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THE DIDACTIC ASPECTS OF NON-TECHNICAL SKILLS ACQUISITION IN MARITIME ACADEMIES FOR FUTURE OFFICERS IN CHARGE OF NAVIGATIONAL WATCH

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Abstract
The fate of the ship and its crew are not the only things that depend on the level of competence of the person in charge of the ship. An officer in charge of navigational watch is also responsible for the normal and healthy existence and sustainability of the surrounding environment and ecosystems as well as the well-being of the population in the current region. A ship can be viewed as a vehicle of marine transportation of cargo, passengers and so on, as well as a tool of resource and in both cases it can be regarded as a valuable contributor to the economy. All this applies if normal operation of the vessel is ensured. It can only be done by an adequately trained officer in charge of navigational watch - not just one who is familiar with the structure of the ship, its navigation and other knowledge of such technical kind. The officer in charge of navigational watch has to also take full responsibility towards the people with whom he is associated. He must be able to work in a team environment, to critically assess any given situation, respond to it quickly and make the correct decisions in order to avoid not only possible damage to the ship itself or any environmental pollution that may occur, but also to simultaneously address other important issues that may arise. The aim of the article is to analyze some of the didactic aspects of acquiring non-technical skills for upcoming officers in charge of navigational watch during the process of their studies. The article analyzes the didactic theory in relation to the study process at a academy along with the results of empirical research which unveils the future officers in charge of navigational watch view on the necessary professional knowledge and skills, as well as to determine the throughout understanding of the need for any and all non-technical knowledge involved in the training process of the seafarers. During the empirical research the data is obtained from the content analysis of the study program "Maritime transport - Navigation" and a seperate survey of the 4th year students. The study results suggest that the assurance of the quality standard for the professional competence level of future officers in charge of navigational watch during the time of their studies should be viewed as a targeted system in which the planning of the study process, its management and quality monitoring is of essential matter. The study process needs to be improved in aspects such as course content and learning itself. This needs to be done in order to ensure the students' ability to independently carry out a qualitative analysis of a situation and act quick in accordance with good marine practice. It is possible to achieve this by integrating the acquisition of technical and non-technical knowledge and skills in the study process.
Keywords: *didactics, non-technical skills, officer in charge of navigational watch, knowledge and attitude.*

Introduction

In order to promote the development of a society which is capable of long-term sustainability, one can and should not wait for the outside world to adapt to his needs. Each person must learn to successfully reintegrate into society along with finding and understanding their place in it. Each person must also act and behave in a way to ensure that their surrounding environment is getting better and more in order. This is important, regardless of one's rank or specialty. The fate of the ship and its crew are not the only things that depend on the level of competence of officer in charge of navigational watch. In fact, he also takes responsibility for the sustainability of the surrounding environment and ecosystems as well as indirectly the well-being of the population in the current region. A ship can be viewed as a vehicle of marine transportation of cargo, passengers and so on, as well as a tool of resource. In both cases it can be regarded as a valuable contributor to the economy if normal operation of the vessel is ensured. It can only be done by an adequately trained officer in charge of navigational watch - not just one who is familiar with the structure of the ship, its navigation and other knowledge of such technical kind. The officer in

charge of navigational watch has to take full responsibility towards the people with whom he is associated with. He must be able to work in a team environment, critically assess any given situation and respond to it quickly by making the correct decisions in order to avoid possible damage to the ship itself or any environmental pollution that may occur. By doing all this he must be ready to simultaneously address other important issues that may arise.

In recent years, the total number of vessels in the world fleet has shown signs of constant growth. If the number of vessels in 2011 was 83283, then in 2013 there are 86484 vessels registered [9]. At the same time, from 2011 to 2013 the number of marine casualties and incidents has doubled, by reaching 2550 in year 2013 [4]. In 2012 and 2013 the number of shipping accidents caused by the loss of ship handling has increased – ship flooding and sinking (31%), collision (20%), fires and explosions (13%) [4]. An analysis of the causes of these accidents reveals that these are generally associated with some maritime specialist's inability to comprehend the situation. They should be able to critically assess it not only from the point of view of the particular events linked to the ship as a vehicle of transportation and its structure, operation and other technical knowledge, but also on from the perspective of human resource unity [4]. The future officer in charge of navigational watch has to acquire a set of certain skills and knowledge on how to handle non-standard situations and how to quickly and purposefully make decisions for a given task. No less of importance and value is a positive attitude towards work and the people with whom he is working together as a team. This means that a challenge has to be faced on how to ensure the ability of the officer in charge of navigational watch and his crew members to use technical and non-technical knowledge in correlation with each other.

The aim of the article is an analysis of some didactic aspects of acquiring non-technical skills for upcoming officers in charge of navigational watch during the process of their studies.

This article analyzes the didactic theory in close relation to the study process at a university along with the results of empirical research which unveils the future officers in charge of navigational watch view on the necessary professional knowledge and skills, as well as determines the throughout understanding of the need for any and all non-technical knowledge involved in the training process of the seafarers. During empirical research the data is obtained from the content analysis of the study program "Maritime transport - Navigation" and a separate survey of the 4th year students.

Results

As a result of analyzing the economic trends and progress tendencies of modern society it can be seen that from a labour market with vertical organization of work, in which there is a certain hierarchy – officer in charge of navigational watch and his subordinates, we move to a more horizontal organization. This is characterized by a close cooperation between all the people involved - working as a team. The quality of life on an individual is judged by the way one develops as a person, how he adapts to the changes in life in general and also to specific situations. Self-affirmation in a multicultural environment in relation to changes in society, the labour market, etc is highly valued. An individual must be prepared to be an expert in various fields during their lifetime, to handle non-standard situations, to resolve different conflicts and also to integrate common human and personal experience [5]. No less of importance are the skills of independent learning, cooperation and communication as well as the understanding of the world of labour, new economic developments and trends in terms of human resources and technology.

During the preparation of the future experts in different specialties of modern economy, the process of acquiring higher education to be exact, more and more attention is being paid to a study process in which the future specialist acquires specific skills according to his selected sectors of the economy along with communication skills, creative and critical thinking, decision-making and problem-solving attributes, organizational skills and willingness to take responsibility, the ability to work with given information. However, a student cannot achieve these skills if the study process is dominated by the lecture as a form of organizing the studies. Only if the teacher purposefully directs his teaching activities on to mutual co-operation with the students - together they identify the goal of the study, mutual responsibility and autonomy is present, which is based on the understanding of the human being as the highest valued asset in the process of active participation – only then any professional values can be formed during the process of studies [8].

