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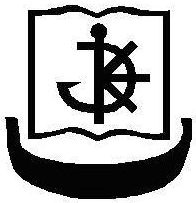

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Latvian Maritime Academy
Research Institute
www.latja.lv
12 k-1 Flotes Street, Riga, LV-1016, Latvia
Phone: (+371) 67161111; fax (+371) 67830138
E-mail: arturs.praulins@latja.lv

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TRANSITION PROCESS SPEED IMPACT ON TORSIONAL OSCILLATIONS

Rihards Indriksons
Latvian Maritime Academy, 12 k – 1, Flotes Street, Riga, LV – 1016, Latvia,
E-mail: rihards1940@inbox.lv

Abstract
This article is dedicated to analytical research of changes of propeller shaft torsional oscillation amplitudes during changes in rotational speed. The linear oscillation system is inspected and assumed that the rotational speed changes evenly. By numerically integration of differential equation of forced oscillations is found how the maximum torsional oscillation amplitude changes, depending on the fastness of rotation speed changes. It turns out that at the workable angular acceleration, this maximum value is constant and close to it, as it would be if the rotation happen at a constant angular velocity corresponding to the resonant frequency. In addition, such scene of amplitude change is both when the transition occurs across the resonance frequency, as well it is not.
Keywords: *torsional vibrations, natural frequency, excitation momentum*

Introduction

Low-speed two-stroke diesel engines are often used for ships propeller propulsion. The excitation forces frequency at nominal engine speed usually is higher than the lowest natural frequency of propeller shaft torsional vibrations. While navigating in narrow waters often we have to change the engine speed, including "walking across" the resonant frequency. Usually it is recommended to make this transition as soon as possible for oscillation amplitude at the resonance frequency would not manage to rise excessively. Faster rotational speed gains need a larger angular acceleration. This linked with necessity for additional engine torque.

The aim of the study was to find out, depending on the "transition" speed changing torsional oscillation amplitude. It was assumed that the engine speed changes during the transition evenly, that is, the angular acceleration is constant.

Model of oscillation system

Typically, the lowest natural frequency of torsional vibrations is determined directly from the shaft stiffness [5]. Therefore, it uses a simplified calculation scheme, which consists of two discs and a flexible shaft between them. One disc moment of inertia equal to the propeller moment of inertia, and the other - with on the flywheel reduced crankshaft together with pistons and connecting rods moment of inertia (Figure 1).

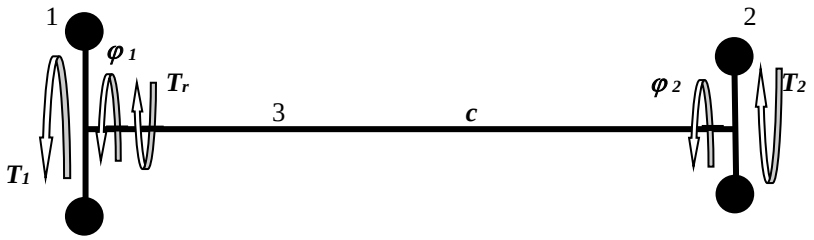

Figure 1. Calculation scheme.

1 – disc with moment of inertia J_1 , instead of the crankshaft, flywheel, damper, connecting road and piston; 2 – propeller with moment of inertia J_2 ; 3 – propeller shaft with stiffness c ; T_1 – engine torque; T_2 – propeller resistance torque; T_r – discs cross-turning speed proportional modulus of resistance; φ_1 and φ_2 – turning angles of discs 1 and 2.

Assume that engine torque:

$$T_1 = T_m + T_a \sin \omega \cdot t \ , \quad \text{where} \quad \omega = \omega_0 + \varepsilon \cdot t$$

Here T_m and T_a – middle value and amplitude of engine torque, ω_0 and ε – constants.

Assume also that: $T_2 = const$; $T_r = \mu(\dot{\varphi}_1 - \dot{\varphi}_2)$.

Here μ – coefficient that characterizes the energy dissipation during oscillations.

Differential equations of discs motion are:

$$J_1 \ddot{\varphi}_1 = T_m + T_a \sin \omega \cdot t - \mu(\dot{\varphi}_1 - \dot{\varphi}_2) - c(\varphi_1 - \varphi_2) \qquad (1)$$

$$J_2 \ddot{\varphi}_2 = -T_2 + \mu(\dot{\varphi}_1 - \dot{\varphi}_2) + c(\varphi_1 - \varphi_2) \qquad (2)$$

From the (1), divided by J_1, subtracts (2), divided by J_2, we obtain differential equation:

$$\ddot{\varphi} = \frac{T_m}{J_1} + \frac{T_2}{J_2} + \frac{T_a}{J_1} \sin \omega \cdot t - \frac{\mu}{J_{eq}} \dot{\varphi} - \frac{c}{J_{eq}} \varphi \quad , \text{ where: } \varphi = \varphi_1 - \varphi_2 \ , \quad J_{eq} = \frac{J_1 \cdot J_2}{J_1 + J_2}$$

The first two items on the right side of the equation allows calculate twisting angle at the rotation without torsional oscillations. Only final three items describes torsional vibrations. Therefore torsion oscillation differential equation is:

$$\ddot{\varphi} + \frac{\mu}{J_{eq}} \dot{\varphi} + \frac{c}{J_{eq}} \varphi = \frac{T_a}{J_1} \sin \omega t$$

To go to the dimensionless form, denote:

$$\frac{c}{J_{eq}} = k^2 \ , \quad \frac{\omega}{k} = p \ , \quad \frac{\omega_0}{k} = p_0 \ , \quad \frac{\varepsilon}{k^2} = a \ , \quad t \cdot k = \tau \ , \quad \frac{\mu}{J_{eq} k} = 2n$$

$$\frac{T_a}{J_1 k^2} = A_0 \ , \quad \dot{\varphi} = \frac{d\varphi}{dt} = k \frac{d\varphi}{d\tau} \ , \quad \ddot{\varphi} = \frac{d^2\varphi}{dt^2} = k^2 \frac{d^2\varphi}{d\tau^2}$$

Then torsion oscillation differential equations dimensionless form is as follows:

$$\frac{d^2\varphi}{d\tau^2} + 2n \frac{d\varphi}{d\tau} + \varphi = A_0 \sin \ p\tau \qquad (3)$$

Here $p = p_0 + a\tau$

By numerical integration of the differential equations (3) with different a was found varies ratio of maximum twisting angle to angle A_0 caused statically added amplitude of excitation momentum. Calculations made for three different parameters of resistance – n = 0.1, n = 0.2, n = 0.3, if dimensionless frequency p changes from 0.5 to 1.5. Calculation results graphically shown in Figure 2.

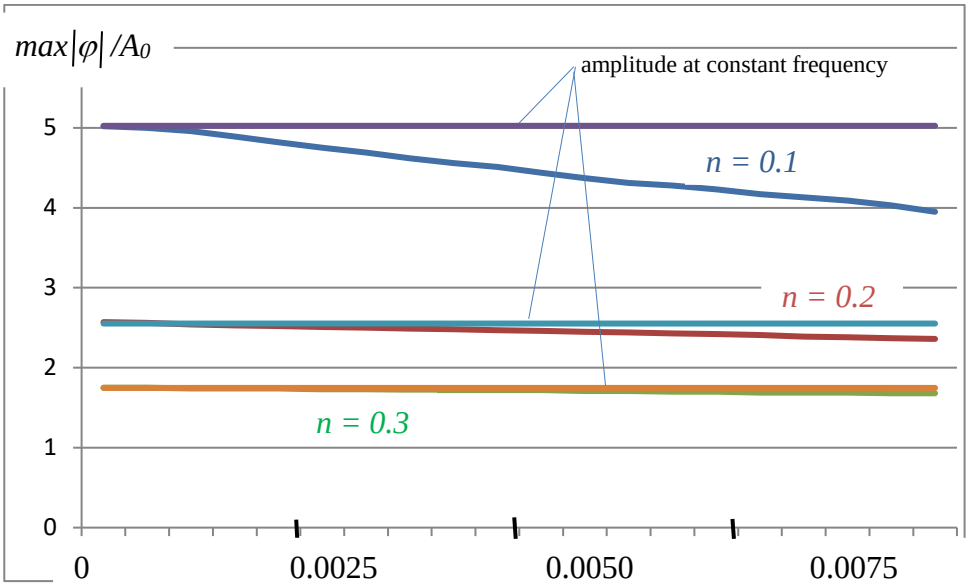

Figure 2. The graph of max|φ| /A$_0$, if α changes from *0* to *0.0100*

The time of transition from p_0 to p: $$t = \frac{p - p_0}{a \cdot k} \qquad (4)$$

Ships with high-power low-speed two-stroke diesel engines are generally lower natural frequency of *40* to *50 rad / s*. In this case the time of transition from *p = 0.5* to *1.5 :*

$$t = \frac{1.5 - 0.5}{a \cdot (40...50)} = \frac{0.025...0.020}{a} \qquad (5)$$

For example, tanker for oil, oil products and chemicals MT "PUZE" has lower frequency *k* = 39.2 *rad / s* and parameter of resistance – *n = 0.11* [6]. In this case the time of transition from *p = 0.5* to *1.5* at *a = 0.0025* should be approximately *10* seconds. In practice, such a rapid propeller rotational speed change is not possible because propulsion system moment of inertia is very large (J_1 *= 26700 kgm^2* , J_2 *= 32970 kgm^2*). But even in this case, the maximum oscillation amplitude is only slightly less than the amplitude at resonance.

Figures 3 and 4 show how the amplitude of forced oscillations changes when the non-dimensional frequency of excitation torque steadily increases from *0.5* to *1.5* at two different speeds - at α *= 0.005* and at α *= 0.001*. The graphs show that the nature of the variations in oscillation changes is practically independent of the frequency change rate and the highest amplitude before resonant frequency is reached.

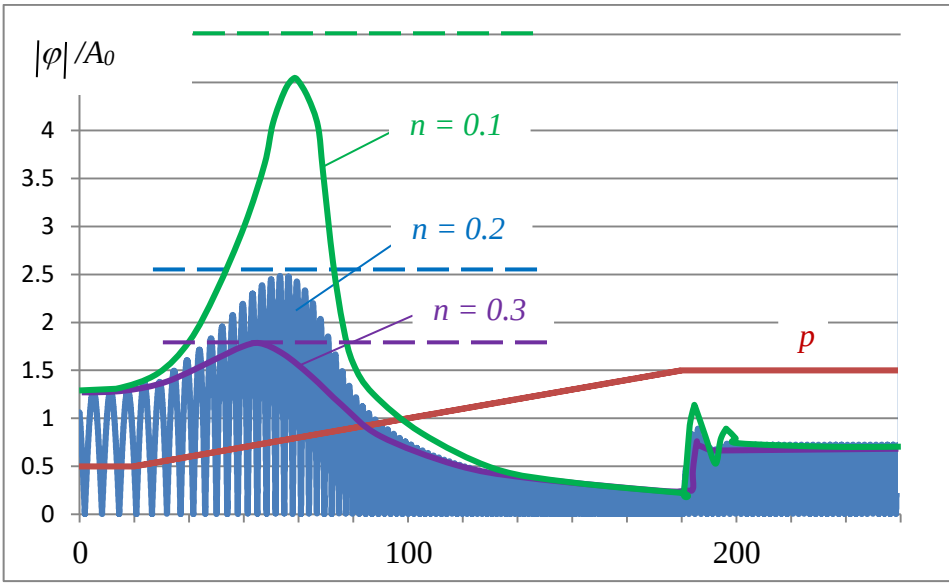

Figure 3. The graph of amplitude of forced oscillations, if p changes from *0.5* to *1.5* and $\alpha = 0.005$

– – – – amplitude at constant resonant frequency

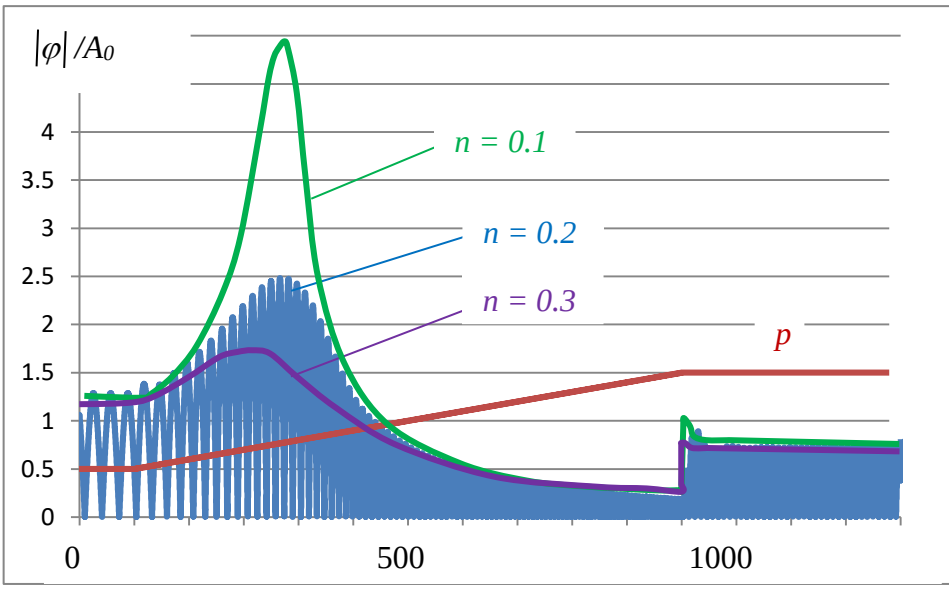

Figure 4. The graph of amplitude of forced oscillations, if p changes from *0.5* to *1.5* and $\alpha = 0.001$

Figure 5 show how the amplitude of forced oscillations changes when the non-dimensional frequency of excitation torque steadily decreases from *1.5* to *0.5* at $\alpha = 0.005$. Also in this case, the maximum amplitude is reached before the resonance frequency.

