileged transport are proscribed by a separate ordinance brought by the minister competent for maritime affairs, with the prior approval of the minister competent for finances and minister competent for island development.[15]

Pursuant to amendments to the *Act*, the highest price of service on each line is determined in the tender documentation. Following the adoption of the decision on the selection of the successful tenderer, the concession-granting authority, i.e. contracting authority is considered to have consented to the pricelist of the tenderer, which may be applied as of the date of entry into force of the awarded contract. According to the previous legal solution, the concession-granting authority determined the highest price of public transport services on a given line in the notification on its intent to grant the concession, with the shipping company granted the concession for the performance of public transport on that line determining the pricelist of services.

The *Act* also changed its regulation of the adoption of sailing schedules. It stipulates that proposed sailing schedules on state lines require the prior approval of the executive body of local self-governing units, the competent harbor master's office and the competent port authority, while the *Agency* gives subsequent approval, following the obtainment of prior approvals. Pursuant to the amendments to the *Act* from 2013, sailing schedules were adopted by the *Agency*, which likewise approved their change. Since such provision, which failed to specify the sailing schedule adoption procedure, created problems in practice, its modification is a positive novelty introduced by the *Act*.

As a novelty, the provisions on *public liner shipper without public service obligation*, which regulate *seasonal transport*, were included in the *Act*. Prior to the 2016 amendments to the *Act*, seasonal transport was considered a part of occasional transport, while it is now regulated separately, as public liner shipping without public service obligation. This transport type is not considered regular public transport, i.e. such lines are not lines with public service obligation, but transport services on such lines are provided according to market principles. The shipping company is required to obtain prior approval of the concession-granting authority/contracting authority competent for the line's route, i.e. the certificate that such transport does not cover over 80 % of the ports of call on any existent line on which regular public transport with public service obligation is performed. The concession-granting authority/contracting authority will, in each individual case, take into account all circumstances when issuing the approval, especially the effect of the performance of transport on the line without public service obligation to the line on which regular public transport with public service obligation is performed.

The 2016 amendments to the *Act* also modified the provisions on occasional transport. Such transport is now elaborated in more detail. The occasional transport of passengers in coastal maritime transport is transportation which is not performed on the basis of established sailing schedules and is not considered public liner transport. *Occasional transport* of passengers must not contain elements of public liner transport. It is intended to cater for the need for one-time transport and does not have the function of transport of daily migration. The occasional transport of passengers especially includes transport as a constituent part of the tourist offer (excursions, package arrangements, passenger transfer), taxi transport and transport of the employees of legal and physical persons for their own needs.

Since a shortcoming was identified in the supervision of the enforcement of the *Act*, the inspection provisions were supplemented with the provisions on administrative supervision of the *Agency's* work, to be performed by the ministry competent for maritime affairs. With respect to inspection, new provisions were added which specify in more detail who performs the inspection and introduce measures at the disposal of the inspector.

The transitional and final provisions of the *Act* of 2016 stipulate that the minister competent for maritime affairs shall, within nine months from the date of entry into force of amendments to the *Act*, adopt the new *Ordinance on the manner of recording of issued tickets of public transport beneficiaries who*

15. For more information see *infra* 3. Ordinance on the conditions and manner of realization of the right to privileged transport on public maritime transport lines.

are not beneficiaries of privileged transport. In spite of the expiry of the envisaged period, the *Ordinance* has yet to be adopted. The *Act* also proscribes the obligation of the minister competent for maritime affairs to harmonize the *Ordinance on the manner and procedure of realization of the right to privileged transport* within nine months from the date of entry into force of amendments to the *Act*. A new *Ordinance on the conditions and manner of the realization of the right to privileged transport on public maritime transport lines*[16] was adopted with a slight delay. Finally, the *Act* proscribes the obligation of the Government of the Republic of Croatia to harmonize the *Regulation on the manner of granting concessions and awarding contracts for the provision of the public services of public transport with public service obligation, evaluation of criteria for granting concessions and awarding public service contracts, criteria for establishing the price of services and public service compensation, amount and manner of payment of concession compensations, types and value of tendering security and other issues relating to concession granting and conclusion of public service contracts* within that same period. This *Regulation* is still not harmonized, in spite of the envisaged period having elapsed. The failure to adopt, i.e. harmonize sublegal acts on time introduces a certain level of legal insecurity which should be avoided, especially since the market is being opened up to European shipping companies. The competent ministry is thus recommended to adopt the new/harmonize the existent implementing regulation as soon as possible, to establish a comprehensive legal system regulating this subject matter.

4. ORDINANCE ON THE CONDITIONS AND MANNER OF REALIZATION OF THE RIGHT TO PRIVILEGED TRANSPORT ON PUBLIC MARITIME TRANSPORT LINES

On 6 April 2017, the minister competent for maritime affairs adopted the new *Ordinance on the conditions and manner of realization of the right to privileged transport on public maritime transport lines* on the basis of the *Act*, which entered into force on 5 May 2017. Upon entry into force of the *Ordinance* the *Ordinance on the conditions and manner of realization of the right to privileged transport on public maritime transport lines*[17] became null and void. The new *Ordinance* stipulates the conditions and manner of the realization of the right to privileged transport on public maritime transport lines with public service obligation, the amount of the discount applicable to the realization of the right to privileged transport in coastal maritime liner transport with discount and the types of documents issued to the beneficiaries of the right to privileged transport.

The separate parts of the *Ordinance* regulate: the beneficiaries of the right to privileged transport; transport with a discount (amount of the discount, transport of passengers with a discount, transport of vehicles at a discount and transport of public services with a discount); free transport (free transport of pupils and students, free transport of children, free transport of pensioners and persons over 65 years of age and free transport of public services); island passes (island passes for passengers and island passes for vehicles); IT system; privileged transport reports; inspection; transitional and final provisions.

As previously stated, privileged transport in coastal liner shipping includes discount transport and free transport. Hence special categories of beneficiaries of the right to discount transport and beneficiaries of the right to free transport have also been identified.[18] A 50 % discount on regular seasonal ticket prices, determined by the concession-granting authority/contracting authority, is granted in case of discount transport. Island passes are issued to the beneficiaries to enable them to realize their right to privileged transport, with the shipping company being obligated to register issued tickets by indicating the respective line, date of trip, price and island pass number, for every trip realized. The *Agency set up the Information system for registering islander rights* (SEOP) to keep track of the beneficiaries of the right to privileged transport, grant rights to privileged transport and monitor the realization of such rights. The SEOP system allows the keeping of records, codebooks and data catalogues necessary for the administration of the privileged transport system. Shipping companies performing public maritime liner transport on state lines are obligated to continuously and immediately enter all data on transported beneficiaries of the right to privileged transport into SEOP, to allow the Agency to compile monthly reports on the basis thereof.

5. DECISION ON THE ESTABLISHMENT OF STATE LINES IN PUBLIC TRANSPORT IN COASTAL LINER SHIPPING

Minimum transport frequency, ship type and minimum capacity, as well as the type of transport on state lines in public transport in coastal liner shipping are all proscribed by the *Decision on the establishment of state lines in public transport in coastal liner shipping*. State lines are established by the Government of the Republic of Croatia at the proposal of the ministry competent for maritime affairs. The *Decision* may only be amended if such change is rendered necessary due to economic interests, i.e. the adjustment of public transport in coastal liner shipping to the newly emerging needs.

In accordance with Article 7, paragraph 1 of the *Act*, the Government of the Republic of Croatia adopted the new *Decision on the establishment of state lines in public transport in coastal*

16. Official Gazette no. 41/17.
17. Official Gazette no. 1/14, 52/15 and 56/15.
18. For more information see Article 2 of the *Ordinance on the conditions and manner of realization of the right to privileged transport on public maritime transport lines*.

liner shipping[19] on 22 December 2016, establishing state ferry, high-speed and shipping lines, and proscribing appropriate ship type and minimum capacity, route and minimum frequency of weekly return trips. The *Decision* established a total of 53 state lines, out of which 25 ferry, 15 high-speed and 13 shipping lines. The first novelty is the reduction of the number of state lines, from 56 stipulated in the previous *Decision*. The second novelty are increased ship capacities and trip frequency on certain state lines. The third novelty is that the so called *coastal ferry line* (Rijeka – Split – Stari Grad – Korčula – (Sobra) – Dubrovnik and back) was once again identified as a year-round line with increased vehicle and passenger capacity. Namely, the *coastal ferry line* was gradually being extinguished. It was first cancelled during low season in 2010, followed by the reduction in the minimum passenger and vehicle capacity, with the option of deploying a smaller ferry in 2013 and the final abandonment of the line by the state shipping company in 2014. The preconditions for the full revival of this line with a long tradition have now been fulfilled.

6.CONCLUSION

The 2016 amendments to the *Act* modify a certain number of articles and introduce some terminological changes. With the adoption of these amendments, this subject-matter became fully harmonized with the EU Acquis in content and terminology, as well as with the acts regulating concessions and public procurement which are also applicable to the system of performance of public transport in coastal liner shipping. A significant number of definitions from the EU Acquis needed to be transposed into the *Act*, increasing its scope. However, interventions into the text of the *Act* did not change its underlying concept. The procedure of selection of shipping companies for providers of public maritime liner transport, as a service of general economic interest, using the mechanism of public service contracts concluded on the basis of public invitations to tender open to all shipping companies from the European Economic Area, has become clearer and more precise.

While pursuant to the provisions contained in the previously applicable text of the *Act*, the right to perform maritime liner transport was obtained on the basis of a concession, new provisions of the Act stipulate that the right to perform public transport services, as services of general economic interest, may be obtained based either on a concession decision or a decision on the selection of the best tenderer, which then serve as the basis for the conclusion of concession contracts or contracts on public transport services, jointly referred to as public service contracts.

The *Act* now also separately regulates public liner shipping without public service obligation, with the aim of ensuring optimum traffic connections between the islands and the mainland under any conditions, while the privileged transport system is regulated in more detail both by the *Act* and sublegal regulations. Another positive novelty is the provision stipulating that the adoption of sailing schedules requires the prior approval of the proposed sailing schedules on state lines by executive bodies of local self-governing units, the competent harbor master's office and the competent port authority, while the *Agency* gives subsequent approval. It supplanted the inadequate provision of the previously applicable text of the *Act* which failed to specify the procedure for the adoption of sailing schedules, causing all sorts of issues in practice.

Although the deadline envisaged by the *Act* for the adoption, i.e. harmonization of sublegal regulations has elapsed, not all regulations have been adopted and harmonized. This is not the first time the ministry competent for maritime affairs is late and unsuccessful in the adoption of changes of implementing regulations within the legal deadline. The non-existence of a comprehensive legal framework introduces a certain level of legal insecurity, and since the market of public transport in coastal liner shipping is being fully opened up to European shipping companies, the ministry competent for maritime affairs is recommended to establish a comprehensive legal framework regulating this subject matter in the shortest period possible.

19. With the adoption and entry into force of the *Decision*, the *Decision on the establishment of state lines in public transport in coastal liner shipping*, class: 342-01/08-01/05, reg. no. 5030116-08-1, of 5 December 2008, class: 342-01/10-01/01, reg. no. 5030116-10-1, of 4 March 2010, class: 342-01/10-01/01, reg. no. 5030116-11-1, of 20 October 2011and class: 022-03/13-04/47, reg. no. 50301-05/20-13-4, of 11 April 2013.

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Standardised English Language Proficiency Testing for Seafarers

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This paper aims at pointing out the necessity of raising the levels of both communicative competence and Maritime English knowledge of seafarers, as well as of introducing a common language testing system into maritime education and training. It provides insight into the process of implementation of improvements in a different, but related practice of Aviation English and the relative regulations. Also, the paper presents the accounts of one aircraft accident, and two ship accidents due to the participants' misunderstanding, or deficiency in English. This is followed by the results of an investigation into the reports published by the Marine Accident Investigation Branch (MAIB) about the sea accidents due to inadequate English language competence, or inadequate professional communication. Although there are commonly more than one cause which combine in each accident, these are usually fuelled by inadequate language competence. It is of utmost importance, especially in emergencies, that all the participants in the maritime venture are adequately competent in Maritime English to handle the emergencies to the benefit of all the persons involved. Therefore, the compulsory introduction of a uniform global language certification is suggested.