Applying such holistic perspective on the occupation of their area of work that the future specialist is prepared for, it is possible to further analyze some processes of the world around us and the correlations that arise between these processes - learn to understand and analyze such happenings along with expressing an analytically evaluative attitude towards them.

Experience in the study process is formed through dialogue in which the learning occurs. This depends on the initial level of understanding and knowledge. Gaining experience is not possible without self-reflection, as well as the student's psychological well-being and a certain level of self-esteem. This means that the initial or primary experience becomes an important aspect of the learning process, on which basis new needs are formed, and a person distinguishes a personally meaningful learning objective for one's self, only to be achieved by learning. In cooperation with the teacher and other students the person can later on evaluate the acquired new or so called secondary experience. Of course, both of the above experiences mentioned above do not exist in parallel to each other but interact in communion [2].

Figure 1. New self-experience [2].

Only study process that becomes important to the student is one in which he is able to see the learning objective, the means to achieve it and the results of the work and to develop personality competitiveness. There had been four components identified in the structure of competitiveness:

   # component of personality orientation including values, attitudes, needs and motives, interests, objectives and aims for one's life, etc.;

   # component of self-conception (comprises the personality's self-conception including self-esteem, the significance of self-respect, self-confidence, reflection and self-assessment);

   # component of self-regulation (comprises the component of volition; the mechanism and functions for the regulation of behavior including the functions for the regulation of emotions; personality's emotional, intellectual and behavioral flexibility);

   # component of competences (types of competences, structural elements of competences, diverse contexts of competence evaluation; levels of competences) [7].

   To find out how exactly the future officers in charge of navigational watch are trained an content analysis of the study process was carried out. During the analysis of the study courses, it was important to find out how the course descriptions single out the expected result of the studies, what proportion is achieved between different knowledge and skills, as well as how the students treat not just the knowledge and skills set they have acquired, but also how they regard themselves and their personal experiences. The results of the empirical study show that, for example, the objective of the course "Communication Organization and GMDSS" is to acquire knowledge and practical skills in use of the international code of signals, radio communication with a radiotelephone, DSC equipment, satellite communication systems and also to prepare for a *"General Operator Certificate" (GOC)* exam, passing which results in a valid GMDSS certificate for the student. The description of the result one achieves once the study course is fully carried out is dominated by knowledge both on the international phonetic alphabets and on radio theory along with marine radio communication equipment design, operation, safety measures and other issues of undoubted importance. It is also mentioned that the required practical skills for radiotelephone use with the GMDSS manual and other radio equipment documentation is to be achieved as well as the ability to speak correctly and use the appropriate vocabulary. In context to this the students also need knowledge of standard terminology and phrases in the English language. To acquire the skills previously listed, the future officer in charge of navigational watch must be able to critically read, understand the information contained in the text and put it into practice - listen to team members and be able to discuss and, if necessary, put motive into their argumentation.

   To judge whether the information included in the courses for students who pursue a ship navigating profession a survey of students was carried out. The analysis of the survey findings reveals that the respondents indicate as the most important courses only those which are directly related to the profession

they have chosen, for example, mentioning such courses as "Watch keeping" because it includes learning about the International Regulations for Preventing Collisions at Sea (COLREG). Also mentioned are "Electronic Chart Display and Information System (ECDIS) Operation", "Communication Organization and GMDSS (Global Maritime Distress and Safety System)", as these courses use simulators to help you learn the skills to identify ships at sea or other water holds and analyze what specific actions can be taken in order to avoid collision. According to the respondent's answers, the above-mentioned study course content also includes issues such as the use of specific equipment. At the same time, these courses do not master the use of non-technical skills to assess the situation, nor the use of human resources and appropriate decision making. This is due to the fact that the students have checked the officers in charge of navigational watch direct responsibilities during the time of their internship at sea such as the navigation of the vessel itself and other main tasks. The students have gained practical experience on the navigation and communication equipment, but they have not been given the opportunity to understand what additional knowledge and skills are used to quickly carry out their duties in accordance with good marine practice, especially in situations of emergency. Students who have already been through their internship at sea have been forced to gain this experience only by performing their particular duties on ships, besides they often do not acknowledge the quality of the experience acquired.

Since professional knowledge and skills are closely related to how the individual is able to think analytically, actively participate in decision-making and solving of problems [1] then, according to the empirical evidence obtained by analyzing the content of the study courses and results of the student survey, the course content would benefit by addressing such issues as teaching the students to analyze different situations and make independent decisions in accordance with good marine practice.

Nowadays the quality of professional education is not based only on exercises that target the acquisition of specific information and the ability to use it in practice, but also those involving the development of an intellectually advanced and analytically minded personality that is able to see the need to act, consciously perform their activities, constantly be ready to increase their individual professional experience and be aware of its identity by confirming it in an intercultural dialogue [1].

Content analysis of the study courses and results of the student survey suggest that the future officer in charge of navigational watch preparation process is dominated by methods that encourage reproductive or explanatory illustrative work. This of course allows the student to learn and explain a specific action or the nature of a process, but does not provide a chance to acquire any non-technical skills that would go along with the knowledge on ship design or operation. Students are not guaranteed non-technical knowledge and skill acquisition to use in accordance with their perception of the subject. They are not focused on in-depth analysis of any situation, but limit themselves to brief analysis of the situation. This is more of a formal action to be taken, not a responsible approach to acquiring the chosen profession.

The empirical results of the study suggest that the upcoming officers in charge of navigational watch do not understand these two concepts: learning as a purposeful process - human activity, which aims to transform oneself. The second – learning as a specific development process for knowledge and skills which is necessary to take part in a practical activity [10].

Reproductive and explanatory illustrative cognitive activity contributes only to receiving information. Learning by doing things yourself can become a tool for the development of different intellectual, emotional and social abilities along with the learning the skill of self-assessment [6]. It is true that in some situations it is important for the student to learn the concrete facts, formulas, or other information. However, it should not become dominant, since it discourages the analytical evaluation of any given information and does not allow to create new knowledge by the analysis, synthesis, comparison or evaluation process with past experiences linked to the new information.