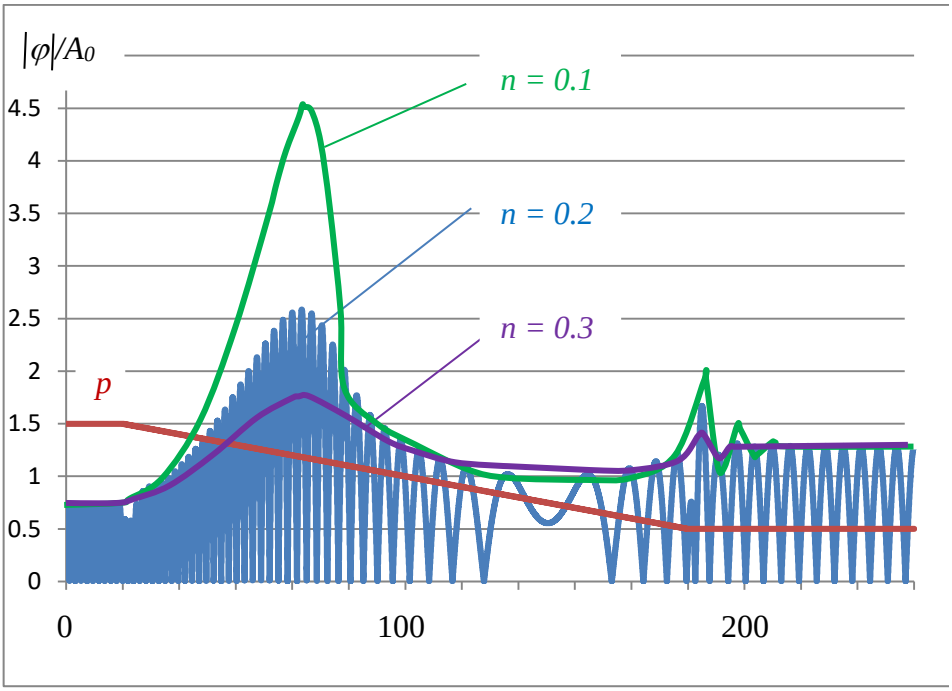

Figure 5. The graph of amplitude of forced oscillations,
if p changes from *1.5* to *0.5* and $\alpha = 0.005$

Figures 6 and 7 shows how the amplitude of forced oscillations changes when the non-dimensional frequency of excitation torque steadily decreases from *1.5* to *1.2* and increases from *0.5* to *0.8* at $\alpha = 0.005$ and n = *0.2*.

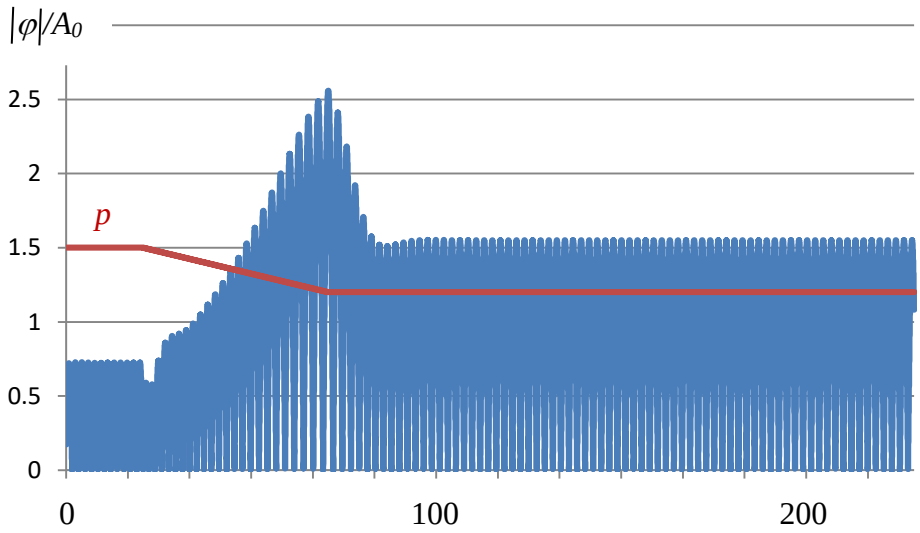

Figure 6. The graph of amplitude of forced oscillations,
if p changes from *1.5* to *1.2* and $\alpha = 0.005$, $n = 0.2$

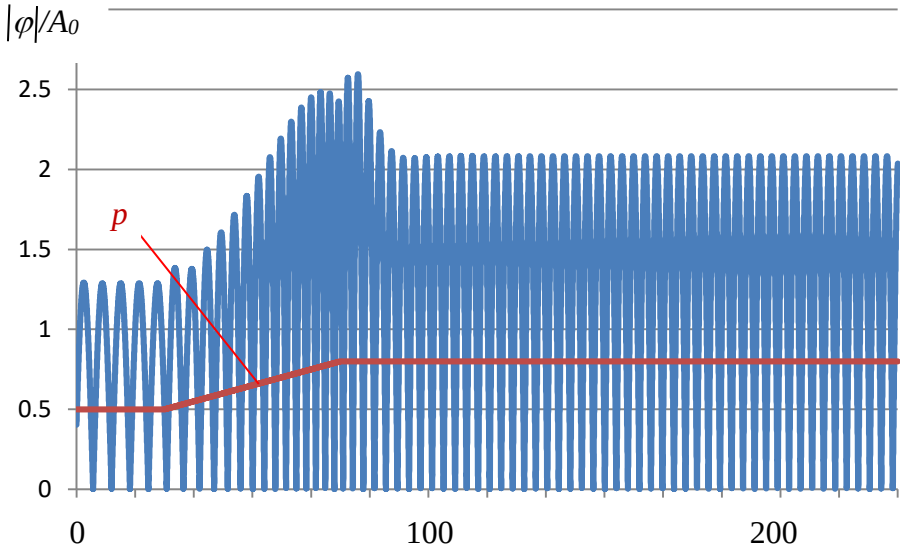

Figure 7. The graph of amplitude of forced oscillations,
if *p* changes from *0.5* to *0.8* and $\alpha = 0.005$, $n = 0.2$

Conclusion

At realizable on the ships speeds of frequency change, maximum of torsional oscillation amplitude is close to what it should be at a fixed resonance frequency and practically does not depend on the "transition" speed. Also, if the frequency does not change over the resonance frequency, the maximum of torsional oscillation amplitude can increase even to its level at a fixed resonance frequency.

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THE THEORETICAL RESEARCH ON THE INFLUENCES OF THE START PRESSURE OF FUEL INJECTION TO THE PERFORMANCE OF THE COMBUSTİON PROCESS, TO THE INDICATORY AND BRAKE POWER EFFECIENCY PARAMETERS OF DIESEL ENGINE TYPE 2Ч10,5/13

Akif Sh. Ismayilov
Azerbaijan State Marine Academy, Baku,
E-mail: a.ismayilov27@gmail.com, phone: +994502770257
Ilham S. Akhundov
Shipping Company "Caspian Marine Services Ltd.", Baku,
E-mail: i.akhundov@caspmarine.com, phone: +994506613511

Abstract
The article is considering some additional inputs made to the mathematical model used for calculating the operating cycle of the two-cylinder four-stroke, water cooled diesel engine type 2Ч10,5/13, with rated power of 15hp, at 1500rpm. The Article is analysing the factor as an impact of starting pressure of fuel injection (SoI) to indicators of combustion process, the influences to in-cylinder indicatory values and brake power efficiency parameters of the engine, as well, as the determination of the optimum data of fuel injection start pressure based on the results of mathematical calculations.
Keywords: ***s****tart pressure of fuel injection (SoI), atomizer, parameters of combustion process, indicated and brake parameters of the engine, brake specific fuel consumption.*

Introduction

Nowadays, it is confirmed that the increasing of fuel efficiency and the reduction of hazardous exhaust gases been greatly improved in diesel engines largely due to the optimization of qualitative flammable fuel mixture and the perfection of combustion process. İn order to obtain a qualitative fuel-air mixture, the injected fuel should be atomised to as fine a mist, as possible and be sprayed as evenly as possible to the entire volume of combustion chamber.

Furthermore, each fuel particle being surrounded by the optimal oxygen content can be completely burned, and thus, it is leading the heat process of the engine to obtain the ideal performance characteristics in a more improved way.

The process of fuel atomization is when the fuel is injected into the combustion chamber towards the end of compression stroke, as the fuel is atomized into a fine mist into the diesel engine cylinders. This process is evaluated in accordance with the different features effecting the quality of the fuel-air mixture, the rate of atomization of an injected fuel and its homogenous nature, the length of penetration of droplet into the cylinder, and the high importancy is the spraying cone angle as well. İn addition to all the relative proportional distribution of fuel spray, these shall be considered to be as main parameters of the considered processes. These parameters will mostly be depended on injection pressure, injection timing and also from the rate of the advance angle of fuel supply and the fuel's flowing speed caused by injection through the orifices on nozzle-fixed atomizer.

The purpose of and the main objective of this investigation work is the theoretical studying, the impacts of the Start pressure of fuel injection to the performance of combustion process, also apparent influences which impact the in-cylinder parameters and brake power efficiency parameters of the diesel engine type 2Ч10,5/13.

Basic part

The mathematical models [1] have been used in order to research theoretically the influence of start pressure of fuel injection to the operating performance of the experimented two-cylinder diesel engine - type 2Ч10,5/13. It is clear that the change of start pressure of fuel injection does have an effect to the formation of flammable mixture and further will be an influencing factor to performance of the combustion process. In consideration of above said and depending on value of start pressure of fuel injection (P_{f0}), and in order to determine the combustion start time, more precisely, the angle (θ_z)

between the initial point of combustion and top dead centre, also to determine the combustion period (φ_z), and heat utilisation factor (ξ_z) of the process, there are some empirical formulae that have been included into the mathematical model. These thoughts as above have been compiled according to following considerations.

Figure 1 shows the graphs illustrating the change of the start of combustion (θ_z), the duration of combustion (φ_z), and heat utilisation factor (ξ_z) in diesel engine type 2Ч10,5/13 at the various data of start pressure of fuel injection (P_{f0}). For the creation of these graphs the results used were taken from the Engine Test Report of the experimented two-cylinder 4-cycled diesel engine type 2Ч10,5/13 in line with information commented on [2].