KEY WORDS
~ Maritime English
~ Aviation English
~ Language certification
~ Competence
~ Emergency

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1. INTRODUCTION

The problem of inadequate English language skills among ships' crews is not unknown. In 2016, 85 total losses of ships of 100 GT and above occurred worldwide resulting in 2,611 deaths.[1] In the subsequent reports and discussion about the actual causes of accidents, technical failure or human error is often cited. In all of the cases, there is clearly an instantaneous overload of the ship's structure, its technical facilities, or the people entrusted with conducting the ship shortly before the accident. A current report by the ship classification society *Det Norske Veritas / Germanischer Lloyd* (DNV / GL) assesses the share of human error at approximately 85 %.[2] The proportion of the technical failure is thus approximately 15 %.

The avoidance of a technical failure is a task for engineers, whose results are continually reviewed and improved. Overall equipment requirements are leading to progressive mechanisation, automation, and digitalization of ships' operation, a development which includes an increased surveillance of the crews. One such example was the introduction of *Voyage Data Recorder* on civilian ships starting from 1 July, 2002.[3] These are comparable to *Black Box* flight recorders, which had existed for several decades in civil aviation before the date mentioned.

In the following parts 1 and 2.1, there is reference to Aviation English, as the participants in the air traffic have already realised the importance of common occupational and working language in the avoidance of accidents, and have implemented the necessary changes.

In order to emphasise the importance of Maritime English as occupational and working language in shipping, an analysis of MAIB reports of accidents at least partly due to language

1. *Source: Allianz Safety and Shipping Review 2017, available at: http://www.marifuture.org/Publications/Papers/COMMUNICATION_AND_PRACTICAL_TRAINING_APPLIED_IN_NAUTICAL_STUDIES.pdf*
2. *Maritime Impact magazine (2014)*
3. *International Convention for the Safety of Life at Sea, Issue 2017, Chapter V, Rule 20, Number 1.1*

incompetency in either General or Maritime English, or both is presented in the part 3 below.

Finally, the need for introduction of a uniform Maritime English testing system is emphasized as means of achieving more balanced Maritime English competence among crewmembers and, thus, raising the level of safety at sea.

2. THE RELEVANT GUIDELINES OF AVIATION ENGLISH

At present, to man seafaring vessels the crewmembers are still not required to present any uniform language certificate. By comparison, the currently existing language certificates in the field of civil aviation were introduced in a globally uniform format by the *International Civil Aviation Organisation* (ICAO) with the *Manual on the Implementation of ICAO Language Proficiency Requirements*, the ICAO Doc 9835, during the 2004-2008 period. This procedure requires the acquisition of a language certificate confirming at least the English language level 4 ('Operational')[4] proficiency for any air-borne or ground personnel entrusted with safety-relevant tasks.

Table 1.
Language Proficiency Levels.

CEFR Common European Framework of Reference for Languages	ICAO Language Proficiency Requirements (LPRs) for Pilots and Air Traffic Controllers
C2 Proficiency	Level 6: Expert
C1 Advanced	Level 5: Extended
B2 Upper Intermediate	Level 4: Operational
B1 Intermediate	Level 3: Pre-operational
A2 Elementary	Level 2: Elementary
A1 Beginner	Level 1: Pre-elementary

Another example is the required language performance testing for certain careers in the *Bundeswehr* (German Armed Forces). Here, the responsibility lies with the Federal Office of Languages (*Bundessprachenamt*) in Cologne/Hürth as well as its approximately 100 service centres, e.g. at the Naval Academy Mürwik at Flensburg. The *Federal Office of Languages* offers total training in over 40 languages.

4. *The ICAO language testing system is divided into 6 levels. Currently, each pilot that is flying internationally must have a minimum level 4 of ICAO English. The exam must be done in an authorized organization. As regards to the validity of ICAO language proficiency certificates, the revalidation which one must undertake is determined by the level achieved: Level 4 – every 3 years, Level 5 – every 6 years, Level 6 - unlimited*

3. COMMUNICATION AS A SOURCE OF ERROR

There are various causes of human error in shipping. Due to the lack of available statistics, reference is made here to publicly accessible accident investigation reports. The high number of ship's Deck Officers involved in accidents corresponds to the typically higher risk related to the job profile of navigating seagoing ships. The study *The Human Element - a Guide to Human Behaviour in the Shipping Industry*, published in 2010 with the support of the UK Maritime and Coastguard Agency, asserts that communication failures are common and have serious consequences in safety-critical industries such as seafaring. According to Gregory, D., Shanahan, P. (2010: 83), these failures account for over 25 % of the accidents.

The objectively problematic language situation in the civilian seafaring is typically addressed with various strategies during normal ship operation. The use of hand signals, repeated orders or requests for clarification, along with intuitive action replaces "*clear communication*" as defined by the international STCW Convention[5] in many cases. This can work when it comes to routine procedures, but immediately after the onset of a marine accident, more complex and at the same time also completely specific communication competences are required. Not only may these differ technically from the usual communication content, but the number of potential communication participants is also multiplied. After experiencing a grave accident, the crew has to coordinate and communicate about not only the damage control on board, but also with other craft in the vicinity, as well as with land-based services. "Clear communication" as required by the STCW Convention should now be used. If the individual language users are overdemanded, the entire accident response is at risk.

3.1. Aviation and Marine Accidents Due to Language Difficulties

The worst accident in the history of aviation happened on 27 March, 1977 at the Airport Los Rodeos on the island of Tenerife. While the just-landed Pan Am Boing 747 was rolling towards the terminal, another KLM Boing 747 was waiting for its take-off clearance. The communication between the Captain and the Flight Engineer in the cockpit of the waiting KLM aircraft was recorded by the voice recorder. At 17:06:32 the Flight Engineer asked: "*Is he not clear, then?*" Two seconds later the Captain replied: "*What do you say?*" At 17:06:34 the Flight Engineer repeated: "*Is he not clear, that Pan American?*" A second after that, the Captain said in an emphatic tone: "*Oh, yes!*" The take-off, the moment a plane loses contact with the earth, was recorded at 17:06:44. Six seconds later, the two aircrafts collided. 583 people

5. *International Maritime Organization (2011), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, Table A-II/1*

did not survive this collision, only 61 escaped. The official accident investigation concluded it was the Pilot's error. Apparently, the communication with the tower did not make clear whether the arriving Pan Am aircraft had already cleared the runway. As a consequence of this accident, new communication procedures were adopted: "*Ready for take-off*" was changed into: "*Ready for departure*", to avoid confusion with the phrase: "*Cleared for take-off*".

The second example involves the grounding of the M/V *S. Gabriel* on the southern coast of the Acores on 21 November, 2009. The M/V *S. Gabriel* is a multi-purpose vessel with about 100-metres' length and the loading capacity of 5,560 tons, sailing under the flag of Germany. Running aground on the rocky coast of the Acores happened in the early morning hours, at about 05:00 local time. The 2nd Deck Officer obviously fell asleep, and therefore failed to alter course in time. The 2nd Deck Officer was of Bulgarian nationality, while the Captain was of German nationality. The working language on board was, as usually, English. Following the stranding, the Captain awoke. The communication at the time the Captain entered the navigating bridge (wheelhouse) was recorded by the ship's *Voyage Data Recorder*. First, the Captain exclaimed: "*Oh, my God! End of my... What´s going on, Second?*" The 2nd Officer replied: "*Uh, Captain; I try to…...* ". Then, the Captain asked: "*Where we are? Were you sleeping?*" This was answered by the 2nd officer saying: "*No. But..... I just…...* ". After a short while, the Captain ordered: "*Give alarm! Wir sind völlig am Arsch! Wir hängen auf Grund! Wir saufen ab! Du bist gegen die Felsen gefahren!*" (From German original into English: "*We are totally screwed! We are aground! We are drowning! You have been sailing against the rocks!*") Two things can be noticed here: the Captain first approached the 2nd Deck Officer in the working language. As the Captain realized that he was receiving no usable feedback to his questions, he fell back into his own mother tongue. Mitigating circumstances could be that the 2nd Deck Officer was in a state of shock. On the other hand, members of the ship management must be in the position to communicate clearly under all circumstances.

The third example was extracted from the official accident report about a very serious accident involving the cruise ship *Sapphire Princess* on 7 August, 2014 in the East China Sea. *Sapphire Princess* with the length of 290 metres sailed under the flag of the United Kingdom. On the day of the accident, Sapphire Princess carried 4,095 persons, of which 2,998 were passengers, the other 1,097 persons on board belonged to the crew. The majority of the passengers were Chinese, while the crew was multi-national. A number of Chinese-speaking Customer Service Agents (CSA), and other crew members of various nationalities had been employed. Passenger information documents and some ship's signage were translated into Chinese. At approximately 12:45 hours local time, a passenger was noticed floating face-down in the *Neptune* swimming pool. In the absence of a dedicated pool attendant, the initial alert was raised by some passengers. At 12:47 hours, a member of the catering staff dialled the internal ship's alert number '911' using the onboard emergency services telephone. The CSA receiving the call could not understand him and passed the telephone to another CSA who, in turn, transferred the call to the duty nurse. The nurse received the call at 12:49 hours, at which point the caller reported that a female passenger had been pulled out of the pool and was unconscious. Following the receipt of the emergency call, the duty nurse retrieved the First Response Bag, ran to the medical centre and explained the nature of the emergency to the senior doctor and senior nurse. They all then proceeded to *Neptune Pool*. On arrival, the medical team noticed some five passengers and a similar number of crew members in the vicinity of the victim, but they also noticed that CPR (cardio-pulmonary resuscitation) was not being carried out. The doctor and the duty nurse began CPR, while the senior nurse fetched the ship's Automated External Defibrillator; the pads were applied to the victim's chest, but the device indicated '*No Shock Advised*'. CPR was then resumed and supplementary oxygen administered. The victim was transferred to a gurney, where resuscitation attempts continued and adrenaline was administered intravenously. Despite the rescue and resuscitation attempts, the victim was pronounced deceased at 12:55 hours.

However, there was a short delay in the emergency team response due to the language difficulties among the crewmembers. Once the alarm was raised, the response to the incident by the ship's emergency medical team was rapid and professional. It cannot be determined how long Ms. Bayinhua had been lying face-down in the water before her predicament was noticed. The working language on board was English. However, the initial emergency call from a Serbian catering assistant working in the Deck 14 food area to an Asian CSA in the Purser's office was not understood due to language difficulties. Fortunately, another CSA was able to understand the caller, otherwise the medical team's response might have been further delayed. These delays might have compromised the effectiveness of the emergency response.

4. INVESTIGATION INTO MAIB ACCIDENT REPORTS

The Marine Accident Investigation Branch (MAIB), established in 1989 following the *Herald of Free Enterprise disaster,* is a branch of the *United Kingdom Department for Transport* which can investigate any accident occurring in the UK waters, regardless of the nationality of the vessel(s) involved, and accidents involving UK-registered ships worldwide. The aim is to present publicly safety lessons which may be learned as a result of the investigation.

The investigation into MAIB reports was based on three key words: 'language', 'communication', and 'English'.

On entering the key word '*language*' into the webpage search engine, 4 reports were returned among which there was the already discussed accident involving the cruise ship *Sapphire Princess*. The key word '*English*' also returned 4 reports including *St.Georgij* and *Ocean Harvest II* accidents, while the key word '*communication*' returned 32 reports. Among the latter, 13 referred exactly to language communication, while in the remaining 19 reports the word 'communication' was found as referring to either communication equipment on board ships involved in the accidents, or crewmembers' interpersonal communication in the sense of a process based on other factors than language.