It is important for any previously acquired experience to occur in new context during the preparation process of the future officer in charge of navigational watch. This succeeds in not only a more sustainable learning outcome, but at the same time also helps to acquire skills in self-regulated work activities. It makes it necessary to use different cognitive and social performance techniques during study the process. No less important is the student's inner freedom to schedule their own time to complete the given tasks, feel well through-out the whole learning process and also the acknowledging the responsibility for the results of their work [6].

It is considered that the most appropriate learning methods used during the study are individual tasks combined with group work, because of all the respondents, 77% say that it is only if the student himself is able to cope with the given task he is then pleased with the progress made. This goes along with the need to learn the appropriate skills to work in a team environment and ensure safe navigation. An important skill to be learned is the ability to manage a process through-out all of its stages, bringing up the staff self-confidence and team building. The future officer in charge of navigational watch also needs to acquire the

skill to use the available resources in a rational manner and to carry out any board duties assigned by a superior officer in accordance with good marine practice.

Conclusions

Applying a holistic perspective on the occupation itself and the area of work that the future specialist is prepared for, it is possible to further analyze some processes of the world around us and the correlations that arise between these processes. We can learn to understand and analyze such happenings along with expressing an analytically evaluative attitude towards them.

The quality standard for the professional competence level of future officers in charge of navigational watch during the time of their studies should be viewed as a targeted system in which the planning of the study process, its management and quality monitoring is essential.

The study process needs to be improved in aspects such as course content and learning itself. This needs to be done in order to ensure the students' ability to independently carry out a qualitative analysis of a situation and immediately act in accordance with good marine practice. This can be achieved by integrating the acquisition of technical and non-technical knowledge and skills in the study process.

The Study process should be updated with such forms of social work as work in pairs or groups. This is important so that the future officers in charge of navigational watch would conceive the need to assess any information in analytical matter, see causal relations, and link their previous experience with the newly gained information in a matter of analysis, synthesis, comparison or evaluation process so that it becomes personally meaningful to the student himself.

It is important for a future officer in charge of navigational watch to acquire collective management skills, resources management skills and the ability to qualitatively carry out specific tasks assigned to him.

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THE MAIN ENGINE REMOTE CONTROL SYSTEM SIMULATOR

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Abstract
The paper describes the simulation of remote control main engine with the engine telegraph. The simulator has a block structure and consists of the following units - the control unit, the engine telegraph unit, the main engine control unit, the signalling unit and power supply unit. This design allows the display of certain and joint works and management of the engine telegraph and the main engine and work with various control console. Signalling unit reflects the work of the simulator in different modes and is made on the LED - diodes. All circuit blocks are made with operational amplifiers. Controlling of the process in the main engine control unit by means of an oscilloscope and then outputting the data to monitor the PC. The simulator is used for the study subjects: "The Main Engine Remote Control System".
Keywords: *simulator, operational amplifiers, regulator, main engine, control system.*

Introduction

The main purpose of the main engine control system is to maintain the specified operation of the engine by means of speed control when the loads on the propeller shaft changes. The control system works in conjunction with the engine telegraph, which comes with the management team. The principle of operation of the engine telegraph is based to compare the control commands, and the work of the engine management system to compare the target and actual speeds. To implement such systems are used as a circuit with operational amplifiers and the PLC components [6, 7]. Selection of the basic elements depends on the number and complexity of the functions performed. Based on the analysis of existing control systems selected and developed a scheme for simulation based on operational amplifiers. The following examines a remote control system block diagram showing the order in which the signal from the telegraph to the team heading into the actuator, resulting in regulating the fuel supply. Telegraph circuitry designed to receive a signal which is fed to the speed controller equipment, alarm systems and indicator schemes. The practical part of the stand is carried out only signal shaping for speed controller, alarm and display functions. Same speed regulating circuit practical part is not covered.

Modern main engine telegraph systems can be used for operational amplifiers. Such systems are based on an operational amplifier circuit that operates in differential mode [8, 9]. Telegraph commands are used for feeding conventional lever-type handle, wherein various modifications. State of the art telegraph, conventional lever handle is replaced by push-button switches. Team most schemes are passed changing the potentiometer resistance. If the lever is set down in the navigation bridge team, operational amplifier input is no longer in balance. The amplifier output voltage appears which includes sound and light alarm. Figure 1 shows the main engine telegraph schematic diagram.
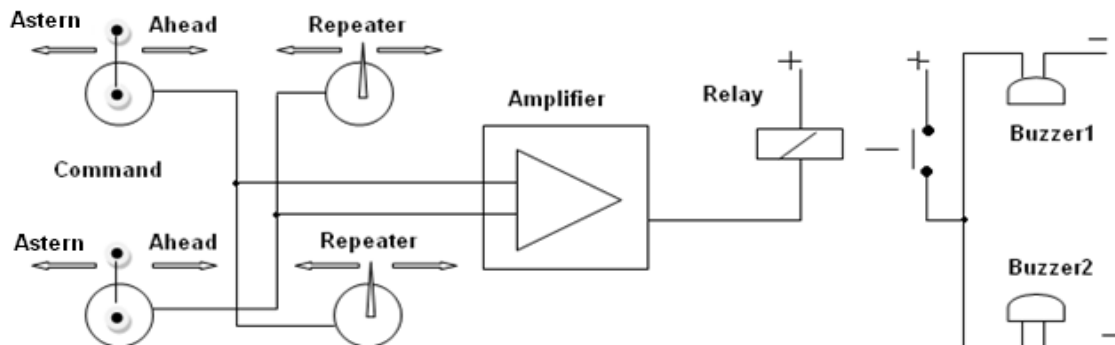
Figure 1. The main engine telegraph schematic diagram

The main engine telegraph simulator block scheme

In the block scheme of the main engine telegraph simulator the commands (**COM1**) and (**COM2**) applied differential amplifier (**DIFF**). Block (**DIFF**) compares the two input signals and the amplifier appears output voltage [4]. The signal for a given speed command can be fed from the bridge (**COM1**) or from the central post in the engine room (**COM2**). Management positions are subject to change with the help of the relay unit (**REL1**). All control commands are displayed on the display unit (**IND1**) and (**IND2**). To reduce interference commands signals pass through proportional amplifier filters (**P1**) and (**P2**).