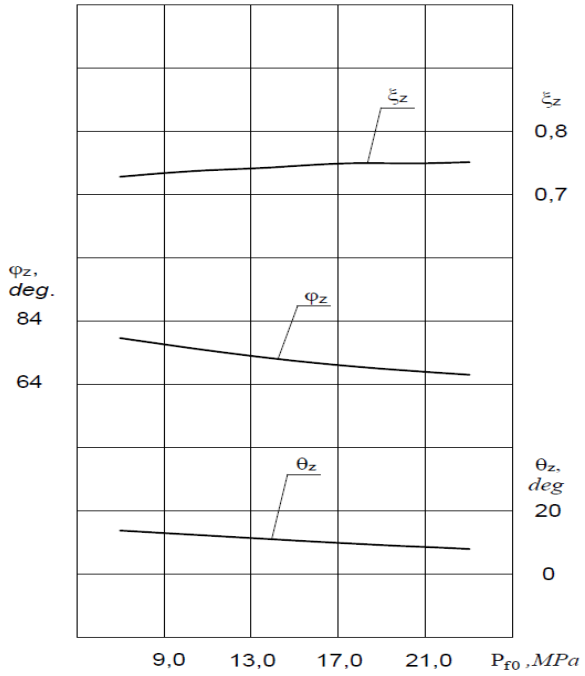

Figure 1. Graphs for illustration the change of the start of combustion (θ_z), the duration of combustion (φ_z), heat utilisation factor (ξ_z) in two-cylinder diesel type 2Ч10,5/13

The change of heat utilisation factor (ξ_z) is carrying the similar character and despite the value of (ξ_z) is definitively grows at the value of P_{f0} < 17,0 *MPa* , but at the value of P_{f0} > 17,0 *MPa* the value of (ξ_z) is getting to be stable.

From Figure 1, it is apparent, that by increasing the start pressure of fuel injectıon (P_{f0}) the start of combustion (θ_z) is shrinking, which in its turn does indicate the definite growth of the induction period despite the advance angle of fuel injection is stable. The thinking is, that this issue of the process is related with a delay of fuel injection into engine cylinder by increasing of the start pressure of fuel injection.

Thus, using graphs from Figure 1- at different values of start pressure of fuel injectıon (P_{f0}), in order to determine the start of combustion, more precisely, the angle (θ_z) between the point of initiate of combustion process and upper dead centre, the duration of combustion (φ_z), and heat utilisation factor (ξ_z), the following 3rd degree equations of curves and used coefficients are offered:

$$\theta_z = a_0 + a_1 P_{f0} + a_2 {P_{f0}}^2 + a_3 {P_{f0}}^3 , \quad (1)$$

$$\varphi_z = b_0 + b_1 P_{f0} + b_2 {P_{f0}}^2 + b_3 {P_{f0}}^3 , \quad (2)$$

$$\xi_z = c_0 + c_1 P_{f0} + c_2 {P_{f0}}^2 + c_3 {P_{f0}}^3 , \quad (3)$$

where, a0, a1, a2, a3, b0, b1, b2, b3, c0, c1, c2 and c3 are numerical odds of equations.

Having equations (1) - (3) which are added into mathematical model of calculation and that the basis of the appropriate software program has been developed, now, it is possible to carry out mathematical experiments which will allow investigation into the change of key characteristics of the operating cycle as dependent on start pressure of fuel injectıon (P_{f0}) for the diesel engine type 2Ч10,5/13.

Figure 2 shows the main indicators of combustion process, i.e. by graphs it is seen the change of duration of combustion (φ_z), the heat utilisation factor (ξ_z) and the change of maximum combustion pressure (P_z) and temperature (T_z) at different values of start pressure of fuel injectıon (P_{f0}). It is clear from the Figure 2 that the maximum pressure (P_z) and temperature (T_z) of the combustion process is growing intensively at the start pressure of fuel injectıon P_{f0}< 17,0 MPa.

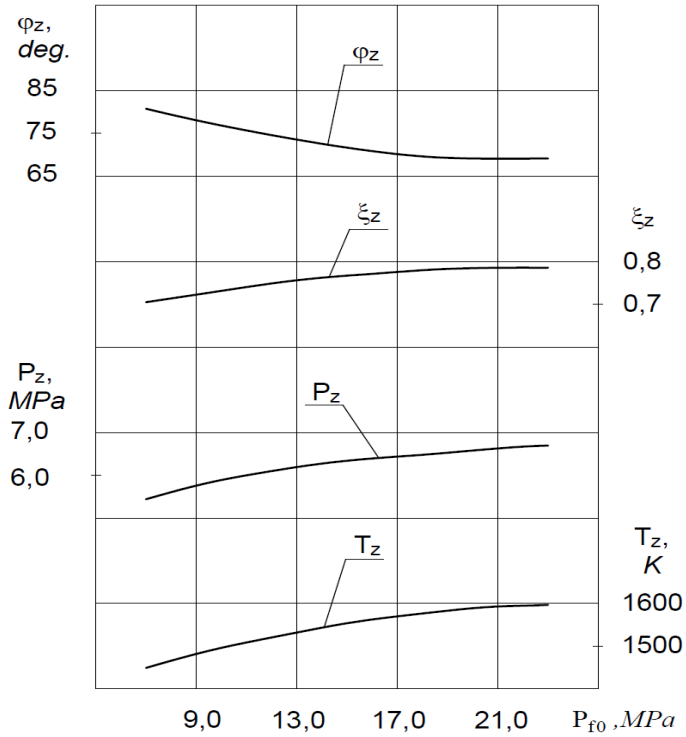

Figure 2. The Graph of the main indicators of combustion process at different start pressure of fuel injectıon (n = 1500 min^{-1}, θ = 24º)

For example, the small change of value of P_{f0} from 9,0 MPa to 17,0 MPa has caused the values of P_z and T_z to have slight increased at 0,5MPa and 90º respectively, when P_{f0} is growing from 17,0 MPa to 21,0 MPa the P_z and T_z are increased correspondingly on 0,1 MPa and 10º. Thus, after P_{f0} > 17,0 MPa - P_z and T_z, almost remain stable.

Figure 3 illustrates the indicated power and brake power efficiency (respectively N_i and N_e), the specific indicated fuel consumption and the brake fuel consumption (respectively g_i və g_e) and the coefficient of air excess (α) at the different start pressure of fuel injection of the diesel engines type 2Ч10,5/13.

As one can observe from the graphs Figure 3, the engine improved values of either indicated or efficiency characteristics, are more clearly reflected at P_{f0} < 17,0 MPa and if, P_{f0} > 17,0 MPa then both values remained virtually stable for this engine. For example, in the terms of Pf0 is in raise from 9,0 MPa up to 17,0 MPa then brake fuel consumption (g_e) decreased to 16g/kw. hour and the brake power (N_e) grows up to 1,1 kw and meantime, P_{f0} grows from 17,0 MPa up to 21,0 MPa accordingly the (g_e) reduces to 3.0g/kw. hour and the brake power (N_e) grows at 0.15 kw only. The excess air ratio (α) remains almost stable at all P_{f0} measurement range. Engine indicated power (N_i) and specific fuel consumption indicator (g_i) have been changed identically.

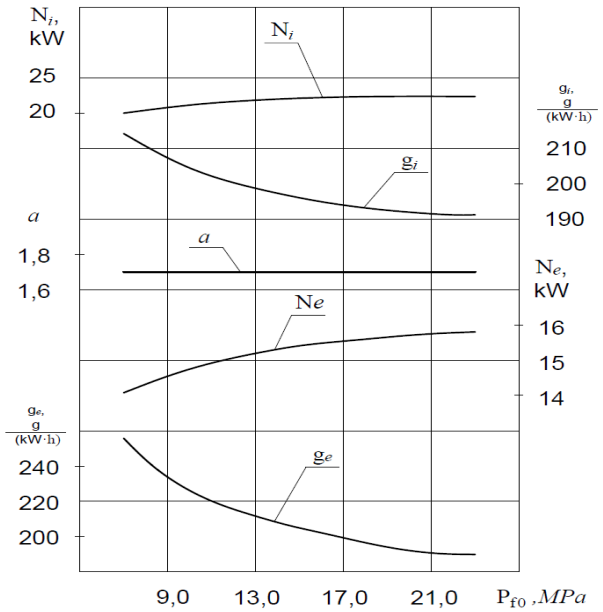

Figure 3. Graph of the indicated and efficiency parameters of the engine depending on start pressure of fuel injectıon (n = 1500 min^{-1}, θ = 24º)

Taking into consideration all said above, it can be concluded that the optimal value of the start pressure of fuel injectıon is advised to be no more than 17,0 MPa as much as assumable factor preferred for such diesel engine experimented at this stage.

Conclusion

The obtained results of analyses, i.e. theoretical study of observed changes of operating cycle's main characteristics (the maximum pressure and maximum temperature of combustion process and the indicated and efficiency parameters of the engine) at a varying values of start pressure of fuel injection, and also, taking into consideration that the tested engine has a swirl combustion chamber design, final conclusion is that the start pressure of fuel injectıon not to be more than 17,0 MPa for diesel engine type 2Ч10,5/13. The recommendation is that the start pressure of the fuel injectıon be set to the optimal value of 13,0 MPa.

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MARITIME LEADERSHIP AS AN EXTRAPOLATION OF SOCIAL ALTRUISM INTO THE MARITIME SECTOR: PSYCHOLOGICAL AMORTIZATION OF RELATIONSHIPS

Saulius Lileikis
Lithuanian Maritime Academy, 7 I. Kanto Street, Klaipėda, LT-92123, Lithuania,
E-mail: s.lileikis@lajm.lt, phone: +370 46 397 240

Abstract
The maritime leadership regarding social altruism is discussed in the paper. The meaning and character of social altruism in the maritime leadership are investigated by considering the leadership as psychological amortization of ship crew relationships, and by analyzing the more important values of the maritime leadership, and limits of altruism. The methodological type of the research is theoretically descriptive. The methodology of the research is based on the STCW convention, the paradigm of the universal upbringing and existentialism. These three methodological principles orient researchers to take into account the nature of the personality regarding leadership and self-leadership development. Methods such as analysis, interpretation, extrapolation, differentiation, classification, systemization and synthesis were used in the research. The methodological limits of social altruism are based on the strategic conception of its extrapolation into the maritime sector without tactical dimension of this phenomenon. It is appropriate to apply the results of the theoretical research to the psychosocial processes of the seafarers' preparation, by developing the more integrated conception of the maritime leadership, and vocationally valuable meaning for the personality of its internalization, and by methodologically basing the empirical researches of the maritime leadership.
Keywords: *maritime leadership, social altruism, seafarers, values, psycho-education.*

Introduction

The maritime policy, applying the leadership on board, uses the support of social altruism as a taking into account the needs of other person in a broad sense, presented by the social psychology. It wishes to achieve the psychological amortization among relationships of different ship crew members, regarding sex, race, nationality, religion, position on board, education, social maturity, etc., at difficult working conditions at sea. It is appropriate to apply principles of the developed maritime leadership by connecting them with the teamwork of the crew, so that reciprocal and subsidiary ties of its members would be based on natural social altruism by creating the good working climate on board.

Maritime leadership as a part of scientific researches on the organizational leadership is directly related to altruism, especially by taking into account the reciprocal help at extreme conditions at sea. Different contemporary leadership styles share altruism as a common characteristic and mediating principle by seeking to consolidate the team, learn from each other and integrally manage the work processes regarding differences of the team members, and their combining for the vocational activity purposes [11; 16].

Social altruism as psychological amortization of seafarers' relationships on board is relevant in general because:

The maritime sector requires to attract the young European workers;

Dictatorship on board is very unattractive for a contemporary youth;

High-tech improves the work that could be partially characterized by more democracy on board;

Differences of the crew members' mentality require openness to otherness for the good cooperation;

Humane factor's motivation is more based on following the leader's example with a pride of honest work (altruism as a working freedom) than careless work by fearing sanctions (defensive egoism as a limited self-expression) in long-term prospect.

Protoaltruism, relevant for leadership, is an initial behavior of living beings, and relates to the natural paternal concern of the master for safety of the crew at sea at psychological level. Generative altruism is a creative and sincere joy of seafarers on mutual working of the team on board and achieving good results. This is a great valuable direction of the leadership. Lack of leadership promotes conflicted altruism at individual level when the seafarer feels unappreciated for his/her good results and cannot implement oneself at work, and pseudoaltruism as a defensive egoistic behavior by demonstrating fake

collaborative efforts of members by schizophrenic concerning for a mutual purpose on board at social level.