Table 2 below shows the results of the investigation, and presents the remarks or recommendations of the Chief Inspector in each of the cases. This points out different aspects of professional communication either praised, or blamed for accidents.

Table 2.
Results of MAIB reports investigation.

No.	Accident:	Chief Inspector's remarks / reccommendations:	Language skills referred to:
1.	Fire in engine room on Panamanian-flagged, 1984-built bulk carrier ***St Georgij*** with 1 person injured and loss of 1 life (19 December, 2005)	improvements in key personnel's ability **to read English instruction books** or **have manuals translated into the working language of the crew**	- Requirement for **English as working** language - **Reading** skill improvement
2.	Fire and sinking of UK-flagged, 1972-built fishing vessel ***Ocean Harvest II*** (3 July, 2006)	… **courses should be provided that are suitable for those that do not have English as their first language.**	- **All skills** required
3.	Drowning in swimming pool on the UK-flagged, 2004-built passenger cruise ship ***Sapphire Princess*** with loss of 1 life (6 August, 2014)	there was a short **delay in the emergency team response due to language difficulties** between crew members	- **Speaking** skill
4.	Collision between fishing vessels ***Immanuel V*** and UK-flagged 1972-built ***Scath Ros*** resulting in Scath Ros sinking (10 July, 2005)	To ensure all crewmembers can **communicate effectively in a common language, especially during emergency situations**.	- **Speaking** skill (SMCPs in emergencies)
5.	Parting of messenger line from tanker ***Queen Zenobia*** (18 June, 2005)	Ensure **ship's crews establish contact and maintain basic communication between themselves and tug crews** when working together.	- **Speaking** skill (SMCPs for Tug Assistance[6])
6.	Collision between pair trawlers UK-flagged, 1999-built ***Fertile II*** and UK-flagged, 1999-built ***Aquarius*** resulting in ***Fertile II*** sinking (28 May, 2005)	The Chief Inspector wrote to the skipper of *Aquarius* **regarding the** standard of lookout, **communications** and maintenance procedures and to the skipper of *Fertile II* regarding the standard of lookout, communications, use of life saving equipment **and the use of VHF in the initiation of a Mayday call**.	- **Speaking** skill (SMCPs for VHF communication in emergencies)

6. *More about SMCPs for Pilotage and Tug Assistance, and the requirement to use English as the only working language in these activities instead of the use of local languages for communication between the bridge team and the tug/s, in Culic-Viskota, A. (2014), (2015)*

7.	Collision between sailing yacht ***Ibis*** and Liberian-flagged 2000-built container vessel OOCL ***Malaysia*** resulting in Ibis sinking (06 February, 2005)	To Associated British ports: - regarding methods of **improving communications between the patrol launch and small vessels**.	- **Speaking** skill (VHF communication)
8.	Contact made by Gibraltar-flagged German-owned oil product/chemical tanker ***Apollo*** with quayside (25 July, 2013)	It is of course fundamental **to establish and maintain good, clear and concise communications**.	- **Speaking** skill (VHF communication)
9.	Grounding of Bahamas-flagged, German-owned, 1997-built passenger cruise ship ***Hamburg*** (11 May, 2015)	Although English was the working language on board Hamburg, **several conversations were in other languages**. Had the SMS been followed, the announcement would have first been made in English, the working language on board, followed by German. **The only announcement following the grounding was made in German and not in the working language on board which was English**.	- Requirement for **English** as working language - **Speaking** skill (VHF communication - SMCPs in emergencies)
10.	Collision between UK-flagged 2007-built container vessel ***CMA CGM Florida*** and Panamanian-flagged, 2004-built bulk carrier ***Chou Shan*** (19 March, 2013)	**The working language on *CMA CGM Florida* was English.** **The working language on *Chou Shan* was Mandarin.** The Filipino OOW asked the Chinese 2/O to do this because he believed there would be a better chance of a positive outcome from the VHF radio call if it was made in Mandarin, which he assessed to be the likely first language of the fishing vessel crews. When he was asked by the Filipino OOW to call the fishing vessels on the VHF radio, he readily accepted the task believing his ability to communicate externally, in the local language, to be helpful in the circumstances. Use of the VHF radio for collision avoidance was common practice in his experience. ... **they were both hampered in their attempts to communicate by having to converse in a second language**. A significant contributing factor to this misunderstanding was that the **communication was conducted in a language which the Filipino OOW was unable to understand**. Even where positive identification has been achieved there is still the possibility of a misunderstanding due to language difficulties however fluent the parties concerned might be in the language being used. An **imprecise or ambiguously expressed message** could have serious consequences.	- Requirement for **English as working language** - **VHF communication** (SMCPs for VHF communication) - Requirement for **clear and unambiguous language**
11.	Grounding and capsize of French berthed trawler ***Saint Christophe 1*** resulting in loss of the vessel (10 March, 2016)	Although one of the river officers attempted to explain the limitations of the berth **using hand gestures** to the skipper of *Saint Christophe 1*, **the skipper did not understand the communication**. The investigation also identified that the Harbour Authority was fully aware that *Saint Christophe 1* would ground on the falling tide but, **due to language difficulties, its staff were unable to make the fishing vessels' skippers aware of this**.	- Requirement for **English as working language** - **Speaking** skill (use of SMCPs in navigational warnings)

12.	Person overboard from cable laying vessel ***Tycom Reliance*** with loss of 1 life (25 June, 2006)	**poor internal communication**	- **Speaking** skill (SMCPs for Internal Communication)
13.	Parting of rope during hauling operation on UK-flagged, 1982-built twin-rig trawler ***Hendrika Jacoba*** with loss of 1 life (20 April, 2010)	Consider further **risk control measures** such as organisation, supervision, **effective communications (between bridge and mooring stations[7])** and clearly marked snap-back areas.	- **Speaking** skill (SMCPs for Internal Communication)
14.	Grounding of UK-flagged, 1991-built potter ***Niamh Aine*** (22 March, 2009)	The Deputy Chief Inspector of Marine Accidents has written to the vessel's owner: - commending the professional manner in which the skipper and crew responded to the accident, particularly with regard to the **skipper's calm and clear communications with the coastguard and rescue helicopter** during the rescue.	- **Speaking** skill **praised** (SMCPs for VHF communication with Coastguard and rescue helicopter)
15.	Close-quarters situation involving Cyprus-flagged, 1989-built liquefied petroleum gas tanker ***Monsoon*** and its contact with mooring dolphin (23 August, 2008)	The Deputy Chief Inspector has written **to the Pilot**, strongly advising him to: - **Keep VTS fully informed of any intended course of action**; - Maintain full situational awareness by gaining information on all scheduled ship movements before boarding, and **utilising the bridge team to relay relevant communications and traffic information as necessary**.	- **Speaking** skill - Requirement for **English as working language** for Pilotage (SMCPs for Pilotage and Tug Assistance)
16.	Failure of main engine on UK-flagged, 1997-built product tanker ***Audacity*** and subsequent parting of tow rope from Spanish-flagged, 2005-built tug ***Red Wolf*** with 1 person injured (19 April, 2007)	The Chief Inspector of Marine Accidents has written to the: Owner and Managers of Audacity, strongly advising that they: -Emphasise the need **for effective communications to be maintained between company vessels and tugs, or other vessels, engaged in towing**.	- **Speaking/listening** skill (SMCPs for VHF communication for Tug Assistance)
17.	Contact made by UK-flagged, 1982-built tractor tug ***Svitzer Constance*** with lock gate (03 September, 2009)	ABP Humber has circulated a Notice to Pilots, to all Pilots and Pilotage Exemption Certificate (PEC) holders, summarising the accident and stating various future measures, including: - Proper concise planning is to be agreed **between bridge teams and tugs, together with clear and unambiguous communication, to ensure safe operations**.	- **Speaking/listening** skill - Requirement for **English as working language** during Pilotage and Tug Assistance
18.	Contact made by UK-flagged, 1992-built oil product/chemical tanker ***Stolt Petrel*** with lock gate (07 April, 2009)	The Chief Inspector of Marine Accidents has written to the company: - Ensure that all crew are aware of the risks of parting mooring lines, and **the need for good communication between the master and crew at mooring stations**.	- **Speaking/listening** skill (SMCPs for Mooring)
19.	Machinery failure and subsequent flooding of UK-flagged, 1973-built long liner ***Port of Ayr*** (29 October, 2009)	The examination noted that none of the crew held a professional Certificate of Equivalent Competency (CEC), and there was **no English speaker on board**.	- **Speaking/listening** skill - Requirement for **English as working language**

7. *Clarification added by the authors*

As it clearly results from the Table 2 above, in all of the accidents listed either the inability to use the working language – Maritime English, the deficiency in the performance of the most important communicative skills – speaking/listening, or both can be observed. Furthermore, the importance of using English as occupational language in shipping has again been emphasized for the Pilotage and Tug Assistance, as well as Mooring, areas which still lack the approval of all the participants in the relative operations to use English exclusively as working language.

5. MARITIME ENGLISH COURSES AND HETEROGENEOUS PREVIOUS EXPERIENCE

From the instructor's perspective, the problem lies in offering generally attractive lessons for classes with widely differing degrees of prior knowledge. While the *German Armed Forces* can arrange more numerous courses, with students at nearly equal language proficiency levels due to a high number of participants, smaller maritime training institutions only have the option of targeted and problem-oriented language promotion in conjunction with well prepared internal differentiation. The idea of an early learning level survey to avoid false evaluations by the teacher seems very reasonable under these conditions.

A 2012 paper titled Communication and Practical Training Applied in Nautical Studies[8] describes the results of a survey in which 64 instructors of Maritime English from 30 maritime academies and universities worldwide participated. The following estimates refer to the 6-stage *Common European Framework of Reference for Languages*. The English language proficiency level of the students from these 30 respondent maritime academies and universities worldwide was specified as 5 % at the level "Beginner" and 19 % at the level "Elementary". For the 64 instructors surveyed, "Upper Intermediate" was the minimum recommended level for the command of a ship, and in some cases even the highest level, "Proficiency", was required.

5.1. Individual Testing Criteria

The criteria to pass an exam at the maritime training institutions are often decided individually. This burdens the examiners with a choice between compliance with the pre-defined testing criteria and the (unofficial) goal of a minimal failure rate, a choice complicated by the desire to prevent potential candidates migrating to other maritime training institutions. Uniform language certificates would not only ensure comprehensive adherence to the English Language Minimum Competency levels, but would also provide relief for the examiners.

Appropriate language tests tailored to the specific demands of the merchant navy are already available on the market. For example, the Glasgow-based MARLINS Company, according to its own information leader in the area of E-Learning and Language Assessment, offers high-quality and low-cost online training courses. The ISF Marlins English Test for Seafarers was developed in close cooperation with the International Shipping Federation (ISF) and is already accepted by several flag states and the UK Maritime Coastguard Agency. The ISF Marlins English Test for Seafarers consists of an on-line test in which 85 questions must be answered within 60 minutes. The test questions are divided into various areas of expertise and are explained clearly in multiple languages before the actual test begins. In addition to this online test, there is also a 20-minute Test of Spoken English (TOSE). There are currently 198 Marlins test centres in 41 countries offering language certificates under test conditions. The official recognition (flag state approval) of the ISF Marlins English Language Test for Seafarers already exists in the countries of Great Britain, Ireland, Bulgaria, and Australia.