The output voltage polarity depends on the choice of the direction motion of the vessel. Then signal is fed to a double-comparator block (**COMP1**) and (COMP2), who with the help of the stabilization block (**STAB**) a voltage is applied to the relay (**REL2**). Relay (**REL2**) connect a flashing sound alarm (**BUZZ**) and light alarm signal (**SIGN**) via multivibrator block (**MV**). Alarm signals stops when the operator on the remote command (**COM2**) executes a command from the (**COM1**). The main engine telegraph block scheme is shown in Figure 2.
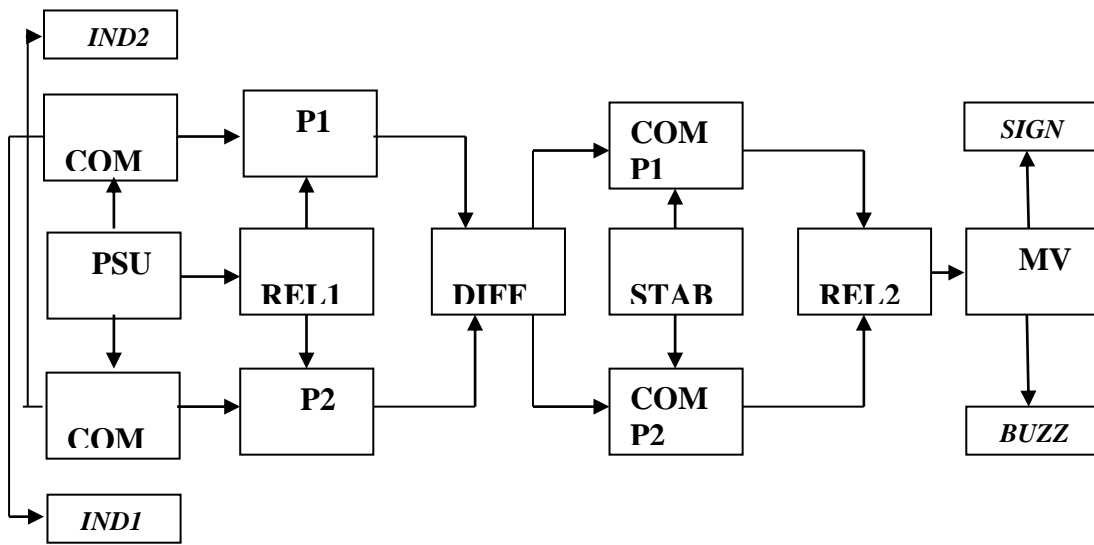
Figure 2. The main engine telegraph simulator block scheme

The different commands of main engine telegraph are generated by a voltage divider, which is directly controlled by packet switches lever – command blocks (**COM1, COM2**). Packet switches consists of two contact group. The first   contacts group is connected to the blocks (**P1**) and (**P2**), a second contacts group is connected to the block (**IND1**) and (**IND2**). Each of the control positions equipped with **LED** diodes. The relationship between the control command and the voltage divider output signal is shown in Figure 3.
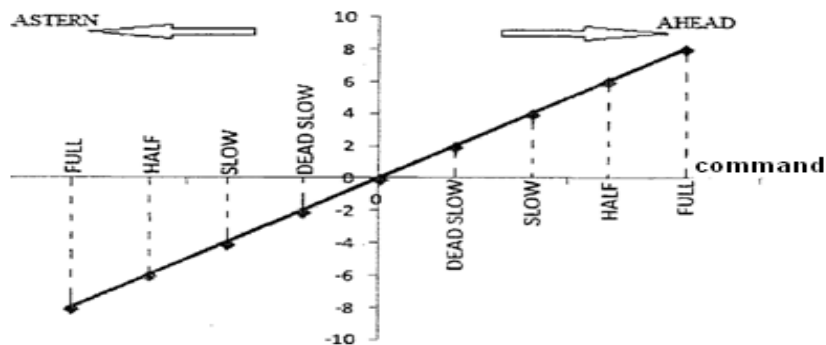
Figure 3. The relationship between the command and the output voltage signal

For the stable operation of the control units the interval between controls command is 2V. The polarity of the signal depends on the direction of the vessel.

Astern Full -8 V   **Ahead**   Full +8V
               Half -6V   Half +6 V
               Slow -4V   Slow +4 V
               Dead Slow -2V   STOP 0V   Dead Slow +2 V

With a voltage divider can also be obtained in addition to the values of +10 V and -10 V, where the model would be supplemented with additional items, such as navigational Full (Maximum navigation course) as well as Emergency Astern (Emergency ride back)[1].

The main engine remote control system simulator block scheme

The control circuit operation of the main engine (Figure 4.) can be used two ways – using command blocks(**COM1),** or through block (**COM1**) and load simulation block (**LOAD**). In the first case, the command is sent directly to the amplifier (**SUM2**) and on to (**PID**) regulator. The quality of the transition process is determined by the settings limited parameters of the regulator block (**LIM3**)   In the second case the control signal varies depending on the load on the shaft. In this case, the control process proceeds over several steps.

In the first stage output command of the amplifier (**SUM1**) set a new value depending on the block (**LOAD**) position (**min\ max. -2V, +2V).** Then signal fed to (**PI 1**) regulator, which together with amplifier (**DIFF**) simulates fuel valve work. At the output of the amplifier (**DIFF**) the alarm unit (**FUEL ind**) shows an increase or decrease in the fuel supply (**max \ min**). The output signal from the (**DIFF**) enters the second (**PI 2**) regulator that simulates the operation of the sensor turns. At the output of the (**PI 2**) the alarm unit (**SENS ind.**) shows an increase or decrease turn of the motor shaft (**max \ min**). The output signal from the (**PI 2**) goes to (**SUM2**), which simulates feedback. The output signal from the (**SUM2**) arrives at the (**PID**) regulators, which restores the specified turn of the motor shaft [4, 9].