The grade of the exploration

The maritime leadership, related to altruistic values, is globally quite widely dominated in the social maritime science [1; 2; 3; 4; 8; 9; 12; 13; 14; 15; 17; 18; 19]. However, the maritime leadership is rarely analyzed regarding a very relevant point of view of the content and limits of social altruism. It is appropriate to integrate these both issues by discussing the maritime leadership as an extrapolation of social altruism into the maritime sector for psychological amortization of problematic relationships in the fleet.

The object, goal and tasks of the research

The object of the research is a maritime leadership. It is analyzed in reference to social altruism.

The goal of the research is a discussion of meaning and character of social altruism in the maritime leadership.

The tasks of the research are as follows:

Revelation of the maritime leadership as psychological amortization of seafarers' relationships in the ship crew.

Analysis of the maritime leadership values which are close to social altruism, and limits of altruism.

Methodological principles and type of the research

The methodology of the research is based on the STCW Convention, the paradigm of the universal upbringing and existentialism.

International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, and requirements of Manila amendments highlight the improvement of the shipping safety developing leadership of seafarers at the level of their preparation along with other actualities. Technological training of future seafarers, and their positive world-view, creativity, understanding of the constructive philosophy and social psychology for the development of one own's personality, wide intellectual and cultural horizons, and the development of internal and cooperative culture influence on safety at sea. All mentioned components could help develop leadership abilities of future seafarers.

The paradigm of the universal upbringing notes the development of all powers of the personality. This holistic approach to the maritime education helps implement improvement of the self-leadership of future seafarers, especially at flexible and creative levels of the adequate reaction to nonstandard physical and psychosocial situations working at sea. The leadership is characterized by a wide conception based on the universal and integral nature of the personality.

Existentialism refers to the human fear on land and especially at sea. Existential psychology is the cause for personality's hope. This psychology denies an attachment to life pleasures, and promotes liberation of the personality, and purification of his/her existence. The development of maritime leadership, especially of self-leadership, expands the intellectual horizon and helps people overcome the tragedy of existence, improve their emotional state and find a unique comfort. Existentialism helps get a valuable basis for self-leadership and self-regulation at extreme conditions. This valuable direction is based psycho-educationally.

The methodological type of the research is theoretically descriptive.

Methods and methodological limits of the research

Methods such as analysis, interpretation, extrapolation, differentiation, classification, systemization and synthesis were used in the research.

The methodological limits of social altruism are based on the strategic conception of its extrapolation into the maritime sector without tactical dimension of this phenomenon. It is appropriate to apply the results of the theoretical research to the psychosocial processes of the seafarers' preparation, by developing the more integrated conception of the maritime leadership and vocationally valuable meaning for the personality of its internalization, and by methodologically basing the empirical researches of the maritime leadership.

The maritime leadership as the psychological amortization of relationships in the crew

The leadership is often reduced to some combination of socially special and personal traits and skills in the management. The long-term researches at level of the maritime sector, performed by the author of this paper, have confirmed the mentioned position. The empirical research [9] has shown one of tendencies of the studying experienced seafarers' statements that the leader on board is "a good specialist and a wonderful person". This description of the maritime leader reveals his/her moral and businesslike authority for the ship crew. It requires such kind of leaders who would be able to take into account the situations of his/her subordinates and to make adequate decisions in problematical situations regarding available resources.

We can find manifestations of the leadership, relevant to seafaring, in the whole seafaring history. It expresses sustainable ties of the leader with the ship crew, moral and businesslike authority of the chief for development of the crew and for organization of the teamwork on board, vocational altruism among crew members, reciprocal help and supporting practice in the crew [20]. Maritime leadership is not a new phenomenon from the traditional point of view. It is more related to recognizing the role of the seafarer's personality at level of the maritime policy.

The countries in Eastern Europe are traditionally more engaged to the combining of seafarers' technological preparation and of bringing up the seafarer's personality, important for the maritime leadership. Not only American and British scientists are interested in psychosocial aspects of the maritime leadership, especially since 20th century. However, the former Soviet Union republics and satellite countries related to the sea business, too. It means - the Russian, Ukrainian, Polish and other researchers of the social maritime science. Moral authority of the seafarer on board and its development as a strategic aspiration of the personality's psychological flexibility, were naturally integrated into technological study programs of maritime academies.

Moreover, the higher education, acquired in Eastern Europe, and higher position on board were more connected than in the West. The conventions of the International Maritime Organization do not require the higher education for chief officers on board. The higher education is based on opportunities to universally develop the seafarer's personality. It helps achieve and ensure a more smooth collaboration in the ship crew from the relevant point of view of the maritime leadership, based anthropologically, in the axiological and psychological context in general.

An especially important opportunity and well-timed decision to combine the personal and technological levels of the seafarers' preparation consist of the maritime studies as higher collegial education licensed internationally, oriented to practice and supported by scientists in the context of the Bologna process. This is the prerequisite, based politically and empirically, to help future seafarers mature vocationally and to develop the relevant technological and personal competencies of social leadership in regard to the seafaring.

The highest harmony of the maritime leadership development is achieved in the symbiosis when teachers of maritime academies are deep personalities - professional practitioners and scientists. Natural, noble and daily communication and cooperation of maritime leaders with the maritime students and colleagues create a good psychological climate and affect positively the future seafarers and their vocational and personal maturity based on persuasive power of the example.

On the one hand, maritime students know the maritime leadership basics and problems by learning the management psychology and other study subjects, e.g., at the Lithuanian Maritime Academy, and by implementing the vocational practice on board at sea. However, on the other hand, the studying seafarers have stated that it is impossible to bring up the maritime leader without obvious application of leadership principles to the seafarers' preparation institutions. This problem is closely related to the students' motivation to choose and especially - to remain at studies on maritime business in the past decade. It relates to student's feeling in the first stage of the seafarer's career, in which opportunities for revelation of the personality's social nature exist or do not exist, regarding vocational actualities on board.

Generally, preparation of the personality for working at sea is in part politically compensated by integrating of the maritime leadership and the teamwork psychology into the seafaring and into the mandatory international trainings for seafarers already because of lack of the vocational self-implementation and creative potential universal development by seeking to create better conditions for solution of difficult social and technological problems on board.

The personality of the maritime leader, enriched at the valuable level only, is able to implement the necessary principles of leadership that are abundantly presented by different authors. We can distinguish some principal moments considering the teamwork, cooperation and supporting as a strategic line of the maritime leadership:

- The leader considers workers rather as partners but not as farmhands only;
- A frustrated leader accuses the workers at any failure by threatening them with disciplinary penalties, salary reduction and dismissal;
- The leader accepts responsibility that characterizes not only subordinates but also the leader;
- The leader looks for what is possible to undertake in the actual situation by discussing with them;
- The leader develops self-confidence and considers problems as the life challenges;
- A frustrated leader does not care for a sound working climate;
- The leader listens to the workers, supports and encourages them, if it is needed and possible;
- The leader loves and respects oneself, his/her own job and feels grateful to the employees.

It is natural that a poor personality of the chief, and anti-leadership related to him/her, the absence of love for his/her job and disrespect for workers, at the level of primitive egoism, affect negatively:

- It disturbs achievement of organizational purposes by misbalancing the work processes and destabilizing the activity;
- It causes the unnecessary increased long-term distress of workers, desperation and psychosomatic illness (e.g., migraine, hypertension, heart rhythm disorders, stomach ulcers, bronchial asthma and neurodermatitis);
- It promotes a negative psychological working climate, the poor self-esteem of employees, conformism, work imitation and a desire for revenge;
- It deprives the self-confidence of workers, working joy, wish to work sincerely and creatively by fully self-implementing at work regarding quality, and by harmonious seeking their own and organizational purposes of the vocational activity.

Poor leadership, that we can find sometimes in the maritime sector, undermines the prestige of working on board at the social level, does not let develop existential motives of the work based on noble love to oneself, and social pride of working in the maritime sector, considered traditionally with respect, as a unique worthy area for the human work and for a socio-cultural and technological life.

The scientific researches have revealed a quite wide spectrum of behavioral expressions of masters or chief officers on board relevant for the maritime leadership that should be generalized by dividing its positive and negative quality:

– On the one hand, there is shared the psychosocial maritime experience characterized by the honorable and noble behavior at extreme work conditions [20];

– On the other hand, e.g., the behavior of guides for the future seafarers' practice on board is analysed by presenting not only those masters and chief mechanics, to whom trainees were grateful for their proper attentiveness and care, but also those ones who often saw the trainees as additional work power only, and their behavior has not developed love to the sea and to the maritime profession selected by young people [5].

Moral problems of the chief's personality is inevitably and directly related to the level of his/her education and managerial competency, especially in popular reference to application of the disproportionate control. It is a natural necessity to control the work. However, it is appropriate to consider the control as a part of leadership and adequately apply it. An increased control is usually applied more, if problems arose, than leadership, characterized by permanence, that promotes not only self-confidence and pride of one's own work, performed honestly, but also the consciousness of seafarers in general [10]. It directly relates to the self-leadership, self-management and self-control of each seafarer's personality. Too much control as well as too much concerning as bothersome altruism is unacceptable. Psychological flexibility is one of the most important tools that amortize the relationships by applying leadership to the crew relationships by technological problems and psychosocial tensions.

The leader is a personality who is developing his/her own leadership, thinking creatively, concerning for his/her vocational life style and moral authority, improving own management, avoiding bureaucratic methods, characterized by anti-leadership and by reducing autonomy and initiative of subordinates, applying progressive methods to the work discipline and avoiding a blind obedience of employees. The business practice has confirmed that not control but the imaginational power, experiment and connected creative struggles are considered as the most important prerequisites for economic success [6].

The nature of leadership consists of favorable conditions for extension of employees' own needs by combining the subjective, objective, physiological, material and civil needs related to the responsible work, safety, psychological comfort and socio-cultural expression, and by creating the prospect of seafarer's worth as the integral and holistic personality.

All that is directly related to the life leadership as a special, unique, first and most important form of the leadership expression. In other words, the maritime leadership begins with the question - how much is the seafarer a leader for oneself, it means - in regard to one's own life, enrichment of his/her personality, relationships with oneself and others, and an entire (inner and external) culture. Such a self-leadership is also valid as a psychotherapeutic direction (in difficult situations of the seafarer's work and life in general from the point of view of autonomy by deciding), the psychic self-regulation and courage application for the professional psychological support if needed [8].

The active self-expression of employees at work is based on self-confidence that rises from the leadership as a supporting management. If there is an opportunity to be proud of the chief, the prerequisites are created to be proud of one's own work place and of oneself as a person who sincerely performs an important work. The teamwork of the ship crew is always psychologically focused on the leader's expression on board. The supporting leadership facilitates the work processes and helps avoid extremes by working at extreme conditions.

Psychosocial researches on the maritime sector, performed by the author of this paper, demonstrate, that a quite poor maritime leadership and frequent disrespect of chiefs for themselves and for employees do not allow achieving the mentioned motivation regarding pride of one's own work. The leadership culture of different seafarers is characterized by different levels, and is depended on factors as follows:

- On political ideologies of the epoch,
- On culture of the state management,
- On the economic situation and social reactions,
- On condition of education,
- On leadership of the seafarers' vocational preparation,
- On peculiarities of the communication among different generations,
- On values dynamics,
- On traditions of the communication on board, etc.

It is a position of studying and older seafarers - generations must change, so that leadership might be applied and change dictatorship on board. This problem of generations relates to the frequent phenomenon when leadership is considered as the same dictatorship but with the new popular name only. It denies the political idea of nowadays maritime leadership that helps amortize psychologically, it means - facilitate the collaboration of the crew and make it more flexible on board. However, the similar position of the leadership conception more characterizes young seafarers.

Application of leadership is difficult at extreme conditions at sea. The moral and businesslike authority of the chief is the most important psychological tool for employees. In other words, they do need a harmony of both moral and businesslike authority by appearing of moral authority in the process of businesslike authority's implementation with teaching, motivating and disciplining. Adequate disciplining as an altruism expression is a practical attention to the problem and to the subordinate regarding the situation.

The leadership is more than different leadership models from the axiological point of view of permanent creation of relationships, and prospects of the long-term organizational activity in general. It is more than depending on situations and other important factors only. The authentic uniqueness of the chief's and subordinate's leadership and self-leadership is based on personality's psychological integrity, vocational improvement and life joy at the strategic level regarding any problematical conditions.

Maritime leadership is not a cheap panacea for solution of socio-technological problems on board regarding assurance of the seafaring safety. The necessary condition for the maritime leadership development consists of complex upbringing of the universal personality. Higher collegial maritime studies oriented to practice with the integral study programs, based on a technological, psychological, ethical and socio-cultural harmony of the seafarers' preparation, can help achieve that.