5.2. Approved Tests on the Market

In the meantime, the ISF Marlins English Tests for Seafarers has been chosen by many crewing companies as the in-house solution. The IMO's (International Maritime Organisation) requirement, as outlined in the International Safety Management Code, saying that "*the company should ensure that the ship's personnel are able to communicate effectively...*" can thus be reasonably satisfied. Then, the Maritime English Instructor Training Course (MEITC), a course developed by Marlins for the IMO, which aims at enhancing the qualifications of the instructors of Maritime English, should not remain unmentioned either. Yet another current advance is the SeaTALK project, funded by the EU Leonardo da Vinci lifelong learning programme. The freely available training materials of the SeaTALK project, which are based on the policies of the communicative approach defined in the IMO Model Course 3.17 for Maritime English, are compiled under the direction of World Maritime University in Malmö (Sweden), in cooperation with nine European maritime training institutions. The training materials are rated according to the skills, refer to the various positions on board the vessels, and are suitable for self-study in addition to being a reference for Maritime English instructors and all other interested parties free of charge. The materials developed in the SeaTALK project form the basis for language competency to be acquired in the individual branches of maritime transport, as well as for the certificates to be acquired in the future. The SeaTALK project refers also to the MarTEL language testing module, developed in the framework of the EU's Leonardo da Vinci programme.

8. *Ziarati, M., Ziarati, R., Bigland, O. and Acar, U. (2012: 3)*

5.3. Time Lag in Shipping

The maritime sector is not known for its rapid implementation of advanced ideas, but the basis for the introduction of uniform language certificates for seafarers is available. Several maritime training institutes, organisations and companies are taking part in their formulation.

This issue has been intensively discussed for many years within IMLA (*International Maritime Lecturers' Association*). The International Maritime Organisation (IMO) has issued a technical manual along with the Maritime English Model Course 3.17. The Maritime Safety Committee (MSC), the international competency body belonging to the IMO, is currently struggling with international coordination problems. However, the introduction of uniform global language certificates for seafarers is foreseeable. Of course, individual flag states possess the freedom to initiate compulsory introduction of language certificates within their national waters. The introduction of such measures would lead to an improvement in the general level of education in the civilian shipping industry, and as a result many human victims, complicated rescue operations, pollution, and high economic losses could be avoided. Finally, this is all about the closure of a still-existing safety gap.

6. CONCLUSION

From the data presented above and the relative discussion, it can be concluded that:

1. The ICAO has long recognised the importance of the introduction of uniform testing of the English language proficiency of the personnel involved in the air traffic. IMO should follow in these footsteps because the Maritime English competence levels of seafarers and others involved in the field of maritime affairs differ significantly.
2. As it follows from the discussion of one air and two maritime accidents above, the knowledge of the specific working language can have the crucial role in the occurrence, or avoidance of an accident. Also, the investigation into MAIB accident reports according to the key words 'language', 'English', and 'communication' has shown that poor communication either causes, or contributes among other causes to the occurrence of an accident.
3. The level of the English language competence of seafarers should be raised and levelled. This can best be achieved by introducing a uniform Maritime English testing system for all seafarers. The achieved knowledge of Maritime English of the present-day seafarers on completing their education differs greatly. The introduction of a common testing system would contribute to effacing the differences by standardising the testing procedures and materials. The knowledge of General English and Maritime English should be tested by adequate tests, but a test of communicative competence, insisting on the listening and speaking skills in particular, is considered just as important and should be conducted as part of the proficiency testing.

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CONTRIBUTION

CONTRIBUTION

News from IMO

Tatjana Krilić

This contribution presents a compilation of information on current work of selected IMO bodies in the period preceding the publication of this issue of ToMs. The outcome of IMO bodies responsible for safety and environment protection has been covered, aiming at informing readers on the decisions taken, as well as on the IMO instruments and/or their amendments that have entered into force.

KEY WORDS
~ IMO
~ Safety
~ Environment protection

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INTRODUCTION

World Maritime Day

World Maritime Day 2017 was formally celebrated at IMO on 28 September 2017 and was marked around the world in a series of events and celebrations led by IMO from its London headquarters under the 2017 theme "Connecting Ships, Ports and People". The aim of the 2017 theme is to focus on helping IMO Member States to develop and implement maritime strategies to invest in a joined-up, interagency approach that addresses the whole range of issues, including the facilitation of maritime transport, and increasing efficiency, navigational safety, protection of the marine environment, and maritime security. In this way, IMO will be contributing to achieving the United Nations' Sustainable Development Goals (SDGs) which are a broad response to the challenges facing the world today – increasing world population; climate change; threats to the environment; unsustainable exploitation of natural resources; threats to food security; societal threats posed by organized criminals and violent extremists; and instability leading to mixed migration. Ultimately, more efficient shipping, working in partnership with a port sector supported by governments, will be a major driver towards global stability and sustainable development for the good of all people.

Summary

Selected decisions and outcome of 98th session of the Maritime Safety Committee (MSC), which was held in London at the IMO Headquarters from 7 to 16 June 2017, and 71th session of the Marine Environment Protection Committee (MEPC), which met from 3 to 7 July 2017, have been outlined in this review, along with the IMO instruments and their amendments that entered into force since the last issue of ToMS.

Read more

More information and highlights on the work of IMO can be found on its website (http://www.imo.org), including press briefings and meeting summaries available in "Media Centre" area.

IMO programme of meetings, meeting documents and circulars are publicly available on the Organization's IMODOCS website (https://docs.imo.org).

Most of the IMO's technical and operational data, some of which is available to the public, is stored in the Global Integrated Shipping Information System (GISIS) (https://gisis.imo.org).

98TH SESSION OF THE MARITIME SAFETY COMMITTEE (MSC 98)

Scoping exercise on autonomous vessels put on agenda

The MSC agreed to include the issue of marine autonomous surface ships on its agenda. This will be in the form of a scoping exercise to determine how the safe, secure and environmentally sound operation of Maritime Autonomous Surface Ships (MASS) may be introduced in IMO instruments. The MSC recognized that IMO should take a proactive and leading role, given the rapid technological developments relating to the introduction of commercially operated ships in autonomous/unmanned mode. The scoping exercise is seen as a starting point and is expected to touch on an extensive range of issues, including the human element, safety, security, interactions with ports, pilotage, responses to incidents and protection of the marine environment. It is anticipated that the work would take place over four MSC sessions, through to mid-2020.

Adoption of passenger ship stability amendments

The MSC adopted a set of amendments to SOLAS chapter II-1, with an expected entry into force 1 January 2020, relating to subdivision and damage stability. The amendments were developed following a substantive review of SOLAS chapter II-1, focusing in particular on new passenger ships. The review has taken into account recommendations arising from the investigation into the 2012 Costa Concordia incident.

Other amendments adopted by MSC

SOLAS amendments (Expected entry into force 1 January 2020)

- Amendments to SOLAS regulation II-2/3.56, relating to the definition of vehicle carrier and draft new SOLAS regulation II-2/20.2 on fire safety requirements for cargo spaces containing vehicles with fuel in their tanks for their own propulsion, specifically vehicles which do not use their own propulsion within the cargo space.
- Amendments to SOLAS regulation II-2/9.4.1.3 to clarify the requirements for fire integrity of windows on passenger ships carrying not more than 36 passengers and on special purpose ships with more than 60 (but no more than 240) persons on board.
- Amendments to SOLAS regulations III/1.4, III/30 and III/37 on damage control drills for passenger ships, to require damage control drills to take place on all passenger ships from 2020.

IMSBC Code

- The 2017 set of draft amendments (04-17) to the International Maritime Solid Bulk Cargoes Code (IMSBC Code), to update requirements for a number of cargoes, was adopted.

HSC Code

- Amendments to the 1994 and 2000 High-Speed Craft (HSC) Codes, clarifying the exemption applicable to certain smaller vessels from the requirement to carry a rescue boat, provided that minimum requirements for carrying survival craft are met and provided that a person can be rescued from the water in a horizontal or near horizontal body position.

LSA Code

- Amendments to the International Life-saving Appliances (LSA) Code, chapter VI, section 6.1 relating to the proof load tests and safety factors that launching appliances and their elements have to withstand. Also related amendments to the Revised Recommendation on testing of life-saving appliances (resolution MSC.81(70)).

MODU Code

- Amendments to the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 (2009 MODU Code) to update and amend the 2009 MODU Code, taking into account recommendations arising from the investigation into the explosion, fire and sinking of the Deepwater Horizon in the Gulf of Mexico, in April 2010. Key revisions concern machinery and electrical installations in hazardous areas, fire safety and life-saving appliances and equipment.

Cyber risk management resolution adopted

The MSC adopted a resolution on Maritime cyber risk management in safety management systems. The resolution reminds stakeholders that the mandatory International Safety Management (ISM) Code includes a requirement for all identified risks to ships, personnel and the environment to be assessed and for appropriate safeguards to be established. The resolution encourages Administrations to ensure that cyber risks are appropriately addressed in safety management systems no later than the first annual verification of the company's Document of Compliance after 1 January 2021.

Piracy and armed robbery against ships

The MSC was updated on the latest statistics concerning piracy and armed robbery against ships, based on incidents reported to IMO. A total of 221 piracy and armed robbery incidents occurred worldwide in 2016, a fall of about 27% compared to 303 incidents reported in 2015, although the Committee noted with concern that incidents in some areas of the world had increased or piracy activity was still active.

Adoption of ships routeing systems

The MSC adopted a number of new and amended ships' routeing measures, including the establishment of a new area to be avoided (ATBA) as an associated protective measure for the "Tubbataha Reefs Natural Park Particularly Sensitive Sea Area (PSSA) in the Sulu Sea" (the Philippines) and the recommended route "Off the western coast of Izu O Shima Island" (Japan).

Implementation of E-navigation strategy and operational safety

The MSC adopted and approved a number of new and revised performance standards and guidelines related to operational safety, including those to implement the e-navigation strategy.

The MSC also adopted amendments to the revised guidelines and criteria for ship reporting systems (resolution MSC.43(64)), addressing mandatory ship reporting systems established in accordance with SOLAS regulation V/11. The revisions update the resolution and encourage the use and recognition of automated electronic means of ship reporting.

Goal-based standards verification audit completed

The MSC confirmed that the initial verification audit of ship construction rules for oil tankers and bulk carriers submitted

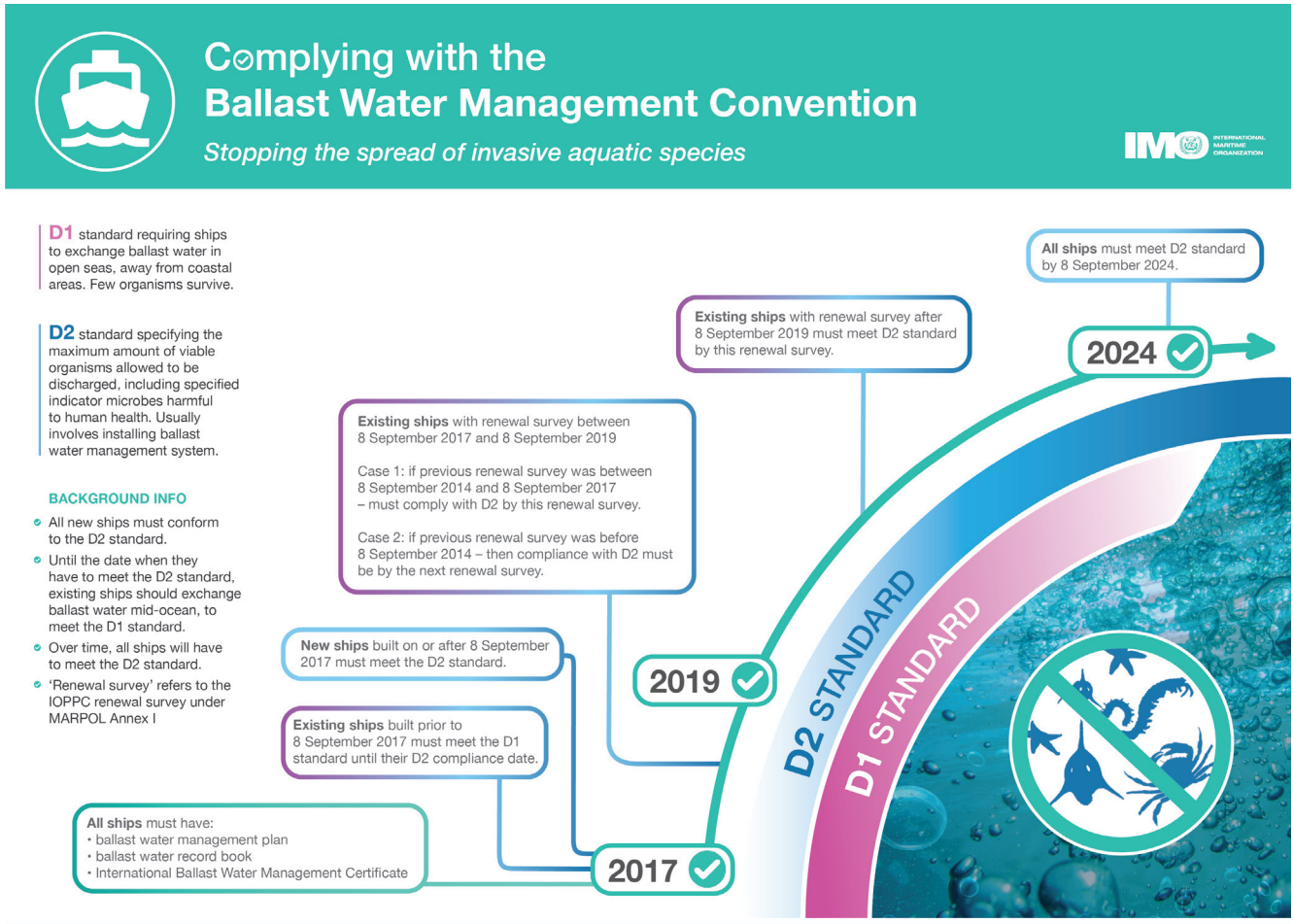


Figure 1.
Source: Image provided by courtesy of the International Maritime Organization (IMO).