In the scheme are settings the control-limiters blocks, which set limits regulatory process (**LIM1, LIM2, LIM3**). Turns of the main engine simulates the (**MOTOR**) via amplifier (**AMP**). The sequence of processes can be seen on the **PC** display unit and the oscilloscope. Power voltage supply block (**PSU**) - **DC12V, DC24V.**
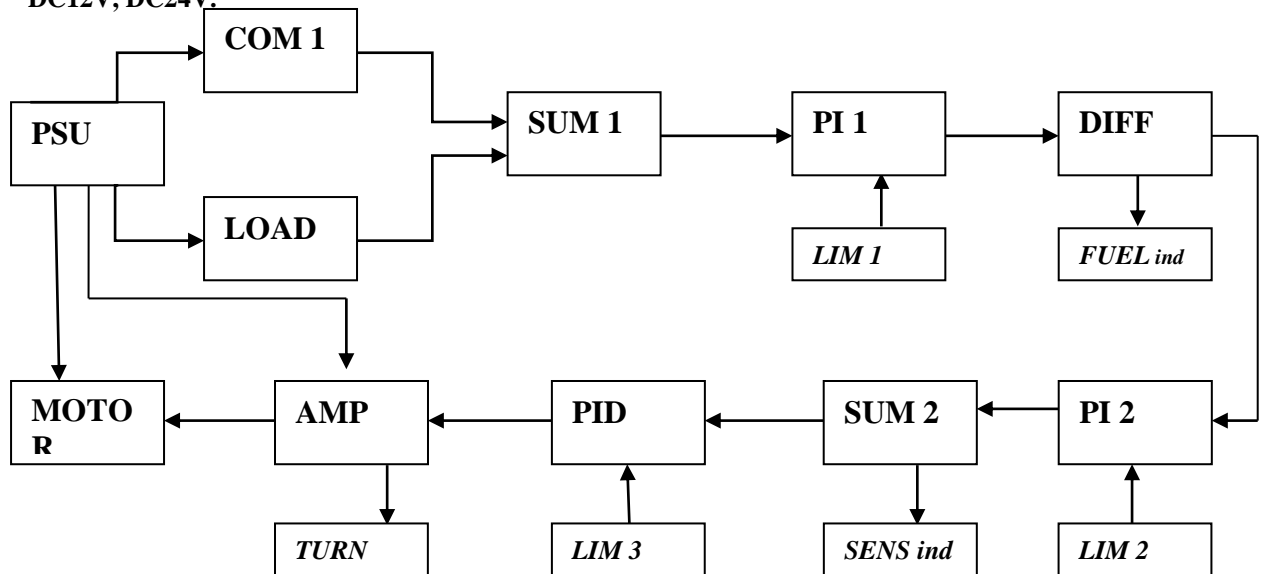
Figure 4. The main engine remote control system block scheme

The equations system and load diagram of the regulatory process

Operation control circuit can be described by the following equations.
In the first case: Command signal $U_n \neq 0$, load signal on the motor shaft $\Delta U = 0$.

$$U_{sum1} = U_1 = kU_n \tag{1}$$

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$$U_{pi1} = U_2 = kU_1 + \frac{1}{T_{i1}} \cdot U_1 \cdot t \tag{2}$$

$$U_{dif} = U_3 = k(U_2 - U_n) = 0 \tag{3}$$

$$U_{pi2} = U_4 = kU_3 + \frac{1}{T_{i2}} \cdot U_3 \cdot t = 0 \tag{4}$$

$$U_{sum2} = U_5 = kU_4 + U_n = U_n \tag{5}$$

$$U_{pid} = U_6 = kU_5 + \frac{1}{T_{i3}} \cdot U_5 \cdot t + T_{d3} \cdot U_5 \cdot \frac{1}{t} \tag{6}$$

In the second case: Command signal $U_n \neq 0$, load signal on the motor shaft $\Delta U \neq 0$.

$$U_1 = k(U_n \pm \Delta U) = ka \tag{7}$$

$$U_2 = kU_1 + \frac{1}{T_{i1}}U_1 \cdot t = ka + \frac{1}{T_{i1}}a \cdot t \tag{8}$$

$$U_3 = k(U_2 - U_n) = k\Delta U + \frac{1}{T_{i1}}a \cdot t \neq 0 \tag{9}$$

$$U_4 = kU_3 + \frac{1}{T_{i2}} \cdot U_3 \cdot t = k\Delta U + \frac{1}{T_{i1}}a \cdot t + \frac{1}{T_{i2}}\left(k\Delta U + \frac{1}{T_{i1}}a \cdot t\right) \cdot t \tag{10}$$

$$U_5 = U_n + kU_4 = U_n + k\Delta U + \frac{1}{T_{i1}}a \cdot t + \frac{1}{T_{i2}}(k\Delta U + \frac{1}{T_{i1}}a \cdot t) \cdot t \tag{11}$$

$$U_6 = kU_5 + \frac{1}{T_{i3}}U_5 t + T_{d1}U_5 \cdot \frac{1}{t} \tag{12}$$

Where:

k — the gain coefficient

T_{i1}, T_{i2}, T_{i3} — integral time constants

T_{d3} — differential time constant

U_n — command signal

$a = (U_n \pm \Delta U)$ — command and load signal

Diagram of the regulatory process via (**LOAD)** unit shown in Figure 5. Equations and diagram shows the signal flow after the command block (COM 1) or when the load changed on the motor shaft. The outputs of the blocks PI 1, PI 2 and PID simulate the position of the fuel rack, PID feedback speed sensor and turnover of the main engine. The simulator is used in the educational process in the study of control systems the main engine.
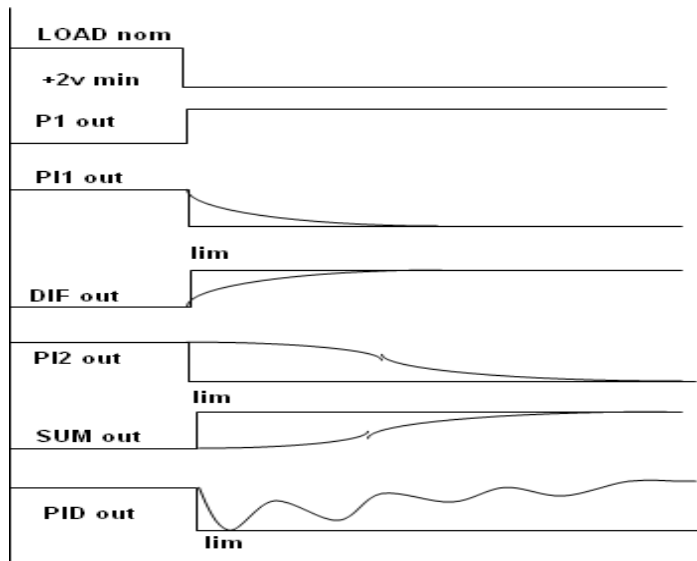
Figure 5. Diagram of the regulatory process