One of the most important challenges for the maritime leadership politically and practically consists of the coordination of democracy with the socially acceptable and unavoidable autocracy by working at sea in extreme situations. The strategic condition and purpose of mentioned axiological and psychological prerequisites for the maritime leadership are an assurance of the safety culture on board that must be transferred from generation to generation (Figure 1).

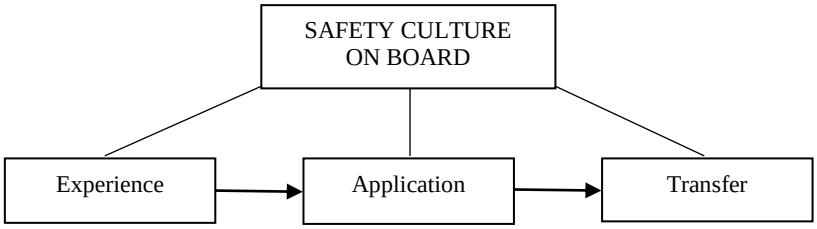

Figure 1. Experience, application and transfer of the safety culture on board

The safety culture on board, that is experienced and applied by young seafarers, brings them up and promotes to foster the supporting leadership, as a relationships culture, and to transfer this experience, as a substance of the psychological climate in the ship crew, to new generations of seafarers for their safety at sea.

Values of maritime leadership and limits of altruism

Researchers analyze the maritime leadership that is close to social altruism in regard to the psychological amortization. They divide the internalized values as the skills, important to empirical researches of multicultural groups based on the leadership theories. There are 21 values classified as the skills of the maritime leader into 6 groups [1]. These groups of the most important features (dimensions) are analyzed in leadership researches by including all possible areas of psychosocial processes for the maritime leadership (Table 1).

Table 1. Features analyzed in leadership researches

CORE DIMENSIONS	PRIMARY DIMENSIONS
Charismatic	Inspirational Integrity Performance oriented Visionary Decisive Self-sacrifice
Team oriented	Collaborative team orientation Team integrator Diplomatic Malevolent (reversed) Administratively competent
Self-protective	Procedural / bureaucratic Conflict inducer Status conscious Face-saver Self-centered
Participative	Participative Autocratic (reversed)
Humane oriented	Modesty Humane oriented
Autonomous	Autonomous

Some differentiated features as primary dimensions repeat the names of features groups as core dimensions but it is no problem because features are mostly divided into items in the theory. Moreover, e.g., *autonomous* (in a broad sense) as a core dimension is differ from *autonomous* (in a strict sense) as a primary dimension.

Charismatic leader would be *a priori* less suited for the work on board at extreme conditions than for the teamwork in general. However, a charisma is extended by researchers to an orientation to the work, and ability to decide and to predict, etc. So, it would suite, especially when researchers divide its dimensions into the important ones regarding social effect - positivity, encouragement and moral authority that is reliable and able to motivate for the work at any conditions. It is relevant by working at

changeable conditions at sea. The important features are discussed - trust, righteousness, sincerity, perfect work, prediction, assumption of risk and participation. The teamwork on board needs these features.

Team oriented leader should be the best for the work at sea. The vessel goes because of its team collaboration only. The collaborative maritime leader is a worth. He/she, being orderly personality, is able to integrate the team. It would be a problem if the leader would be too diplomatic, and worst when he/she is malevolent, impolite, harsh, shouting, not controlling oneself, manipulating and too egoistic. It disintegrates the team and expresses the anti-leadership by promoting obedience from fear of a punishment. Such chief is a loser from the point of view of the leadership. However, the personality requires the normal and healthy egoism for self-identity and autonomy.

Self-protective leader is concerning for his/her safety, does not feel - working in one's own position, self-expressing vocationally or relating to his/her job. Such kind of a leader is seeking the image - "all is okay" from the formal and bureaucratic point of view. Good bureaucratic abilities is a great advantage by working at sea because it is necessary to fill accurately the ship documents. However, the mentioned personality is characterized by promotion of conflicts, by permanent control, by excessive concern for a good reputation that can not fit the reality, by evasion, by not solution of problems, and by egocentrism. So, he/she is not a positive leader whom the crew members should follow.

Participative leader is acceptable for the work on board regarding the maritime leadership. Moderate autocracy is needed by managing the crew. However, the crew is based on collaboration and delegation of some duties. Only then it is possible to discuss on application of the leadership on board as the maritime leadership in general. If the active leader is not right regarding his/her subordinates, is picky and autocratic, demonstrating supremacy, participating but not collaborating and not consulting, so, his/her negative participation is rather disturbing than helping at work on board from the point of view of the team leadership.

Humane oriented leader principally suits for the political idea of the maritime leadership as a psychological amortization on board based on social altruism. Such a leader is calm, patient, reticent, autonomous and not bothersome and is not requiring an attention of others. The theory indicates modesty but it is appropriate when based on mentioned features only. Modesty cannot be based on fear or shyness, which does not suit for the work at extreme conditions. The maritime leader might be characterized by generosity and moderate mercy, which is based on the natural humane empathy. However, a difficult work at sea requires strength by dutifully achieving the goal. So, mercy of the leader, characterized by sensitivity, calls into question his/her work position at extreme conditions.

Autonomous leader is very important on board. The autonomy is divided into individuality, independence and uniqueness that characterize the maritime leader in the theory [1]. Autonomy of the master defines the substance of his/her personality in the maritime leadership. He/she is relatively independent. The master assumes the full responsibility for the processes on board. But he/she being the leader can delegate some duties by sharing his/her responsibility but after the autonomous decision only. Discussion is appropriate regarding the situation but the final decision is made by him/her. The uniqueness as a feature is natural for each person, especially for the enriched personality. The work on board does not require uniqueness as a purposeful feature usually. However, the master, being special in something, is able to form his/her moral authority only. His/her duty on board makes him/her exclusive. However, richness of the personality, the quality of social decisions and the ability to insight and to predict, mostly make the master special and unique.

Seeing that Asians are dominating at seafaring, it is relevant to analyze the values, important mentally for them, regarding internalization. Asia is characterized by old traditions. Asians follow the Eastern philosophical values systems more in some way. It is as a general tendency. So, it is appropriate to analyze the Confucianism values system, formulated by Mencius, as a psychological amortization on board regarding altruism. This system, according to the maritime leadership, is expressed by nowadays scientists.

The leader's moral spirit is analysed by using dimensions as follows:

~ Humaneness - a leader behaves with a human heart and humility;
~ Righteousness - a leader shows love and righteousness;
~ Resolution - a leader is committed to the resolution of righteousness;
~ Goodness - a leader's mind shows goodness and morality;
~ Conformity - a leader shows a moral mind from the perspective of accordance;
~ Selflessness - a leader is selfless within society;
~ Discipline - a leader has great moral discipline;
~ Spirit - a leader has a determined moral spirit;
~ Benefit - a leader sacrifices his/her own interests to benefit others;
~ Kindness - a leader shows patience and peace of mind [13].

This study believes that great maritime leaders are similar to the saints and should use their humane governance to treat all people as one would treat oneself. It is difficult to assess the Asian mentality, pantheism and educational criteria of the moral spirit of their leadership correctly, by using the Western rational approach to the maritime leadership.

However, it is acceptable at work of seafarers when the leader shows righteousness, moral mind, great moral discipline, patience and peace of mind in general. It is very important that the leader does not panic and does not shout in problematic situations and does not aggravate the tensed psychological climate on board. When the leader is selfless within society and sacrifices his own interests to benefit others, he/she is related to altruism. Nevertheless, how much should it suit for the leadership on board, it does need additional empirical researches by taking into account the differences of Eastern and Western mentality.

Interpretation of Mencius ideas (in a sense of moral powers) is also relevant to the concept of the Western maritime leadership, by analyzing the leader's humane management implementation:

~ Achievement - a leader treats employees with respect regarding their culture and civil rights;
~ Ruling - a leader pursues the goal of being a great man;
~ Possession - a leader has nothing to be ashamed before other men;
~ Compassion - a leader cares for the global environment and prevents pollution;
~ Courage - a leader has no fears and has the courage to achieve a humane government;
~ Tolerance - a leader emphasizes staff health and a safe working environment;
~ Principle - a leader takes care of a humane government;
~ Endurance - a leader inspires a mind that produces an enduring nature;
~ Flood-like *qi* - a leader is produced by a sudden revelation of righteousness;
~ Determination - a leader is extremely dedicated to the human governance [13].

The mentioned moral powers, relevant for the maritime leadership, help the leader treat employees with respect regarding their culture and civil rights, care for the global environment and prevent pollution, emphasize the staff health and safe working environment, inspire a mind that produces an enduring nature from the point of view of the healthy altruism as a practical activity at sea. It is important on board, by taking into account the ecological behavior of seafarers, health, healthy life style, correct management and long-term productive collaboration according to the conventional needs of the maritime sector, and to the natural possibilities for the seafarer personality's vocational expression.

The maritime leadership does need the social altruism as taking into account the needs of another person, so that the traditional dictatorship on board would be less by integrating consciousness, delegation of duties, self-respect and encouragement. It is a supporting leadership, valid as a psychological amortization of social problems in the crew and as an aid to solve them. However, altruism has to be rightly understood, so that it would be accepted, internalized and applied in technological processes of the collaboration on board. So, it must have the clear limits as an opportunity for a productive application in the maritime leadership.

General directions of altruism researches in the science are as follows:

~ Altruism as an extreme idealism;
~ Altruism opposed to egoism;
~ Altruism considered as a synthesis of egoism and self-sacrifice;
~ Altruism as a developed egoism [7].

If altruism would be explained as the extreme idealism, we would get into the situation of no-go. Altruism as the highest ideal, self-sacrifice and the highest level of love, which is found in the Christianity, has been traditionally considered by idealistic philosophers. Pragmatic and exploiting cynicism is stigmatizing love and is opposed to such kind of altruism. A small part of this altruism might be applied in the maritime leadership, so that seafarers do not lose the noble approach to their work despite difficulties. It is very ease to become a cynic after the experience of difficulties by working at sea. However, it is better when seafarers learn to creatively solve their problems regarding self-respect and common purpose of the crew work from the point of view of the mental health.

Altruism is often opposed to egoism. The famous American Baptist minister Martin Luther King, Jr. has declared that every human must decide whether he/she will walk in the light of creative altruism or in the darkness of destructive selfishness. Such separation of altruism and egoism is partially correct because limits of both concepts are remained in general. However, life is more complex than "black - white" only, especially by discussing on the work at sea full of surprises.

Classics of the science on altruism have tried to search the relations between the both extremes. There are problems rised in the opposite case. The famous physician and medical missionary Albert Schweitzer has declared that a self-sacrifice ethics is too narrow because it can be connected to an

exploitation of the benefactor. So, it is unacceptable in relationships at the teamwork on board. The famous Jesuit paleontologist Teilhard de Chardin has practically declared that idealistic requirement "to love a whole and all" is incorrect and is ending as impossibility to love someone. Scientists do not refuse a part of egoism in the altruistic motivation. It is stated that we cannot unambiguously define the concrete activity. A contraposition of both altruism as a goodness and egoism as an evil, is not a comprehensive characteristic of their content and relationship.

Egoism does not have to be understood as a poor selfishness. The serious attention to one's own welfare is a great value. Such kind of egoism is characterized by some altruism in respect of oneself. A self-limitation and openness to others cannot be self-denial. The extreme materialism, that becomes more important than a friendship, only composes the prerequisites for asocial and destructive egoism. Altruism is always partially selfish. So, altruism must be considered as some development of egoism, e.g., the good seafarer gets a salary for his/her sacrificing work; a Muslim seafarer, doing something well, is seeking to go into heaven after his/her life time, etc. Each person naturally has his/her own motives, in which he/she endeavors for a common good of the crew on board.

It is appropriate to solve the relation problem, of both altruism and egoism, by accepting altruism as a developed egoism. However, it is not a primitive form of egoism. It should relatively help develop altruism as an elementary and not extreme idealism, which does not let the youth naturally engage for others, especially when young people have to orient themselves in their own life and in values tensions, and to keep up a balance among the personal happiness and social and vocational welfare.