by 12 classification societies had been successfully completed, following rectification of the non-conformities reported, as instructed by MSC 96.

GMDSS modernization plan

The MSC approved the Modernization Plan of the Global Maritime Distress and Safety System (GMDSS), prepared by the Sub-Committee on Navigation, Communications and Search and Rescue (NCSR). The plan envisages the development of amendments to SOLAS and related instruments for approval in 2021 and their adoption in 2022, with entry into force in 2024.

71TH SESSION OF THE MARINE ENVIRONMENT PROTECTION COMMITTEE (MEPC 70)

Ballast Water Management Convention clarity

The MEPC agreed a practical and pragmatic implementation schedule for ships to comply with the IMO Ballast Water Management (BWM) Convention, which aims to stem the transfer of potentially invasive species in ships' ballast water.

The treaty entered into force on 8 September 2017 and, as at 15 September, the BWM Convention has been ratified by more than 60 countries, representing more than 70% of world merchant shipping tonnage.

From the date of entry into force, ships are required to manage their ballast water to avoid the transfer of potentially invasive species. All ships are required to have a ballast water management plan and keep a ballast water record book. Ships will be required to manage their ballast water to meet the so-called D-1 standard or D-2 standard.

Draft amendments to the treaty approved by the MEPC clarify when ships must comply with the requirement to meet the D-2 standard and are expected to be adopted at the next MEPC session (MEPC 72 in April 2018). The infographics "Complying with the Ballast Water Management Convention" shows the important milestones in compliance with the Convention.

The MEPC adopted a resolution which resolves that Parties to the BWM Convention should implement the schedule for compliance outlined in the draft amendments, ahead of their adoption and entry into force.

MEPC also made progress in other work focusing on implementation of the BWM treaty, with the adoption and approval of a number of related documents.

Implementation of the global sulphur limit - scope of work agreed

The MEPC agreed the scope of work needed to achieve consistent implementation of the 0.50% m/m global limit of the sulphur content of ships' fuel oil, which will come into effect from 1 January 2020. The 0.50% limit is prescribed in regulation 14.1.3 of MARPOL Annex VI.

Reduction of greenhouse gas emissions from ships

The MEPC continued to build on the solid work the Organization has undertaken to address greenhouse gas (GHG) emissions from international shipping, with work on track for the adoption of an initial IMO strategy on the reduction of GHG emissions from ships in 2018, in accordance with a Roadmap approved at MEPC 70.

Energy efficiency measures for ships

Energy-efficiency design standards for new ships and associated operational energy-efficiency measures for existing ships became mandatory in 2013, with the entry into force of relevant amendments to MARPOL Annex VI. The Committee was informed that nearly 2,500 new ocean-going ships have been certified as complying with the energy efficiency standards.

In other work related to the implementation of the mandatory energy efficiency measures in MARPOL Annex VI, the MEPC adopted a number of related documents.

Oil pollution model courses approved

Updated IMO Model Courses on Oil Pollution Preparedness, Response and Cooperation (OPRC Model Training Courses) were approved by the MEPC. The OPRC model training courses have been revised to provide up-to-date guidance for preparedness and response to marine oil spills.

IMO instruments and their amendments that entered into force

The following treaties and/or their amendments entered into force **on 8 September 2017**:

- ***Ballast Water Management Convention***; and
- ***2016 amendments to MARPOL***, including amendments to Annex II – Appendix I – Abbreviated legend of the revised GESAMP hazard evaluation procedure (MEPC.270(69)); amendments to regulation 13 of MARPOL Annex VI – Record requirements for operational compliance with NOX Tier III emission control areas (MEPC.271(69)); amendments to the Technical Code on Control of emission of nitrogen oxides from marine diesel engines (Testing of gas-fuelled and dual fuel engines) (MEPC.272(69)); and amendments to MARPOL Annex IV – Amendments to regulations 1 and 11 concerning the Baltic Sea Special Area and to the appendix concerning the form of the International Sewage Pollution Prevention Certificate (MEPC.274(69)).

65 Years of "Pomorska večer" Radio Programme

Pero Vidan

65 years is a magical number. Many can hardly wait for it, because it is the age at which one is legally entitled to retirement. Nevertheless, the 65th birthday of "Pomorska večer" (Seamen's Evening) radio programme of the Croatian Radio and Television (Croatian Broadcasting Corporation) represents a jubilee, and not retirement by any means. This programme can do anything but retire.

Unique in the world, a champion of Croatian maritime tradition, "Pomorska večer" is a programme of the Croatian Radio and Television which came on air at the time when Croatian Radio Television (Croatian Broadcasting Corporation), as we know it today, did not exist. In 1952 the programme was initiated on the Zagreb Radio by Branko Knezoci, and since 1970s it has been broadcast on local radio stations along the coast. The radio programme on the Rijeka Radio was edited and hosted by Branka Malnar.

The programme used to be transmitted via radio transmitters located along the Croatian coast, and through MF and HF Radio Communication to the ships at sea. At the time when there were no satellite communication or the Internet, the seamen's families would use the programme to extend their greetings to their loved ones aboard ships. They would mark births and birthdays, they would wish a happy return, calm seas, and safe harbours.

Today this programme is broadcast from the Pula studio of the Croatian Radio (edited by Budimir Žižović), as well as from the studios in Rijeka (Branka Malnar), Zadar (Gordan Kurtović), Split (Jadran Marinković), and Dubrovnik (Božica Đurđević and Božo Bržica). The programme is still being transmitted all over the world; however, today the radio has been replaced by the Internet.

The programme is dedicated to the sea, seamen, and fishermen: to all those who, as the saying goes, live off the sea and for the sea. In this respect it may be considered unique: not even major maritime countries, who honour their maritime tradition and heritage, have a radio programme for seamen broadcast on a weekly basis.

The 65th birthday of this highly acclaimed radio programme of the Croatian Radio (HRT – HR) was festively celebrated

aboard the training ship *Vila Velebita 2* in Rijeka, from where it was directly transmitted. In a festive atmosphere, accompanied by a number of treats marking the occasion, the editors Jadran Marinković, Branka Malnar, Božica Đurđević, Dorina Tikvicki, and Vladimir Šetka hosted, among others, State Secretary for the Sea Maja Markovčić Kostelac, Deputy Minister of Fishing Ante Mišura, General Secretary of the Seamen's Union Neven Melvan, teachers of the maritime faculties, heads of fishermen's associations, representatives of shipping companies and port authorities, as well as a number of other guests. There was no shortage of serious subjects concerning the sea, seamanship, and shippers. Changes in the maritime legislation (Maritime Code and Maritime Statutes), issues regarding Croatian fishing, expected to be in the focus of this year's fishermen's conventions, were discussed as well. The editors also hosted the newly appointed management of the shipping company *Jadrolinija* and addressed the readiness of our biggest shipper for the demands / requirements of cabotage. Some young seamen expressed their expectations regarding the "Pomorska večer" radio programme, which has for more than six decades been dedicated to seamen, sea, and seamanship.

The varied programme, improvised on the navigating bridge of the training ship, was accompanied by a series of toasts proposed on the deck. Along with the good wishes and greetings to the seamen from their families, everyone wished calm seas to all seamen, wherever they might be.

Presentation of the Book Entitled Brod i More

Luka Mudronja

Figure 1.
Introductory speech of the President of the Association of Navar Architects.

Brod i more (The Ship and the Sea) is a new book by Igor Belamarić, a versatile naval architect and Ph.D., who, through a series of books, professional and popular papers presents his rich professional and life experience.

Igor Belamarić, Ph.D., born in Šibenik in 1927, graduated in naval engineering in 1952 at the Department of Naval Architecture at the Faculty of Technical Sciences in Zagreb. He spent his entire professional career at the Split Shipyard, where he worked as the chief designer, innovator, and naval architect in the true sense of the word. He has written many books dealing with naval architecture and social issues, such as *Brod i entropija (The Ship and Entropy), Alma Mater, Poznavanje broda (Knowledge of the Ship)*, etc. He is also the author of many professional papers, along with the column entitled *Igorova promišljanja (Igor's Reflections)* in the scientific professional journal *Brodogradnja (Naval Architecture)*, with fifty-three issues published so far.

The book *Brod i more* comprises designer's observations and reflections, ranging from reminiscences of his first voyages across the Adriatic and the Mediterranean to his decisions he reached in his responsible and demanding task concerning ship designing. The author presents some of his major ambitious projects, such as establishing the cargo ship as a substitute for the famous *Liberty* ships, design of the decks, stems, the propulsion engine, etc. Apart from its technical character, the book is imbued / pervaded with / demonstrates / exhibits sensibility and humanity nurtured by the author for his ships during his entire career. A striking thought should, therefore, be singled out: that the designer should design the ship as if he himself and his family would embark her, and it is certain that to his family he wishes all the best, as well as for the ship to safely reach her harbour. Such a safety can only be attained through a deep reflection upon design solutions and accumulated experience. By giving his book a fitting title *Brod i more (The Ship and the Sea)*, the author joins the different techniques of navigation in the calm seas and in heavy weather, under load; however, by means of the correct design and geometry of the construction of the equipment and machinery, is capable of meeting all the challenges.

The book was presented to the public on October 4th 2017 on the premises of the Association of Engineers of Split, under the auspices of the *Association of Naval Architects of Split*, of which the author is a member.

Figure 2.
Igor Belamarić, the author, despite his advanced age, is still passionate about conveying his knowledge .

Lateen Sail Regatta 2017

Luka Mudronja

The 20th regatta of traditional boats, such as sailing-boats, *gajetas*[1], and *leuts*[2] on lateen sail drive took place at Murter on the Island of Murter on October 1st 2017. The 19th anniversary of the regatta, initiated in 1998, and taking place to the present day, was thus marked. It gathered 66 boats from all over Croatia, from Istria to the Island of Hvar. The regatta makes part of the *Lateen Sail Days*, a series of events held in the course of September, concluded with the regatta. Both *Lateen Sail Days* and the regatta are organised by the *Latinsko idro (Lateen Sail) Association* from Murter, aimed at preserving and promoting traditional boats and forms of navigation.

Figure 1.
The start of Murter Regatta.