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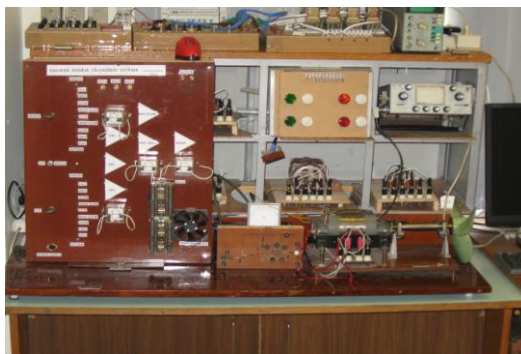
Figure 6. The main engine remote control system simulator

Conclusions

The simulator is used in the educational process in the study of control systems the main engine.

The simulator is used for the study subject "The main engine remote control system".

Controlling of the process in the main engine control unit by means of an oscilloscope and then outputting the data to monitor the PC.

The work performed in the laboratory of ship automation. Further work on the simulator continues.

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FINANCIAL STABILITY ASSESSMENT OF LAND TRANSPORT SERVICES AT BALTIC TRUCKING LOGISTICS, JSC

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Abstract
At the current moment, as long as the world's economic sanctions continue to be carried out against Russia and vice versa, the land freight transport market is feeling a reduction in quantities and orders on lines between Russia and the European Union. The carriers that are working on these lines have been forced to switch to other, more favourable markets, otherwise they are going to lose financial stability. Baltic Trucking Logistics, JSC, a freight transportation service by land transport, is the object of the research. The company focuses its main activity in Western Europe. Although the company is not oriented towards the Russian market, closing it would increase the possibility that companies that were working mostly with the Russian market would switch to other lines in the Central and/or Western European market. In that case, this would directly decrease the orders to the company itself, and this would affect the company's financial stability. The main goal of the research is to find out methods to preserve the company's financial stability.
Keywords: *economic sanctions, transport market, financial stability*

Introduction

It becomes complicated for logistic companies to survive in today's constantly changing market environment. The increasing competition, spread of information and development of new technologies force the companies to constantly examine their financial situation, because only then they can make the right financial decisions, allowing for improvement. Each solution has a positive or negative impact on a company's financial results and its financial position.

The expansion of business opportunities at the Baltic Trucking Logistics, JSC transport company are analysed in this research by taking into account a financial stability indicator. The company operates in the Western European transport market and has 40 of its own trucks, most of them no older than 5 years. Thus, it is relevant for the company to effectively use its assets, compete in the market and make a profit, as is the goal for every existing business company. The competition in the transport market is constantly growing, and because of the collapse of the transport market in Russia, most companies focus their activities on the Western European market. It is not enough to provide high-quality services; the activities need to be constantly developed, and the fleet of trucks must be updated and improved. The problem of a company's financial stability arises there.

The object of the research is the economic activity of Baltic Trucking Logistics, JSC. The analysed transport company provides freight services in Central and Western Europe.

The purpose of the research is to assess the financial stability of Baltic Trucking Logistics, JSC.

The objectives of the study:

1. To describe the theoretical development and financial stability interface of land freight transport services

2. To analyse the financial stability of Baltic Trucking Logistics, JSC in 2009-2013.

3. To assess the development and financial stability interface of the transport company.

Problematic topics: What is the impact of the company's maintenance of its financial stability on its enterprise development? What is the impact of transport enterprise development on the company's financial stability?

Research methods: the analysis of scientific literature, statistical analysis (chains, changes in relative sizes), financial analysis (Debt ratio factor, equity ratio, leverage ratio), graphical analysis, logographic.

This research is intended to assess the transport company's financial condition by an analysis of changes in financial stability, and provide enterprise development opportunities linking it to financial stability.

Theoretical interface of land freight transport services development and financial stability

Transport (*lot. transporto* - to carry) is the economic sector covering freight and passenger transportation by various roads and by a variety of different means. On the basis of EU transport policy, all European transport enterprises are provided with equal competitive conditions and the full range of markets are open [2]. Emerging problems are solved jointly by taking into account the needs of all countries, and the opportunity of the European transport sector to compete in the rapidly evolving global market is the desired result.

Vehicles, infrastructure, and management are the main components forming the transport system [9]. The system improves the efficiency of reciprocity and reduces transport costs; the number of vehicles can be reduced by rapid redistribution of the various means of transport (Figure 1).
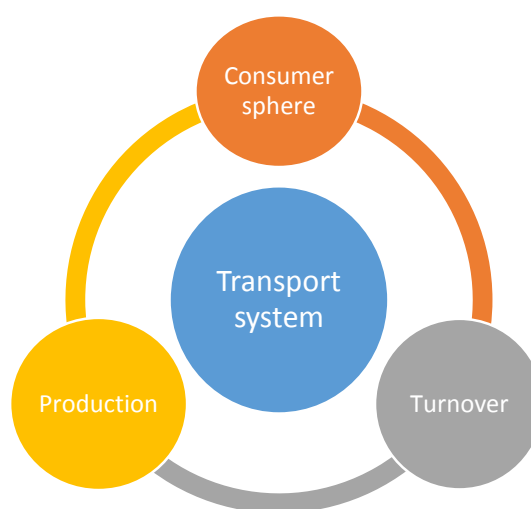
Figure 1. Functions of transport system [13]

In the sphere of production, transport supplies the means of production, products and employees. Finished goods are transported between producers and consumers according the territorial division of labour in the sphere of turnover. Trucks and vans are used for transport in the consumer sphere, and they are also used at supermarkets and shops [12].