How much it is possible, so much it is appropriate to learn, to extend one's own erudition and to be open and honest. It is the basis for building of the maritime leader's moral authority. It is important to know other people, their mentality, moral and religious convictions, feeling, aspirations that determine their working motivation from the point of view of the maritime leadership in general. It helps ensure the more coordinated team working on board, and the maritime leadership based on practically applicable social altruism as a psychological amortization of working relationships among the crew members for the prevention and solution of problems.

Conclusions

1. The maritime leadership, as an extrapolation of social altruism into the maritime sector, is characterized by psychological amortization of relationships among seafarers on board. The educated and cultured leader helps create the safety culture on board. Managerial competency of the maritime leader is related to his/her personal maturity and self-leadership that ensures his/her own vocational development. Young seafarers might experience the climate of the safety culture on board, learn to apply and to constructively transfer it to other generations of seafarers. The substance of the maritime leadership consists of combining of moral and businesslike authority of the leader on board at the level of social altruism.

2. The most important features as the maritime leadership values, regarding social altruism, are positivity, encouragement, moderate autocracy, patience, temperance, non-boringness, autonomy and moral authority that is trustful and able to motivate for the work at any conditions. The collaborative maritime leader is a worth because he/she, being an orderly personality, is able to integrate the team. Confucianism values system, as a righteousness, moral mind, great moral discipline, patience and peace of mind, formulated by Mencius, characterizes the maritime leader. It is very important that the leader does not panic and not shout in problematic situations. An ecological behavior, health, healthy life style, correct management and long-term productive collaboration of seafarers are emphasized.

3. Limits of altruism consist of a principle that it has not to be perceived as an extreme self-sacrifice. However, it is a farsightedly developed egoism that is meaningful, by applying it practically to the ship crew at the vocational level. The methodological limits of social altruism are based on the strategic conception of its extrapolation into the maritime sector without tactical dimensions of this phenomenon. It is appropriate to apply the results of the theoretical research to the psychosocial processes for the preparation of seafarers, by developing the more integrated conception of the maritime leadership and vocationally valuable meaning for the personality of its internalization, and by methodologically basing the future empirical researches of the maritime leadership.

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THE CASE OF MELNRAGĖ WRECK FRAGMENT: A PILE OF WOOD OR A HISTORICAL SOURCE OF INFORMATION?

Klaidas Perminas
Klaipėda University, Lithuanian Maritime Academy, Kadagių Street 11-8, Klaipėda, Lithuania,
E-mail: klaidas.p@balticum-tv.lt, phone: +37065798991

Abstract
A fragment of a wooden sailing ship became exposed on the shore in Melnragė (part of Klaipėda city, Lithuania), north of Klaipėda port entrance in autumn of 2014. The fragment constitutes the aft part of a carvel-built ship. The ship was built in the 19th century and represents the period of active shipbulding and international trade among different regions of the Baltic and North Seas. Apart from dendrochronological analysis, several features of the wreck, namely, scale denoting the draught of the ship and several timber marks scribed on one of the ribs help in dating the wreck. The study of these features are the main task of this paper.
Keywords: *Melnragė, wreck, timber marks, draught, ship.*

Introduction

This article is a case-study introducing a massive fragment of a historical wreck that emerged on the seaside of Klaipėda (former Memel), Lithuania, in autumn of 2014. Therefore, the main object of the study is the fragment of the wreck as an authentic source providing valuable historical information. The article is based on the paper "The case of Melnragė wreck fragment: a pile of wood or a historical source of information?" read at the 4th International Maritime History Readings "Maritime history research in the Baltic Sea Region: challenges, achievements and results", held at Latvian Maritime Academy, Riga, 12 October 2017.

The study encompasses a number of problems of different character. First of all, the historical value of this kind of fragment – is it unique and valuable from historical and scientific points of view? For maritime historians and archaeologists there is no space for such a question. Members of interested academic community are always concerned about latest discoveries related to historical navigation and similar topics. Therefore one of the aims of the article is to introduce the object of the study into academic circulation as a source for further scientific research. Beyond a doubt such discoveries bring new data on the past of *homo navigans* – the navigating human. Another relevant problem, which, however, will not be discussed in this study as it requires a separate research, is the legal status of such objects. It is a serious issue because the way of treatment and attitude may determine destiny of such cultural heritage objects, that is, – either protection or destruction of potential material historical source. Even if an object has been saved – what other steps and by whom should be taken to keep it safe? What institutions should take care of objects like this? Should this particular wreck fragment and future findings be put on display? These questions arose to interested people and institutions while deciding what should be done with the Melnragė wreck. The problem of legal status of such "unforeseen findings" is important as the position of heritage protection institutions and their readiness to react is essential for retaining maritime heritage objects for future studies and cognition. In Lithuania many people from non-academic world and even some official institutions sometimes show absolute lack of interest and understanding how valuable such objects may be. This is why the title of this article, embracing the problem of attitudes, has been formulated such as it is – for specialists it may sound as a rhetorical question and for non-experts it may sound quite reasonable. Scientific approach to and a closer look at some details of this "pile of wood" do not only give some explanations about it, but also raise certain questions, answers to which may reveal some additional historical information. The author uses the case-study type of research in order to obtain as much information from the rest of the wreck as possible. The results of the study should become a basis for understanding, protection and further research of this particular wreck fragment and similar future findings.

The main goal of the article is to analyse the Melnragė wreck fragment as a historical source that provides data for further studies in different fields (shipbuilding, maritime history, trade history, regional history, historical geography, maritime heritage protection, etc.). Special attention will be paid to defining

the chronology of the fragment. The object under discussion is an authentic, therefore – the primary source for studies mentioned above, as the historical archive of Memel (Klaipėda) has not been extant.

The tasks of the study are as follows:

1. To present the circumstances of the discovery of the fragment;
2. To introduce the remaining constructional elements of the wreck;
3. To analyse the specific features of the wreck (scale of draught and timber marks);
4. To argue the chronology of the finding;
5. To review the historical context of the finding;

The only publication about the Melnragė wreck fragment published so far is an introductory article by Romaldas Adomavičius regarding the fragment as a possible exhibit of the Lithuanian Sea Museum [1]. The novelty and relevance of our research is based on the fact that no scientific study regarding special constructional features of this wreck fragment has been published. This article claims to be the first publication of this kind and it should contribute to promotion and protection of maritime cultural heritage. Any finding of this kind is, undoubtedly, of high importance to the whole maritime community not only of the Baltic Sea region, but the whole northern Europe. Geographical aspects, presented in the study, can support this statement.

The methods used include field work, analysis of written sources and relevant literature, studies on historical maps and satellite imagery, research on the wreck construction, different methods of dating (including dendrochronological analysis carried out by Dr. Rūtilė Pukienė from the National Museum of Lithuania). The author of the article personally participated in the works of salvaging the wreck fragment consulting the salvagers, carrying out photo-documentation and taking measurement records.

Circumstances of the discovery

The fragment of a wooden ship became exposed on the shore in Melnragė, approximately 770 m north of Klaipėda port entrance, around 1November 2014. The geographical coordinates of the site are: 316985, 6181797 (LKS); 55° 44' 10.08", 21° 5' 7.83" (WGS) (Figure 1).

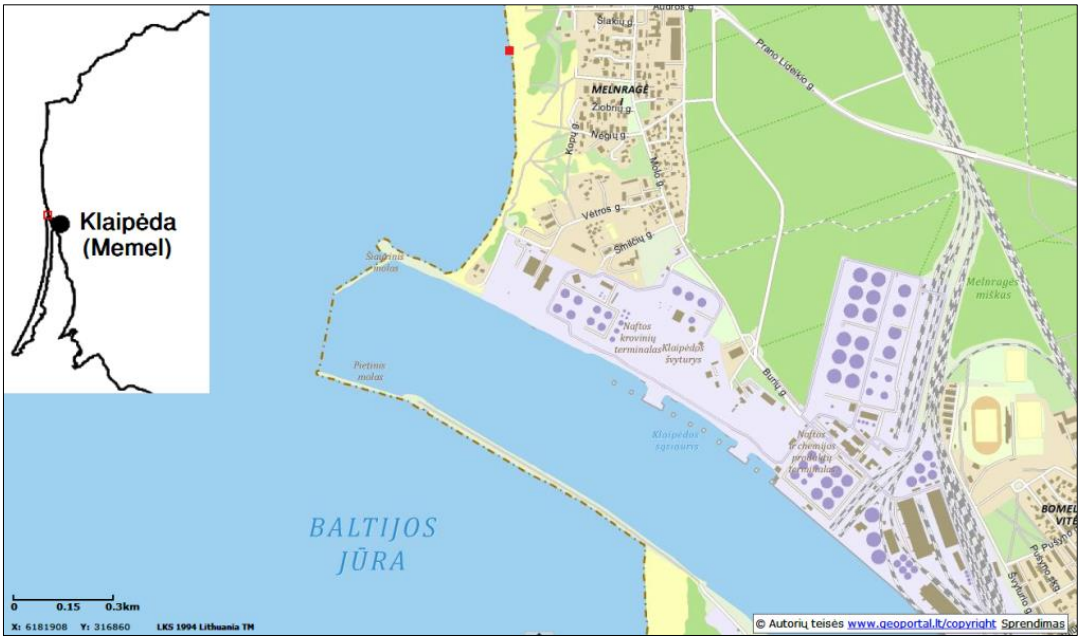


Figure 1. The finding site of the Melnragė wreck (marked by red square). Map source: https://www.geoportal.lt/map/

In Lithuanian sea coastline it is usual that parts of wrecks are washed ashore after heavy storms, however this time it was not the case. During the first days of November, 2014, weather conditions were mild with E–SE 2–5 m/s wind. The shore relief at the site allows a presumption of strong erosion caused by littoral current which uncovered the wreck fragment (Figure 2).

Figure 2. The Melnragė wreck fragment in its geographical surroundings 7 November 2014. The northern breakwater at right top. Note the surface of eroded shore on the left behind the two men. Photo by K. Perminas.

Erosion of the shoreline at the site has been scientifically confirmed through geological studies: "The investigations of shoreline fluctuation in the vicinity of Klaipėda port jetties (breakwaters – K.P.) after the reconstruction in 2002 year, when the northern jetties was lengthened by 205 m, the southern ones by 278 m showed intensification of shoreline erosion. The main reason was interception of litoral drift and the change of wave diffraction points. The formation of the bay at Melnragė is a result of reverse currents due to diffracted waves" [9]. The reconstruction of Klaipėda port breakwaters is not the only reason for strong erosive processes at the site. Natural powers, such as frequent storms, strong winds and currents also make a great impact on the whole shoreline north of Klaipėda, not excluding the finding site of the wreck fragment: "During the period of the months of January between 2008 and 2015, the 4 km strip of the Baltic Sea coast (Northern breakwater – Giruliai) decreased by 3.7075 ha, in the 0.7 km strip of the Ist Melnrage area coastline has moved more than 30 m inland. During the seven-year period (during the months of January between 2008 and 2015) erosive processes dominated in the Baltic Sea coast (from the Northern breakwater to Giruliai (i.e., including the site of the fragment – K.P.)): erosion process made up 83%, and accumulation process made up 17 % [8]. The site has always been geologically very dynamic. Retrospective analysis of coastline positions at Melnragė in different historical periods shows that the fragment of the wreck emerged on the shoreline that existed in 1870s. After overlaying reconstruction map of former shorelines [20] with Google Earth program the shoreline of 1878 at the wreck site spot coincides with the shoreline on 23 April 2014 and the shoreline on 6 June 2017 (Figure 3).