Numerous similar events, marking the navigation tradition and history of naval architecture, with the goal of preserving identity and teaching younger generations, are taking place in the course of the year in other parts of Croatia as well: e.g. Mošćenička Draga, the Islands of Krk, Rab, Pašman, Zlarin, Prvić, Krapanj, Hvar, Murter, etc. Apart from the regatta, Murter hosts many lectures, concerts, literary evenings, and workshops as well. It should be emphasised that the regatta does not promote the spirit of competitiveness, rather the originality and innovation concerning the ship designing solutions. The 20th anniversary of Murter Regatta will take place next year.

Figure 2.
In full sail.

1. *Gajeta: a traditional half-decked one-mast fishing boat, typical of the Croatian Adriatic coast*
2. *Leut: a type of traditional fishing boat*

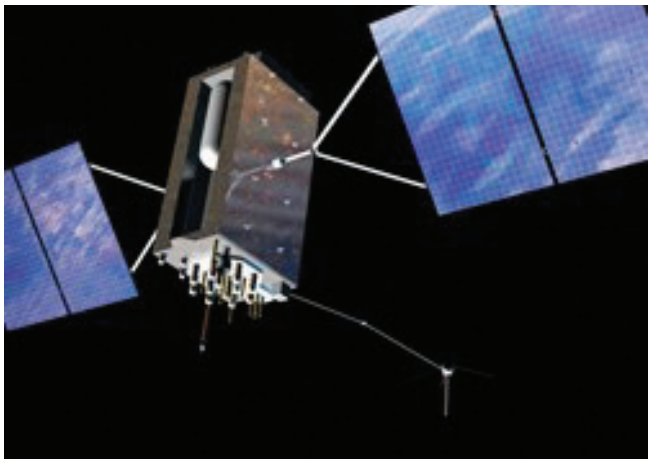
NEWS

Seamen depend more and more on communications technologies and modern satellite navigation. Hence, a step forward is presented in the next two titles:

- The USAF has declared the first GPS III satellite (GPS III SV01) to be 'Available for Launch' (reprinted with permission from http://www.rin.org.uk/Newsitem/5042/First-GPS-III-satellite-ready/Feed),
- Broadcom Ltd US company has introduced its BCM47755 as a mass-market, dual-frequency GNSS receiver (reprinted with permission from http://www.rin.org.uk/newsitem/5038/Dual-frequency-GNSS-receiver-introduced),
- ToMS tries to increase awareness of safety at sea. In this role, a contribution is reprinted from https://www.wartsila.com/twentyfour7/innovation/raising-the-bar-on-safety (with permision from Wärtsilä),
- ToMS also promotes green energy in maritime industry. In this direction, an article from https://www.wartsila.com/twentyfour7/in-detail/catching-the-surge is reprinted (with permision from Wärtsilä).

First GPS III satellite ready

The USAF has declared the first GPS III satellite (GPS III SV01) to be 'Available for Launch'.



The declaration is the final acceptance of Lockheed Martin's first GPS III space vehicle prior to its expected 2018 launch. GPS III SV01 now awaits pre-launch preparations; in the meantime, it is being stored in an environmentally-controlled clean room, where it can be maintained and serviced

Lockheed Martin explain that GPS III SV01 is the first space vehicle of an entirely new satellite design, using next-generation technology and capability compared with the 31 satellites in the current operational GPS constellation.

Benefits of the GPS III satellites include:

- Better accuracy, claimed to be a 3-times improvement on current capability.
- Improved anti-jam capability, claimed to be 8-fold with powerful transmissions; also a ~70 % digital payload, giving greater operational flexibility.
- Stronger design, with more resilience and a designed operational life of 15 years.
- Inclusion of new civil signal L1C - the common signal being adopted by other international Global Navigation Satellite Systems (GNSS) such as Galileo.

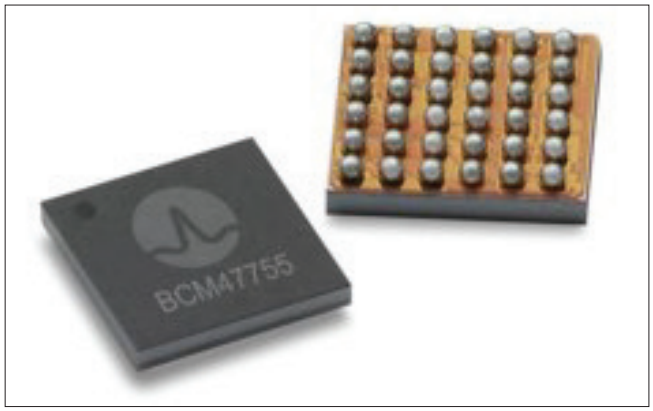
Dual-frequency GNSS receiver introduced

Broadcom has introduced what is claimed to be the World's first dual-frequency GNSS consumer receiver with centimetric accuracy.

US company Broadcom Ltd has introduced its BCM47755 as a mass-market, dual-frequency GNSS receiver designed to enhance location based services (LBS) applications for the likes of mobile phones, tablets and fitness wearables. It measures 15 × 9 × 5 mm.

It explains that the device is equipped with the latest GNSS innovations and is capable of centimetric accuracy with minimal power consumption and footprint - enabling new high-precision LBS applications, including lane-level vehicle navigation and mobile augmented reality (AR).

The higher precision is largely due to the fact that the delay of GNSS signals passing throught the ionosphere - the



ionospheric group delay - is inversely proportional to frequency squared; hence, with 2 frequencies received from each satellite, an accurate estimate of total electron content (TEC), and therefore delay for each satellite used in calculations, can be made.

The BCM47755 can simultaneously receive the following signals:

- GPS L1 C/A
- GLONASS L1
- BeiDou (BDS) B1
- QZSS L1
- Galileo (GAL) E1
- GPS L5
- Galileo E5a
- QZSS L5

The manufacturer stresses that the BCM47755 delivers this higher level of location accuracy whilst also meeting rigorous battery power and footprint needs in devices such as mobile phones.

Raising the Bar on Safety

The International Convention for the Safety of Life at Sea (SOLAS) has existed in some form for over a hundred years, but it's certainly not sitting around gathering barnacles. Instead, the rulebook is continually changing to reflect the industry's enhanced capabilities when it comes to safety on the seas – particularly when it comes to a ship's powerhouse. With technology continually raising the bar on safety, keeping a vessel safe and sound means staying very up to date with both the rules and the technological possibilities. It means both staying informed, and taking action to ensure that a vessel's set-up meets the highest of standards.

"Engine rooms are, by their nature, hot spaces," says Wärtsilä Services' Senior Product Manager, Jyrki Salo, "but we've come a long way since the intimidating, steamy bunkers of a century ago. In fact, engine rooms these days are becoming, in every sense of the word, a whole lot cooler."

Digitalisation, 3D modelling technology, and real time monitoring are just a few of the latest advances that are allowing for more reliable, cooler, and increasingly efficient engine rooms.

"While digital 3D scanning offers designers a real-life design environment, guaranteeing best performance of the insulation design in a specific engine room, real time monitoring systems, for example, detect fuel leakages in a very early phase thereby giving operators time for corrective actions.

And for Salo, it's obvious that SOLAS standards will rise to reflect our increased capabilities when it comes to safety.

Engine room safety a hot topic

Salo explains that Wärtsilä is already working alongside cruise ship companies and classification societies to prepare new class notations. They're aimed not only at lowering surface temperature limits, but also at increased monitoring of possible threats to the engine.

"It's not yet binding legislation, but that's only a matter of time," he states.

This means there's no point setting the bar low when it comes to investing in safety.

Wärtsilä's SOLAS solutions, including safety audits, training services and their wireless big-end bearing monitoring solution are all designed not only to meet legal requirements, but to exceed them, whether it's for retrofitting or a new build.

"Every day we are learning," says Salo. "The technology is improving, materials are improving – and we implement the latest."

This approach enables Wärtsilä to provide customers with the highest quality solutions, meaning there is never any reason to compromise on safety.

Figure 1.
Engines inside Viking Grace's engine room.

Getting smart about monitoring

Thankfully, there are plenty of opportunities to enlist great tech when it comes to keeping ahead of the legislative curve, explains DNV GL Maritime expert, Hans Eivind Siewers.

"Today, almost everything on board a vessel, including internal equipment like engines, can be fitted with smart sensors to monitor performance and catch irregularities early on," explains Siewers.

Operators can even benchmark their vessels against the world's fleet, report real time functionality from ship to shore, or even model potential changes by running 3D simulations in a so-called "digital twin".

Siewers also sees an industry that's keener than ever to stay ahead of the game, explaining that voluntary class notations such as F-AMC (meaning a vessel has installed additional fire protection) have been introduced by DNV GL in response to a heightened willingness to address growing safety concerns. This means owners now have a way to officially demonstrate that they employ enhanced systems when it comes to issues like fire safety.

Figure 2.
The engine room of Royal Caribbean's Oasis of the Seas cruise ship.

Safe business is good business

As a Wärtsilä customer, Kimmo Heikkilä is also pleased to have been able to invest in measures that go above and beyond mere compliance. This is because, as Director of Powerplant & Technical Systems at Royal Caribbean Cruises Ltd., (RCCL) he sees the safety of passengers and crew as the highest priority.

"We've installed additional big end bearing temperature monitoring systems which allow faster engine shutdown in case of failure," he says. "Plus, we've also installed engine specific fuel oil shut-off valves."

According to Heikkilä, these upgrades allow for improved reaction times on the part of the crew, mitigating or eliminating any consequences that could adversely affect safety on board.

There are many signs to indicate that ship owners are more willing than ever to embrace technology. The industry's best are keen to stay one step ahead of the requirements, rather than find themselves caught out when new rules inevitably come into force.

Thankfully, with a range of advanced technological solutions at Wärtsilä's fingertips, there's an ocean of exciting solutions for customers when it comes to playing it safe.

Catching the 'Surge'

Capturing the power of the waves is a complex task, as the sea is constantly changing. One of the most promising wave energy devices is WaveRoller, a submerged panel equipped with Wärtsilä's components.

When the British naval architect Chris Ridgewell visited Wärtsilä's Vaasa offices at the start of the project to develop the first LNG-fuelled passenger ship at Turku shipyard, as a surveyor for Lloyd's Register, he saw first-hand how adept Wärtsilä can be with developing technologies.

So after he returned to Finland to become Chief Technology Officer for the wave energy start-up AW Energy, he knew where to turn.

"LNG has now really taken off and Wärtsilä is a main player," he says. "They've built it from a new technology to an established industry. Now we are at the same point in the development cycle, and Wärtsilä again is involved in that transformation."

Wärtsilä has supplied AW Energy's first full-scale WaveRoller with metallic bearing housings, composite bearings, lip seal housings, and hydraulic couplings. The equipment was being fitted this summer before the device is shipped to Peniche, Portugal, for a year's trial operation in the early autumn. In September, Wärtsilä annouced it will partner with AW-Energy adding wave power generation to its capabilities as energy system integrator.

WaveRoller is unusual among wave energy devices, because it generates energy from the 'surge', the back-and-forth motion waves make when they travel from the deep ocean to shallower waters. It has the potential to be one of the most popular devices for power utility customers.

The device consists of a steel panel, which is fixed to the seabed, near the shore, at a water depth of about eight to 20 metres.

The back and forth movement drives a closed hydraulic circuit, which in turn drives a generator. An energy storage system then turns the pulsating output into smooth, grid-compliant electricity.

Being near the shore brings the advantage of a short grid connection, while being fixed to the seabed, under the surface, means the device is not as exposed to extreme waves as most rival devices. For power utilities the more even generation and easier maintenance WaveRoller promises bring clear advantages over rival devices.

The wave forward

Wärtsilä's parts are essential to the device's durability as they withstand rough weather and require minimal servicing.

"The majority of the year, the waves are quite small: one to two metres," Ridgewell explains. "And that's why the bearings are so important: they allow the panel to move in small wave heights. Because we're structurally efficient, we're very responsive to the waves."