Land transport remains the main transport for carrying goods not only in Lithuania, but all over the world (Figure 2). In the latter period, maritime transport has taken up an increasing share of the transport market, but air transport services have remained unpopular because of their higher cost compared to road and rail transport.
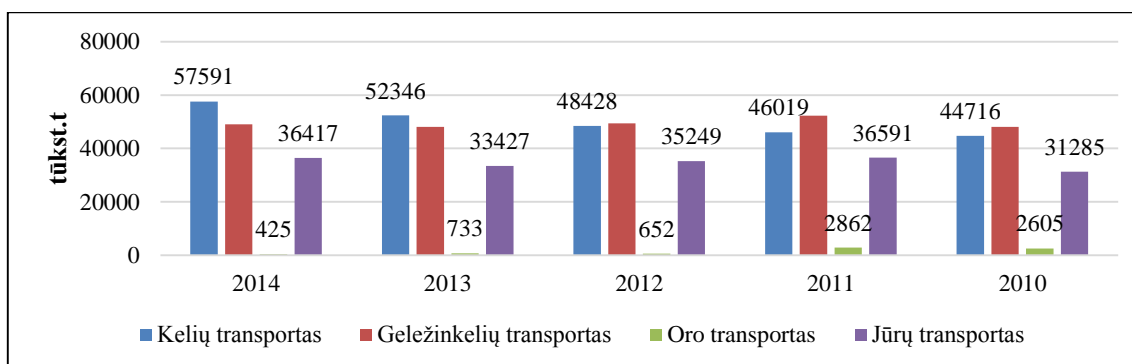
Figure 2. Land, rail, air and sea freight transport dynamics in Lithuania in 2010 – 2014 [3]

Compatibility of price and time is the essence of land transport popularity. Thanks to this, transport cargo can be quickly, comfortably and safely transported, and this is especially important if the load has a term of validity. Although the carriage of goods by sea takes a long time, the largest amount of freight in the world is transported by maritime transport. [16]

The transport system includes: land transport, water transport, air transport and pipelines. [13]. All this variety of transport forms the transport system market of all companies or countries, and the persons employed within the system create a national product. Land transport is closely related to water transport, and together, these transport methods complement each other. Water transport is capable of carrying cargo from port to port, and once in port, the cargo can be taken by land transport. Such cooperation combines maritime transport with consumers.

Transportation of ordinary and dangerous freight, warehousing, customs brokerage, multimodal transportation, veterinary services, and oversized cargo transportation are the services provided by land transportation companies. We need to find out the ways and indicators according to which a company's financial stability can be calculated after clarifying the composition of the transport system, and setting its type.

Financial stability analysis is the research of closely related and interdependent processes and phenomena [8]. Solvency and financial stability factors will help to calculate a company's financial stability. In calculating them we shall determine the criteria by which it will be possible to improve the management of the subject under research and increase the profitability and stability of the company. The financial stability will be analysed by taking into account the following assessment factors: debt ratio, property factor and leverage.

It is necessary to allocate resources and use them in such a way that a company remains solvent and a profit can be earned under the risk of normal business conditions in order to develop the company's activities, and increase the number and diversity of services. In most cases, companies have two sources for funding their activities, i.e., the owners (equity) and outside capital. Companies that own property in the form of equity are at higher risk in performing their activities than those carrying on their activities at the expense of borrowed capital. This situation occurs because the lenders have the right of pre-emption in relation to the shareholders. The interest must be paid and the debt repaid according to strict deadlines, and the resources must be allocated fairly using loan capital. The financial stability assessment indicators used to determine whether a company is solvent and works profitably will be used below in Table 1.

Table 1. Financial stability assessment indicators [8]

No.	Index	Equation	In the equation	Normative value	Purpose
1.	Debt ratio factor	$K = \dfrac{K_n + IS_{ilg.}}{T}$	K_n – equity capital, € $IS_{ilg.}$ – long-term liabilities, € T – capital, €	appropriate ≈ 0.8 to 0.9	Part of the assets, financed by long-term sources of finance
2.	Equity ratio	$F = \dfrac{IS}{T}$	IS – liabilities, € T – capital, €	≤0.4	Shows the ratio of borrowed to owned resources
3.	Leverage ratio	$G = \dfrac{Gs}{TS}$	G_s – receivables, € TS – current liabilities, €	≤1	Shows the level of short-term liabilities coverage

A company's financial stability depends on a wide range of macro-economic factors that have direct or immediate impact on the stability of the company [17]. This summarizes the status of all the company's economic conditions that determine a company's ability to operate and expand. The concept of financial stability indicates that the trends of all the indicators must be analysed in all cases. Business owners and managers, in order to achieve the highest possible financial results, must consider business continuity, i.e., whether the company will remain stable, will it withstand competition in the market, or whether its financial results will remain unchanged. Business Development and continuity are important not only for the company itself, but also for its affiliated entities, such as: investors, shareholders, banks, suppliers and other participants in the business. Therefore, each company has to develop its own rating system to evaluate the stability and continuity of its activities. [9]

It is well known in practice that there is no business that does not involve a number of risks, even in a profitably operating company. Wrong decisions can affect the company's operations and future plans. In order to ensure the continuity of its activities, it is necessary to examine its potential for development,

as an evaluation of the likelihood of bankruptcy is not enough. Corporate executives often make risky decisions in an effort to increase profits. [14]

In order for a company to become financially stable and competitive, it is necessary to create a financial control system to ensure the profitability of transactions, as well as reducing the dependence on external sources of funding. [10]

Development, which begins with a company's investment in the restructuring of the company's management structure, is one of the main ways for a company to remain competitive in the field of business [11]. Then, the factors affecting a company's development process appear.
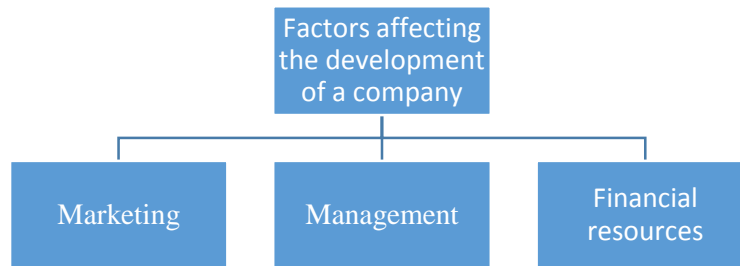
Figure 3. Factors affecting the development of a company [11]

Planning and coordination of these three key factors during all stages of development are the essential problems faced during the process. However, it may lead to a false image of a company's development, or the conclusion that there will be no obstacles or hazards during the course of the development of a company. There are limits in the development process of a company, beyond which a company may enter into a complex situation [15], for example, a situation where a company creates immense development plans and their implementation requires significantly more resources than are available to the company.