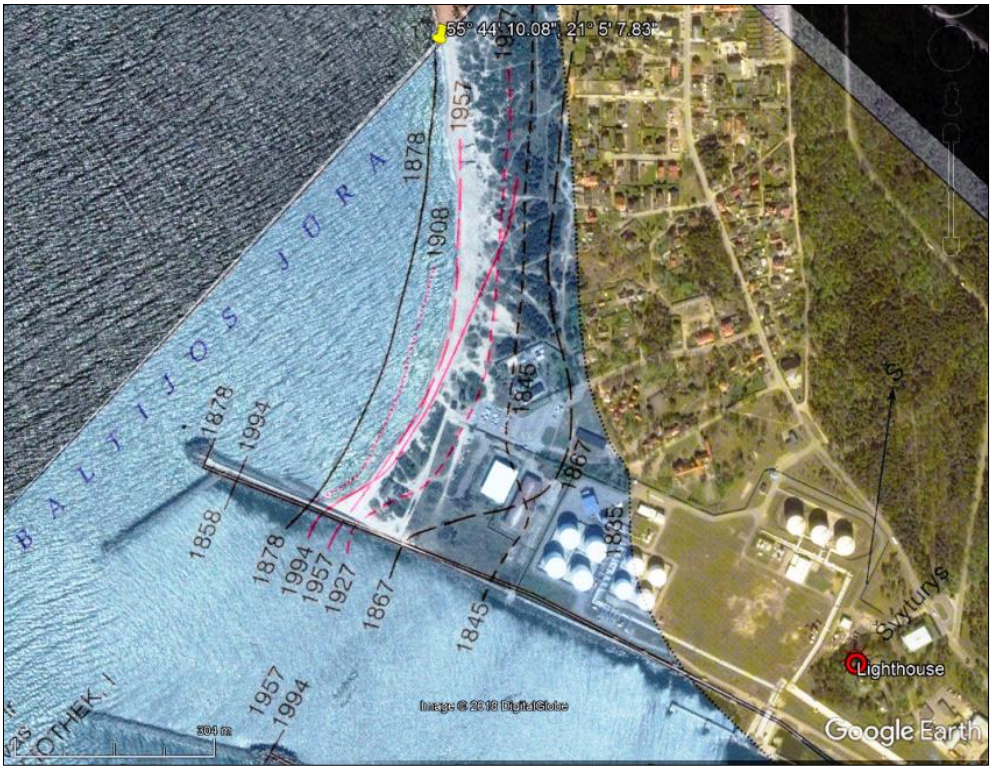


Figure 3. The finding site of the Melnragė wreck (marked with yellow pin) in the context of former shorelines at Melnragė concides with the shoreline of 1878. Google Earth 2014-04-23 satellite image overlayed with Melnragė shoreline reconstruction map compiled by R. Žaromskis [20].

One week later, 8 November 2014, the main part of the fragment was still in water, but on 13 November the greater part of it was on the shore due to change of wind to eastern direction and therefore regression of water level. Some parts of the fragment were overgrown with *Amphibalanus Improvisus*, which shows that some of the fragment had stayed above the bottom of the sea. Five days later, 13 November, works of salvaging the fragment started. Thus, 12 days passed from the emergence of the fragment until it was transported to the Lithuanian Sea Museum.

Remaining constructional features of the wreck

It is the aft part of a carvel-built ship with a part of starboard. Approximate size of the fragment – 7x8 m, although some planks are as long as 10–11 m. Remaining parts: keel (5.5 m long, 0.25–0.32 m wide, 0.35–0.4 m high) and false keel (5.5 m long, 0.25–0.32 m wide, 0.35 high), sternpost (5.3x0.25x0.43 m) with five iron gudgeons (the lowermost one has a piece of a broken pintle pin inside) for attaching the rudder stock (not extant), deadwood, framing (trapezium shaped base floor timbers, futtocks (5 pairs on the starboard side, 1.5–5 m long, 0.3–0.36 m wide, 0.2–0.26 m high), inner and outer planking (17 pieces, 2–11 m long, 19–25.5 cm wide (predominant width 23 cm and 25.5 cm), 4 cm, 4.5 cm, 5 cm, 6 cm, 7 cm and 8 cm thick). The planks were joined by tree- and ironnails with 3–3.5 diameter heads (3 cm predominates). The sternpost has several inscriptions in form of Roman numerals indicating the draught of the ship (see chapter below). The sternpost is attached to the false keel by a metal clamp. Some parts of the wreck‘s framing had been cut off in the past which shows that the wreck had been exposed for some period in the past, most probably after heavy storms. There were also several separate iron parts in the vicinity of the fragment. Nothing is known about the rest of the wreck (Figure 4).

Figure 4. The Melnragė wreck fragment *in situ* 13 November 2014. Photo by K. Perminas.

Dating

Dendrochronology

The fragment was dated using the dendrochronological, or tree-ring, method carried out by Dr. Rūtilė Pukienė (National Museum of Lithuania) in 2015 [15]. The total of 17 samples were taken from 5 planks and 12 ribs. Annual rings were measured with 0.1 mm accuracy using a stereomicroscope and Lintab (Rinntech) measuring system. 3 samples out of 17 were damaged while drilling and taking them out therefore they became unsuitable for analysis. 14 samples were analysed out of which 11 were successfully dated. The results showed strong correlation of oak tree-ring dimensions with oak material from Gdańsk (former Danzig) region; the oaks were felled during the season of autumn 1838 and spring 1839; 4 samples (ribs 5, 7, 8 and 15) had the outer underbark tree-ring which formed in 1838; chronological interval of tree growth: 1704–1838 (134 years). The timbers were impregnated with tar.

After being felled and sawed up, timbers had to be seasoned in order to prevent damage of wood. Air, or natural, seasoning of hard wood, such as oak, might take up minimum two or three years [6, 14, 17]. The building process of a medium size sailing ship in the 19th c. might last up to 3 years. Of course, the time range of building process might vary due to various circumstances – financing, number of labour force, intensity and efficiency of work, etc. Lacking any other additional information about the building of the Melnragė ship, we can only guess that the ship was built in 1840s or later.

The results of dendrochronological analysis correlate with the chronology of timber marks carved on one of the ribs of the fragment (see section “Timber marks“).

Scale of feet

As mentioned before, the extant part of the sternpost features a set of inscriptions – several Roman numerals with lines evidently indicating the draught of the ship (Figure 5). This feature is another kind of aid helping to define the chronology of the ship use.

Figure 5. The scale of feet carved on the sternpost of the Melnragė wreck fragment. Photo by K. Perminas.

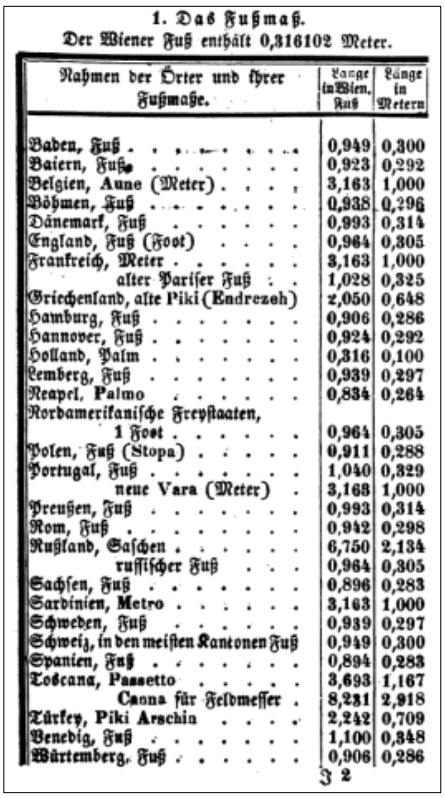
At this point it is important to discuss the use of water-, or draught-, line, in the 19th century. The United Kingdom, with the utmost effort of MP Samuel Plimsoll, was the first country to set the rule of marking load lines, today sometimes still called "Plimsoll line". The British Merchant Shipping Act of 1876 was the first official document that required to mark the load line on British merchant ships. This is the literal quotation of the Act: "*A scale of feet denoting her draught of water shall be marked on each side of her stem and of her stern-post in Roman capital letters or in figures, not less than six inches in length, the lower line of such letters or figures to coinside with the draught line denoted thereby. Such letters or figures shall be marked by being cut in and painted white or yellow on a dark ground, or in such other way as the Board of Trade may from time to time approve* [18].

In 1876 the Parliament of Great Britain officially put the Unseaworthy Ships Bill as law into force, therefore the date of 1876 is the initial chronological point making load lines for merchant British ships compulsory. It is noteworthy that requirement for foreign ships visiting British ports to mark the load line went into force in Great Britain in 1906 and the International Load Line Convention was adopted in 1930 [7, 24]. The above mentioned facts allow a presumption that the Melnragė ship wrecked not earlier than 1876. Otherwise it would be improbable that the owner of the ship would have voluntarily performed the load line marking which was not required prior 1876 and which would have required some extra work and time consumption taking measures and also extra financial expenses (hiring workers, purchasing

paint, etc.). On the basis of the presented historical material we can also make an assumption that the wreck fragment under discussion was a British merchant ship, or, at least, it was the property of a British merchant. Had it been a non-British ship, the owner would have been obliged to mark the draught scale in 1906 or later. Keeping in mind the discussed dendrochronological dates of the Melnragė wreck fragment (1838/1839) it is very unlikely that the ship would still be used in 1906 or later. Besides in the first half of the 20th c. wooden ships became *rarae aves* even in provincial ports since the tradition of wooden sailors was fast falling into decline as they were being intensively replaced by steamships (see section "Historical context").

Further a more detailed analysis of the scale of the Melnragė wreck fragment is presented. The numerals include VI–XI inclusive. Numeral XI is poorly visible due to strong abrasion of wood. There are no signs of numeral XII, but there are dim traces of lower graduation line of the supposed XII, which is the uppermost graduation line, carved 3.83 m above the bottom part of the false keel, and which indicates the maximum legal draught (i.e., 12 feet) of the ship. All the cuts are 1–2 mm deep. The distances between the graduation lines are (number(s) in brackets show(s) the thickness of lower graduation lines): VI–VII – 31 cm (1 cm); VII–VIII – 31.2–31.4 cm (1 cm); VIII–IX – 31.3–31.4 cm (0.8–1 cm); IX–X – 31.2–31.4 cm (0.9–1 cm); X–XI – 31–31.2 cm (1 cm); XI–XII – not shorter than 31 cm. As we can see, the two outside, minimum and maximum, numbers are 31 and 31.4 cm, which is an approximate length of a foot, a unit of length.

The lower graduation line of number VI is 188.6 cm from the very bottom part of the false keel, which should indicate the minimal draught of the ship. The position of VI foot mark allows us to calculate the length of 1 foot: 188.6 cm÷6 feet=31.4333...cm. Figure 6 shows lengths of a *foot* in different countries in the 19th c. [13].



1. Das Fußmaß.

Der Wiener Fuß enthält 0,316102 Meter.

Nahmen der Örter und ihrer Fußmaße.	Länge in Wien. Fuß	Länge in Metern
Baden, Fuß	0,949	0,300
Baiern, Fuß	0,923	0,292
Belgien, Aune (Meter)	3,163	1,000
Böhmen, Fuß	0,938	0,296
Dänemark, Fuß	0,993	0,314
England, Fuß (Foot)	0,964	0,305
Frankreich, Meter	3,163	1,000
alter Pariser Fuß	1,028	0,325
Griechenland, alte Piki (Endrezeh)	2,050	0,648
Hamburg, Fuß	0,906	0,286
Hannover, Fuß	0,924	0,292
Holland, Palm	0,316	0,100
Lemberg, Fuß	0,939	0,297
Neapel, Palmo	0,834	0,264
Nordamerikanische Freystaaten, 1 Foot	0,964	0,305
Polen, Fuß (Stopa)	0,911	0,288
Portugal, Fuß	1,040	0,329
neue Vara (Meter)	3,168	1,000
Preußen, Fuß	0,993	0,314
Rom, Fuß	0,942	0,298
Rußland, Saschen	6,750	2,134
russischer Fuß	0,964	0,305
Sachsen, Fuß	0,896	0,283
Sardinien, Metro	3,163	1,000
Schweden, Fuß	0,939	0,297
Schweiz, in den meisten Kantonen Fuß	0,949	0,300
Spanien, Fuß	0,894	0,283
Toscana, Passetto	3,693	1,167
Canna für Feldmesser	8,231	2,918
Türkey, Piki Arschin	2,242	0,709
Venedig, Fuß	1,100	0,348
Würtemberg, Fuß	0,906	0,286

J 2

Figure 6. Different foot lengths used in the 19th century [13].