Ridgewell approached Wärtsilä. The request filtered down to Les Creak, Wärtsilä's Business Development Manager for Hydro, largely because his team had worked extensively with other developers and start-ups in Ocean Energy over the past decade.

"AW Energy have come up with a fantastic invention, which has been proven to work at sea, but the information they are able to extract on the longevity of the bearings and seals is from simulated exercises," Creak explains. "What we're giving them is a balance of mature technology in the equation — so they're able to use the past performance figures to a degree."

Even if the core technology is new, both investors in AW Energy and the company's potential customers will gain assurance from the fact that key components have been used for decades, and come from a reliable supplier such as Wärtsilä.

"They're able to use the past performance figures to a degree," Creak says. "Derivatives of the seal and bearing technology have been operating in other applications for over 50 years. This gives a sense of security and reliability."

Ridgewell, who spent 17 years working for Lloyds Register, says WaveRoller has tapped established, respected suppliers for other parts as well.

"We try to take as much off-the-shelf technology as possible to limit the risk. There's lots of new stuff in there already."

Wärtsilä's seals and bearings business, based in Havant, UK, has unrivalled experience supplying seals to the emerging wave and tidal energy industry.

When the Marine Current Turbine device was pulled out of Strangford Lough at the start of 2016, it had produced most of the world's tidal energy. So Wärtsilä, by extension, had at that point sealed 90 per cent of the world's tidal power produced.

"We had experience, and still have to this day, we believe, that no other seal manufacturer has," says consultant engineer Simon Thompson, one of Creak's team members.

Striking the right balance

But AW Energy was drawn to Wärtsilä for the company's expertise as well as for its equipment.

"When you look at a technology there are a lot of rules and standards that people use. However, there's a lot of conservatism in that, and it's really unravelling that conservatism," says Ridgewell. "With renewable energy, you cannot justify having a lot of the costs."

When Simon Thompson, Kerry Jones and Ross Strickland first met Ridgewell at Wärtsilä's in-house composite manufacturing facility in Slough, outside London, it did not take long to find ways that Wärtsilä could improve the WaveRoller product.

"I think AW Energy had limited in-house resources and expertise available," recalls Creak. "They certainly understood about the bearing and what they wanted the bearing to do, but they had limited understanding of what the performance limitations and requirements could be on their seal."

Wärtsilä consulted on the overall seal and bearing arrangement and recommended a transition towards a totally water lubricated solution. This simplified the application and at the same time addressed another environmental concern.

"There are studies and papers out there that look at the portfolio of seal offerings in the market and the general consensus, specifically in tidal applications, is that a mechanical face seal is the go-to choice," Thompson says. "But those don't respond well in high-duty reciprocating motions."

Wärtsilä also decided to invest more time into supplying the WaveRoller by developing a structural composite housing for the lip seals at its in-house composite manufacturing facility in Slough, outside London. This will reduce the weight of the device, making it easier to install and service.

The other attraction for AW Energy is Wärtsilä's Services Division. Ridgewell is aware that operation and maintenance is key to the WaveRoller's cost-effectiveness and appeal to utilities. It has ballast tanks that allow it to float back to the surface for easy servicing, limiting the need for expensive and dangerous diving operations.

The 'glocal' touch

Having a global supplier such as Wärtsilä manufacturing key parts means that when the device is rolled out globally, it will be easy for utilities to service and replace these parts wherever they are located.

"If you look at the service centres and representative offices of Wärtsilä and then you place on that a global map of the world wave resources, they pretty much match," Ridgewell points out.

But there are challenges as well as benefits for a small start-up in working with a company of Wärtsilä's scale, particularly in navigating through Wärtsilä's many divisions.

"There's a lot of expertise, but it is finding the expertise that's the challenge," says Ridgewell. "You need to find that person who has sufficient contacts to find the person that knows."

Creak is similarly conscious of the challenges that come with working with a much smaller company.

"We are very aware that we're a very, very big company and they're a very, very small company. That can create some challenges in communications," he says.

The other issue is financial. The value of the equipment sold to AW Energy for its maiden project provides very little immediate return for the time Creak's team has spent.

"We would be disingenuous to say that it's a major contribution to our annual turnover and profitability. However, we make these investments because there's a potential," says Creak

If WaveRoller is successful and deployed around the world, it has the potential to be one of the most popular devices for power utilities.

"It's a really big opportunity for them at the end of the day," Ridgewell argues. "When this industry really takes off, which it will, we're talking tens of thousands of units. And for every WaveRoller, you need two bearings, so we're talking about a very large business opportunity."

With AW Energy, the opportunity is considerably greater, but so is the competition, with more than 200 devices under development.

But Wärtsilä believes AW Energy, which is the first device to receive a technology certification from Lloyds Register and to be certified against DNVGL standards, is among the most promising.

"There are a lot of players out there, but it doesn't take a lot of time and investment to work out the likely winners," Creak says. "And then we would typically offer our services to the ones that we perceive have the greatest chance of success."

The double certification, together with reliable, time-tested components, and the knowledge that service engineers are nearby, will help utility customers convince their own financial backers and project insurers that the risks have been as much as possible contained, making it easier to get the first projects off the ground.

It seems to be working. AW-Energy has a pipeline of commercial projects and active business development in six countries on four continents. And when WaveRoller ends its trial on Portugal's Atlantic coast in late 2018, AW Energy's device will be one step closer to the market.

ART

ĆÂJA

Dobrila Franetović Kuzmić

PA[1]

trans. by Mirna Čudić

Ćaja,
kad mìslīn nã te
òpēt san mâli
pristràšeni štìć.

Svè ti svojè grìže,
gropè i mrkînte
klājdèn nà prsi.

Sedìn ti na kolìna,
glèdān tvojû
kapitânsku kàpu
i znân,
da si bî
nâjlipji kâpo
na svītù.

Pa,
whenever I think of you,
I once again become a
frightened little bird.

All my rocks,
knots, and crags
I lay upon your chest.

Sitting on your knees,
I look at your
captain's cap
and I know
that you were
the handsomest *kapo*[2]
in the world.

RJEČNIK

ćaja	tata, tatica
štić	ptičica
griža	kamen, stijena u krševitu kraju
mrkinta	hrid, izbrazdan oštar kamen uz more
klajdat	stavljati
sedit	s jediti
kapo	upravitelj stroja

1. *An old-fashioned hypocoristic for 'father': 'dad', 'daddy'.*
2. *A Croatian dialectal expression (Italian loanword capo di macchina) for 'chief engineer', a person in charge of a ship's engine room and its equipment.*

KAD ZATRŨBI VAPÔR KUN PROÌZDA DÎVNE GRĒDÙ U LŪKÙ

Dobrila Franetović Kuzmić

WHEN THE STEAMSHIP BLOWS HER HORN NEAR PROIZD[1], BONNY LASSES GO TO THE PORT

trans. by Mirna Čudić

Usùd po svītù
cùre su cùre
sâmo u Lūcì
cùre su "dîvne",
obo u Lūcì zàistinu
"dîvne" su dîvne.
Kad zatrũbi vapôr kun Proìzda,
cîli procesjūnì
grēdù u Lūkù:
"dîvne", ženè, dicà,
a nâjvìše "dîvne",
"dîvne".
S mòkrīn vlāsìma
povrh čelà,
jàbukami na obràzu
rìcami ìsprid ùhā
i nasmījanin zūbìma,
s pāndìlima u cvîću,
što plêšu kolo bòka
i ne znàju fremàt.
Igràle su rûkē
kolo botũni na prsìma,
da se zemljà trēsla.
I postòli su nà sūncū
blīšćìli ožbjàkānī.

All over the world
girls are just girls
only in Vela Luka
the girls are '*divne*'[2]:
the bonny lasses of Luka
for the girls of Vela Luka are truly the bonny lasses.
When the steamship blows her horn near Proizd,
whole processions
descend towards Luka:
girls, women, children,
and most of all *divne* (bonny lasses),
bonny lasses.
Damp hair
crowning their foreheads,
apples in their cheeks
curls surrounding their ears
smiling teeth,
their skirts in blossom,
dancing around their hips
unable to stop.
Their hands fluttering
over the buttons on their bosom
making the earth quake.
Their white-washed shoes
glittering in the sunshine.

1. *a small island at the entrance of the Vela Luka harbour*
2. *a young girl, the Croatian word also implying a beautiful young girl (divan, divna, adj. beautiful, gorgeous)*

A kòža je sjàla, sjàla
oprānà u lavamânu
na bûlti nà sūncū.
Kad bi zatrūbi vapôr kun Proìzda,
svè bi strâde procvitàle.
I stîne bi ožīvìle.
I kôrte su se
sâme otvāràle
da jih mîndeli
i oleândri vìdū.
Zarad njīh je
rîvu môre plākàlo.
I pâlme su jih
s pùno pŕsti
dotìcāle ne tĭcajuć.
Ni sûnce nî znàlo
maknùt pòglēd s njîh,
pã bi užeglò, užeglò...

A onè su sjàle, sjàle, sjàle...

Vonjàla je ârija
na saplûn, basìlàk, mètvicu,
na cvît narânče, lemūnà, lovorìku.
Na snè o jūbàvi
i jūbàvi u snù.
Vonjàlo je na žêlju
u rūkàmi i u tîlu,
pròpita se čùlo
kakò mlàdost hūčî,
kakò kŕv vrìjē,
kad zatrūbi vapôr kun Proìzda.

A zatrūbì je bomè
za pozdràvīt "dîvne",
obo "dîvne" su dîvne
i to sâmo u Lūcì.

Their skin shining, shining
scrubbed in the wash basin
on the terrace in the sun.
When the steamship blew her horn near Proizd,
all the streets would blossom.
And the stones would come to life.
The courtyard gates
would open on their own
so that the almond trees
and the oleanders
should take a glance.
In their honour the sea
lapped at the shore.
The palm trees would caress them
with numberless fingers without touching them.
Even the sun was unable
to avert his eyes
and he would scorch, scorch…

And they would shine, shine, shine…

The air was fragrant with
soap, basil, mint,
orange blossom, lemon blossom, laurel.
With dreams of love
and love in a dream.
It was fragrant with the desire
in hands and bodies,
one could indeed hear
the merry din of youth,
blood boiling,
when the steamship blows her horn near Proizd.

And she indeed did blow her horn out
to salute the bonny lasses,
for *divne* are gorgeous
and only in Luka.

RJEČNIK

vapor	parobrod
kun	pored, pokraj
Proizd	otočić na ulazu u Vela Luku
divna	djevojka, cura
gredu	idu
usud	svuda, posvuda
svit	svijet
obo	jer, zato što
rica	kovrča
pandil	suknja
fremat	stati, zaustaviti se
botun	puce, gumb, dugme
postol	cipela
blišćit	sjati
ožbjakan	izbijeljen
lavaman	lavor
bulta	terasa, balkon
strada	ulica
korta	dvorište kuća dobrostojećih građana
mindel	bajam, badem
plakat	oplakivati obalu
ticati	dodirivati
vonjat	mirisati
arija	zrak
saplun	sapun
basilak	bosiljak
lemun	limun
žeja	želja
propito, propita	naprosto, jednostavno
bome	bogme

About ToMS: Ethics, Conflict of Interest, License and Guides for Authors

The Journal is published in English as an open access journal, and as a classic paper journal (limited edition).

ToMS aims at presenting the best maritime research primarily, but not exclusively, from Southeast Europe, particularly the Mediterranean area. Papers will be double-blind reviewed by 3 reviewers. With the intention of providing an international perspective at least one of the reviewers will be from abroad. ToMS also promotes scientific collaboration with students and has a section entitled Students' ToMS. These articles also undergo strict peer reviews. Furthermore, the Journal publishes short reviews on significant papers, books and workshops in the fields of maritime science.

Our interest lies in general fields of maritime science (transport, engineering, maritime law, maritime economy) and the psychosocial and legal aspects of long-term work aboard.