Thus, the feet of the scale on the fragment, being 31.4 cm long, are, apparently, not English. A foot that was 31.4 cm long was used only in two countries in the 19th c. – Denmark and Prussia, the English foot being 0.3048 m. Gdańsk (Danzig), where the timber of the fragment originated, became part of Prussia in 1814 and since the establishment of German Customs Union in 1834 (germ. *Zollverein*, 1834–1919) the city and its adjacent territories belonged to this coalition which managed policies of economy and customs. Since 1871 Gdańsk (Danzig) became an integral part of German Empire. Hereby we might presume that the ship might have been built in Gdańsk (Danzig) or its vicinity and later it was registered as a British merchant ship. It is also possible that the primary owner of the ship might have been a

Prussian merchant who later sold the ship to a British merchant, who, following the requirement of The British Merchant Shipping Act, in 1876 was obliged to mark the scale of feet. There is also a possibility that the timber or at least some if it (see chapter "Timber marks") for building the ship had been exported from Gdańsk (Danzig) or its vicinity to England where the ship was later built.

Regarding the scale of the Melnragė wreck fragment, there is one incompatibility with the requirement of The Merchant Shipping Act: it states, that Roman capital letters or figures of the scale ought to be not less than six inches in length (i.e., more than 15 cm). Taking an inch as 1/12 of a foot (in our case – 31.4 cm), we get 2.61666... cm for 1 inch. Therefore, the numbers in case of the Melnragė wreck should be at least 15.66 cm in size, but they are not: the height of the numbers is as follows: VI – 13.5 cm; VII – 13.5 cm; VIII – 14 cm; IX – 13.7–14 cm; X – 13.8–14 cm; XI – ~14.5 cm. This does not work with the British foot either. There is no definite explanation for this error. We can only guess that the maker of the scale was not precise in following the rule. Yet, the other major requirements for marking the draught scale on British merchant ships were fulfilled.

Metric system?

Predominant width of graduation lines of the scale being 1 cm seems to represent the metric measurement system used. This can also be supported by the fact that the diameter of majority of nail heads in the fragment is exactly 3 cm (instead of close 1 inch – 2.61 cm (that is 1/12 of a Danish or Prussian foot (31.4 cm)). Some more examples of metric system can be noticed in the construction of the wreck fragment, e.g., diameters of holes of four gudgeons on the sternpost (from top downwards) are as follows: No. 1 – 5.5 cm, No. 2 – 5.5 cm, No. 3 has no opening, No. 4 – 6.5 cm and No. 5 – 6–6.5 cm. Round numbers of the metric system can also be seen in intervals between the gudgeons: interval between the first (uppermost) gudgeon and the second one is 95 cm, interval between the second gudgeon and the third one is 18 cm, interval between the third gudgeon and the fourth one is 60 cm, interval between the fourth gudgeon and the fifth (lowermost) one is 102 cm and the distance from the fifth gudgeon to the base of the sternpost is 93.5 cm. Metric system is also represented by sizes of outer planks – predominant width of planks is 23 and 25.5 cm, while thickness of planks, being 4, 4.5, 5, 6, 7 and 8 cm also shows exact metric dimensions. This short analysis shows a quite convincing use of metric system. German Empire signed the Metre Convention (Treaty of the Metre) in 1875 [22], therefore, theoretically, it is possible that the fragment features the use of metric system. This correlates with the last days of the use of the ship (see previous chapters). On the other hand considering that the trees for building the ship were felled in 1838 at latest it is not likely that metric system would have been applied in construction that early. It is more likely that the ship was built in 1870s. However in this case it would mean that timbers had to be seasoned for 30–40 years before they were used in building the ship, which is a rather long period.

Timber marks

There is another feature on the fragment that can help with preliminary dating of the ship. One of the ribs has 7 slanted carvings which are typical rase marks of commercial timber in the 19th century England, historically called "Baltic shipping marks" [3], (Figure 7).

Figure 7. Timber marks on the Melnragė wreck fragment. Photo by K. Perminas.

The earliest timber marks date back to the Middle Ages and their design was different from that of the 19th c. The first official publications of shipping marks appeared in 1870s, which showed the rising necessity to organize and systemize the variety of shipping marks. These publications were of catalogue type, being continuously updated due to constant appearance of new marks and brands. However, even in the second part of the 19th century, there were only initial attempts to do this: for example in 1880s there was still no official (state) requirement to mark timber in Memel (Klaipėda) [4].

Usually timber marks "... comprise numerals of the Arabic and Roman convention and simple letters (usually one or two)" [2]. The size of marks on the Melnragė wreck fragment ranges from 7.5 cm (No. 4) to 32 cm (No. 1). They are of a simple geometrical style, 4 of them (No. 1, 3, 4 and 7 (as seen from left to right)) being in shape of straight lines, mark No. 2 resembles a schematic digit "2" (digit "2" of similar style is known from 19tc c. England [3]) and marks No. 5 and 6, in shape of two brackets, stand for digit "zero" with shorter and more convex left bracket, which is untypical compared to timber marks of the 19–20th c. from Poland or Great Britain [2, 10]. If we turn the image (Figure 7) upside down, then we have a more typical writing of "0" – i.e., the left bracket is a bit longer and less convex than the right one. However in this case digit "2" loses its regular and recognizable shape. In current position marks No. 2 and 3 may constitute numeral "21".

The rightmost mark, No. 7, is approximately 95 cm from the end of the timber. The very piece of timber is 2.05 m long, 0.32–0.35 m wide and 0.26–0.3 m high (thick). It is difficult to conclude what exactly these marks mean in our case, however in general terms marks of this kind most often indicated the following characteristics: 1. Number of the balk; 2. Quality of timber; 3. Dimensions of the balk; 4. Owner of the balk [3].

There is one more separate mark on one of the outer planks. The mark has shape of a small cross inscribed on the cut off branch (Figure 8). The width of the cuts is 3 mm, the lengths of the bars are 3 and 4 cm. Most probably the mark was made to indicate the branch that had to be removed. This mark does not give any additional information.

Figure 8. A cross-shaped mark on a plank of the Melnragė wreck fragment. Photo by K. Perminas.

Historical context

As Carl Olof Cederlund, a Swedish maritime historian and archaeologist, states, "The archaeological remains of ships quite often are functionally and culturally connected with the geographical areas in which the ships were originally wrecked. In other words they are seldom originally "strange birds" in the environment in question, but often connected with it in many ways [5]". This idea of C. O. Cederlund

means that the Melnragė ship had also to have some relations between England and Prussia. These two, in this case, geographical locations, have been highlighted on the basis of the information obtained after analysis of the wreck fragment in the above chapters.

The historical context of the two regions in the 19th c. in terms of communication and economic relations is marked by intensive timber trade among ports of the Eastern Baltic and Great Britain. Memel (Klaipėda) had very strong positions in this trade. The cultural situation of the period, caused by extensive trade with England already in the beginning of the 19th c., can be well illustrated by impressions of Gottfried Peter Rauschnik (pseudonym Rosenwall) who in 1814 was travelling via Memel (Klaipėda) [16]: "If a Russian or German is going to England it would be useful for him to stay in Memel for some time, and here he would adapt to English customs and manners that at first look nasty for every non-English person. Residents of Memel who have business affairs abroad almost exclusively with the British are so fond of the customs of the island people that they mimic them on each occasion, which, of course, does not dispense with excess and causes laughter. Only English is spoken in houses of trade; eating, drinking, playing and entertaining is performed in English manner; and residents of Memel are as rude and unfriendly as the English" (translated by K.P.).

This is how the port of Memel is introduced in a contemporary geographical, statistical and historical dictionary, published in 1865 [12]: "MEMEL, a fortified sea-port town of the Prussian dom., being the most northerly of any size in the kingdom, and one of the principal shipping ports on the Baltic, prov. Prussia, gov. Konigsberg (...). Timber, particularly oak-plank and fir, of the very finest quality, is the great article of export from Memel; but corn, staves, flax and hemp, linseed for crushing, hides, bones, bristles, wool. &c., are also largely exported. Timber, hemp, and flax, and most other articles shipped from this, and, indeed, from most Baltic ports, are bracked, that is, they are inspected, and assorted into three qualities, according to their degrees of goodness, by persons appointed by government for the purpose. We have a pretty considerable intercourse with Memel, especially when there is a demand for foreign corn in England. (...).The present average export of timber is reckoned at about from 75,000 to 80,000 loads fir timber, 5,000 loads oak timber and plank, 700 mill-oak pipe-staves, and about 600,000 fir planks."

Table 1 shows situation of trade ships in Memel (Klaipėda) after 1838. The information is based on statistical data recorded by Johannes Sembritzki, a contemporary writer and historian of the period. The dominant trade in the 19th c. Memel (Klaipėda) was export trade. Exported goods were mainly timber, flax, hemp, linseed and grain. As we can see from the Table, annual numbers of arriving and departing ships in the port of Memel (Klaipėda) reached hundreds. The peak in years 1854–1855 was caused by the Crimean War (1853–1856) during which the port of Memel (Klaipėda) served as the only port of the Baltic where Russian goods could be exported and also imported [19]. Another peak of trade rose in 1870s when the total arriving and departing ships exceeded 1000. It is the period which correlates well with information on the Melnragė wreck obtained from our study (see previous chapters).

Under such intensive navigation ship accidents were an inevitable reality. On 14 September 1860, a fully rigged ship "Ann Louisa", built in Liverpool, wrecked near Memel [25]. in 1868 two more sailing ships perished near the northern breakwater [1]. On 10 November 1874, hurricane wind of south-western direction cast a three mast barque "Minerva" (built in 1854 in Memel) on the shore near the northern breakwater. The hull of the ship was broken in half. On 10 January 1874, schooner "Louise Laura" during towing was cast on a shallow nearby the northern breakwater and was also broken in two [1]. On 28 November 1897, in Melnragė, not faraway from the northern breakwater, Danish schooner "Ernst" was washed ashore. The crew was saved, but the ship was destroyed by waves. Due to lack of written sources and more detailed information no relations between the Melnragė wreck fragment and the above mentioned ship accidents can be traced.

The last sailing ship in Memel (Klaipėda) was built in 1876 [19] and during the two last decades of the 19th c. (1880–1900) the fleet of sailing ships of Memel (Klaipėda) consisted of only 28–40 vessels, in 1899 – there was only one sailing ship – barque "Express", but 28 steamships [11, 19]. Considering that Memel was a province of German Empire the transition from wooden ships to steamships in major ports of the Baltic took place more rapidly. Consequently, it is hard to believe that the ship under discussion operated in the first half of the 20th century.

The historical and economical context of the 19th c. that has been shortly presented, corresponds well in terms of geographical locations, economical relations and the special features of the wreck under discussion. Supposedly the Melnragė wreck fragment represents the period of intensive, or even the most intensive, trade between Memel (Klaipėda) and Great Britain in the second half of the 19th century.

Table 1. Numbers of ships in Memel (Klaipėda), 1842–1899 [19].

Year	*No. of ships arrived*	*No. of ships departed*
1842	544	- (not known)
1847	901	-
1848	504	-
1849	1074	1061
1850	848	854
1851	1104	1088
1854	1766	1570
1855	1600	1643
1856	883	862 (620 to Great Britain)
1857	-	788 (586 to Great Britain)
1858	-	808 (560 to Great Britain)
1859	-	808 (559 to Great Britain)
1860	-	964 (590 to Great Britain)
1864	1023	979
1870	965	933
1871	1173	1180
1872	1112	1174
1873	1195	1216
1874	1257	1301
1875	-	1205 (432 to Great Britain)
1889	-	1184 (250 to Great Britain)
1890	-	974
1891	1040	1102
1892	868	863
1893	790	802
1894	751	756
1895	714	723
1896	786	789
1897	762	792
1898	761	773 (156 to Great Britain)
1899	587	607

Conclusions

Appearance of the wreck fragment in Melnragė is most probably related to the prolongation of the northern breakwater of port of Klaipėda which is causing the erosion of the Melnragė shore. Therefore it is very likely to discover similar object in this area in the future.

The research has shown that the fragment of the wreck was a British sailing vessel built within 1840s–1870s of wood from Gdańsk (Danzig) region and was related to international trade between Great Britain and Prussia. With some precaution we can presume that two systems of measurements were applied on the ship – the traditional foot system for the scale of draught and modern metric system for construction of the ship. The type of the ship remains unclear.

Results of different analyses presented in the study show that the ship perished in 1876 or later running aground not far from the entrance to the port of Memel (Klaipėda).

Beyond a doubt it is a unique and significant historical source, telling about shipbuilding and ship construction, interregional trade routes, history of navigation in the 19th c., economical and cultural relations between Great Britain and Prussia, in particular – Memel (Klaipėda).

Any findings of this kind spread more light on the history of local, neighbouring and faraway regions and they should be treated as valuable historical source.

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