1. PUBLICATION ETHICS

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6. GUIDELINES FOR AUTHORS

The Journal is published in English as an open access journal, and as a classic paper journal (limited edition).

ToMS aims at presenting the best maritime research primarily, but not exclusively, from Southeast Europe, particularly the Mediterranean area. Papers will be double-blind reviewed by 3 reviewers. With the intention of providing an international perspective at least one of the reviewers will be from abroad. ToMS also promotes scientific collaboration with students and has a section entitled Students'ToMS. These articles also undergo strict peer reviews. Furthermore, the Journal publishes short reviews on significant papers, books and workshops in the fields of maritime science.

Our interest lies in general fields of maritime science (transport, engineering, maritime law, maritime economy) and the psychosocial and legal aspects of long-term work aboard.

6.1. Before you Begin

6.1.1. Ethics in publishing

For information on Ethics in publishing and Ethical guidelines for journal publication see Publication Ethics

6.1.2. Conflict of interest

All authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work.

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Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere including electronically in the same form, in English or in any other language, without the written consent of the copyright-holder.

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6.2. Guidelines for Authors: Manuscript Preparation and Submission

6.2.1. Organization of the manuscript

First (title) page

The first page should carry:

a. the paper title;
b. full names (first name, middle – name initials, if applicable), and last names of all authors;
c. names of the department(s) and institution(s) to which the work should be attributed. If authors belong to several different institutions, superscript digits should be used to relate the authors' names to respective institutions. Identical number(s) in superscripts should follow the authors names and precede the institution names;
d. the name, mailing address and e-mail of the corresponding authors;
e. source(s) of research support in the form of financial support, grants, equipment or all of these.

Last page

The last page should carry:

a. ethical approval, if required;

b. authors' declarations on their contributions to the work described in the manuscript, their potential competing interests, and any other disclosures. Authors should disclose any commercial affiliations as well as consultancies, stock or equity interests, which could be considered a conflict of interest. The details of such disclosures will be kept confidential but ToMS urges the authors to make general statements in the Acknowledgement section of the manuscript.

c. a list of abbreviations used in the paper (if necessary);

Other pages

Each manuscript should follow this sequence:

- title page;
- abstract;
- text (Introduction, Methods, Results, Conclusions/ Discussion);
- acknowledgments;
- references;
- tables (each table complete with title and footnotes on a separate page);
- figures and figure legends, and the last page.

6.2.2. Text organization and style

6.2.2.1. Abstract

The second page should contain the Abstract. ToMS requires that the authors prepare a structured abstract of not more than 250 words. The abstract should include (at least) four sections: Aims, Methods, Results, and Conclusion, not necessarily separated.

Aim. State explicitly and specifically the purpose of the study.

Methods. Concisely and systematically list the basic procedures, selection of study participants or laboratory/ experimental/simulation setup, methods of observation (if applicable) and analysis.

Results. List your primary results without any introduction. Only essential statistical significances should be added in brackets. Draw no conclusions as yet: they belong in to the next section.

Conclusion. List your conclusions in a short, clear and simple manner. State only those conclusions that stem directly from the results shown in the paper. Rather than summarizing the data, conclude from them.

6.2.2.2. Main text

Do not use any styles or automatic formatting. All superscripts or subscripts, symbols and math relations should be written in MathType or Equation editor.

Introduction

The author should briefly introduce the problem, particularly emphasizing the level of knowledge about the problem at the beginning of the investigation. Continue logically, and end with a short description of the aim of the study, the hypothesis and specific protocol objectives. Finish the section stating in one sentence the main result of the study.

Results

Key rules for writing the Results section are:

a. the text should be understandable without referring to the respective tables and figures, and vice versa;

b. however, the text should not simply repeat the data contained in the tables and figures; and

c. the text and data in tables and figures should be related to the statements in the text by means of reference marks.

Thus, it is best to describe the main findings in the text, and refer the reader to the tables and figures, implying that details are shown there. The formulations such as "It is shown in Table 1 that the outcome of Group A was better than that of Group B" should be replaced by "The outcome of Group A was better than that of Group B (Table 1)."

The need for brevity should not clash with the requirement that all results should be clearly presented.

Discussion/Conclusions

The discussion section should include interpretation of study findings in the context of other studies reported in the literature. This section has three main functions:

a. assessment of the results for their validity with respect to the hypothesis, relevance of methods, and significance of differences observed;

b. comparison with the other findings presented in the relevant literature; and

c. assessment of the outcome's significance for further research.

Do not recapitulate your results, discuss them!

6.2.2.3. Tables

Information on significance and other statistical data should preferably be given in the tables and figures. Tables should not contain only statistical test results. Statistical significances should be shown along with the data in the text, as well as in tables and figures.

Tables should bear Arabic numerals. Each table should be put on a separate page. Each table should be self-explanatory, with an adequate title (clearly suggesting the contents), and logical presentation of data. The title should preferably include

the main results shown in the table. Use tables in order to present the exact values of the data that cannot be summarized in a few sentences in the text.

Avoid repetitive words in the columns: these should be abbreviated, and their explanations given in the footnotes. Present data either in a table or a figure.

Each column heading for numerical data given should include the unit of measurement applied to all the data under the heading. Choose suitable SI units.

Place explanatory matter in footnotes, not in the heading.

Explain in footnotes all nonstandard abbreviations that are used in each table.

6.2.2.4. Figures

Figures should be numbered in sequence with Arabic numerals. Legends to figures should be listed on a separate page, in consecutive order. Minimum resolution for all types of graphics is 300 dpi and 600 dpi is recommended. The legend of a figure should contain the following information:

a. the word "Figure", followed by its respective number;
b. figure title containing major finding (e.g. Manuscripts which follow Guidelines for Authors had higher acceptance rate, and not Relationship with manuscripts style and their acceptance rate).

Use simple symbols, like closed and open circles, triangles and squares. Different types of connecting lines can be used. The meanings of symbols and lines should be defined in the legend.

Each axis should be labeled with a description of the variable it represents.

Only the first letter of the first word should be capitalized. The labeling should be parallel with the respective axis. All units should be expressed in SI units and parenthesized. Make liberal use of scale markings.

Graphs, charts, titles, and legends in accepted manuscripts will be edited according to ToMS style and standards prior to publication.

Preferred format for graphs or charts is xls. Graphs and charts saved as image (raster) files such as JPG, TIF, or GIF and imported or copied/pasted into Word or Power Point are not acceptable.

The resolution for photographic images should be at least 300 dpi, and minimum image width should be 6 cm. Please submit files in RGB format. For published manuscripts, image files will be posted online in their original RGB format, maintaining the full color of your original files. Note that we will still need to convert all RGB files to CMYK for printing on paper and color shifts may occur in conversion. You will not receive a CMYK proof. You can view an approximation of print results by converting to CMYK in Adobe® Photoshop® or Adobe® Illustrator®.

6.2.2.5. Authorship statement

All contributing authors must fill out and sign these statements and submit them to the Editorial Office. Accepted manuscripts will not be published until signed statements from all authors have been received.

6.2.2.6. Acknowledgments

Technical help, critical reviews of the manuscript and financial or other sponsorship may be acknowledged. Do not acknowledge paid services, e.g. professional translations into English.

6.2.2.7. References

References cited in the manuscript are listed in a separate section immediately following the text. The authors should verify all references. Usage of DOIs is mandatory.

Examples of citation in text:

It is well known fact (Strang and Nquyen, 1997; Antoniou, 2006) that FT is not an appropriate tool for analyzing nonstationary signals since it loses information about time domain.

First group of authors (Vetterli and Gall, 1989) proposed Multiresolution Signal Analysis (MRA) technique or pyramidal algorithm. Second group (Crochiere et al., 1975; Crochiere and Sambur, 1977) proposed subband coding algorithm. Legal acts are cited as in example: The Constitution of the Republic of Croatia (Constitution of the Republic of Croatia, 2010) is the main legal source for this subject matter, as well as any other subject matter relating to the Croatian legal system. References from the Web are cited in the text as (Author(s) last name, year of origin if known (year of accessed in other cases). If the author is unknown, such as in case of company web page, instead of author's name, title of the web page is used.

Examples for reference section:

Journals

Petrinović, R., Wolff, V. S., Mandić, N. and Plančić, B., (2013), International Convention on the Removal of Wrecks, 2007. – a New Contribution to the Safety of Navigation and Marine Environment Protection, Transaction on Maritime Science, 2(1), pp. 49-55., https://doi.org/10.7225/toms.v02.n01.007

Pennec, E. and Mallat, S., (2005), Sparse Geometric Image Representations with Bandelets, IEEE Transactions on Image Processing, 14(4), pp. 423 – 438., https://doi.org/10.1109/TIP.2005.843753

Web links

Donoho, D., Duncan, M. R., Huo, X. and Levi, O., (1999), Wavelab, available at: http://www.stat.stanford.edu /_wavelab/, [accessed 12 August 2011.].

Unknown, Wavelab, available at: http://www.stat.stanford.edu /_wavelab/, [accessed 12 August 2011.].

ToMS home page, available at: http://www.toms.com.hr, [accessed 12 July 2012.].

Books

Mallat, S., (2009), A Wavelet Tour of Signal Processing, 3rd Edition, New York: Academic Press.

Chapter in book

Hymes, D. H., (1972), On Communicative Competence, in: Pride, J. B. and Holmes, J. (eds), Sociolinguistics, Selected Readings, pp. 269-293. (Part 1 if exists), Harmondsworth: Penguin.

Šoda, J., Beroš, S. M., Kuzmanić, I. and Vujović, I., (2013), Discontinuity Detection in the Vibration Signal of Turning Machines, in: Öchnser A. and Altenbach, H. (eds), Experimental and Numerical Investigation of Advanced Materials and Structures, Advanced Structured Materials (serial name if applicable), 41 (volume number if applicable), pp 27-54. (part if applicable), Heidelberg: Springer., https://doi.org/10.1007/978-3-319-00506-5_3

Conference proceedings

Łutowicz, M. and Lus , T., (2013), Effect of Loss of Cylinder Pressure Indicating Channel Patency on Parameters Values Obtained from Indicating Graph, Proc. 5th International Maritime Science Conference, Solin, Croatia, April 22 – 23, pp. 382-389., available at: http://www.pfst.hr/imsc/archive/2013/IMSC2013_proceedings.pdf

Kingsbury, N.G. and Magarey, J.F.A., (1997), Wavelet Transforms in Image Processing. Proc. First European Conference on Signal Analysis and Prediction, Prague, Czech Republic, June 24 – 27, Birkhauser, pp. 23 – 24., available at: http://www.sigproc.eng.cam.ac.uk/~ngk/publications/ngk97b.zip, [accessed 12 August 2011.].

Regulations, standards or legal acts:

Constitution of the Republic of Croatia, (2010), Narodne novine, 2010(76), pp. (if known).

6.2.2.8. Supplementary materials

Supplementary materials are optional. Authors can submit different types of materials which will be available on-line.

6.2.2.9. Language

Authors may use standard British or American spelling, but they must be consistent. The Editors retain the customary right to style and, if necessary, shorten texts accepted for publication.

This does not mean that we prefer short articles – actually, we do not limit their size - but rather a resection of the obviously redundant material.

The past tense is recommended in the Results Section.

Avoid using Latin terms; if necessary, they should be added in parentheses after the English terms. Real names rather than "levels" or "values" should refer to parameters with concrete units (e.g. concentration).

6.2.2.10. Abbreviations

Only standard abbreviations and symbols may be used without definition and may be used in the title or the page-heading title.

Non-standard abbreviations should not be used in the title or page-heading title. They must be explained in the text in the following way: the term should be written in full when it appears in the text for the first time, followed by the abbreviation in parentheses; from then on, only abbreviation is used in the text. This applies separately to the Abstract and the rest of the text.

6.2.3. Submission of manuscripts

Paper submission via Open journal system.

Manuscripts can also be submitted to:

Editorial office

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Faculty of Maritime Studies,
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