Thus, the functioning of a transport system is important for each company, but in order to facilitate its development, we need to align the three most important factors. In this case, a financial analysis helps a company identify its weaknesses. It is necessary to calculate the coefficients of solvency and financial stability, which will show whether a company carries out its activities properly, and that there is scope for the development of services in order to determine the financial stability of a company more exactly.

Criteria analysis for the development of transport services at Baltic Trucking Logistics, JSC

Baltic Trucking Logistics, JSC is a transport company that was established in 2008. Its aim is to provide transport services in Europe. The company hires drivers with many years of experience and an ADR license (European Agreement concerning the International Carriage of Dangerous Goods by Road). Such requirements for the employees of the company ensure the client's requirements for the transportation of many types of cargoes, while the ADR license allows for the transportation of dangerous goods throughout Europe. However, the company is not satisfied with the current market conditions and would like to expand its services (Table 2, Figure 3).

Table 2. Services provided by transport companies

Baltic Trucking Logistics, JSC	A. Griciaus trucking company	Arijus, JSC	Girteka Logistics, JSC
• Cargo transportation • Transportation of dangerous goods.	• Transportation by refrigerated trailers and semi-trailers • Oversized cargo transportation • Design movement • Multimodal transportation.	• Freight transportation • Warehousing • Customs brokerage.	• Cargo transportation in both Europe and Russia • Warehousing • Customs • Veterinary services.

Currently, Baltic Trucking Logistics, JSC has the lowest diversity of services among the companies presented above, but it provides transportation of dangerous goods, an extremely important service which is strictly regulated by legislation (Table 2). The transportation of dangerous goods is governed by the European ADR agreement [1].

The available number of transport vehicles determines the diversity and differences of the offered services. Girteka Logistics, JSC has the largest truck fleet, with 2700 vehicles (Figure 4).
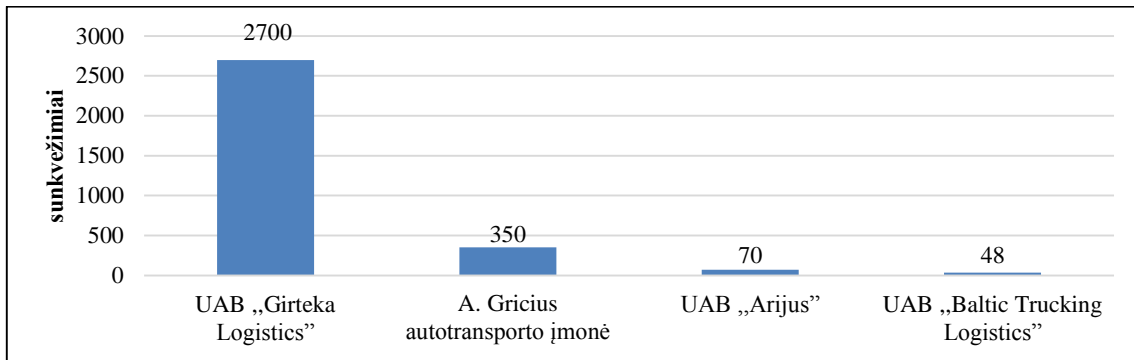
Figure 4. The largest transport companies in Lithuania

Girteka Logistics, JSC has the advantage of having the largest number of transport vehicles and can influence the entire Lithuanian land transport market through a flexible marketing system, not only in Lithuania, but also in other Baltic countries.

The operating sphere of Baltic Trucking Logistics, JSC is especially relevant during this period, since the European Union is currently following the economic sanctions against the Russian Federation (embargo). Because of this, companies that are focused on the Russian market are facing problems in the transportation of cargo.

According to the data of the Trans.eu system together with the "Linava" transport association project, the negative consequences of the Russian embargo have resulted in a 43% decrease in the number of shipments in Lithuania, Latvia and Estonia (Figure 5).
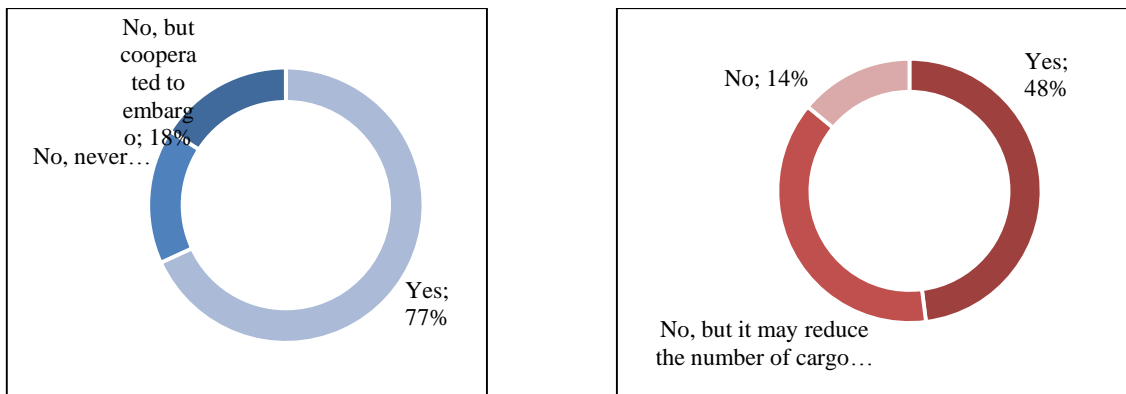
a) Cooperation of companies with partners from Russia b) Incurred by the negative impact of the sanctions
Figure 5. The diagram of the consequences of the Russian embargo on the transport market in the Baltic countries

In order to survive in the market, companies are forced to invest their funds in new modern transport vehicles which are able to refocus on other markets and Western Europe. Baltic Trucking Logistics, JSC is likely to suffer from the effects of increasing competition, as it carries on its activities exclusively in Western Europe. The Western European market environment rarely changes very radically, but the reluctance of the major countries (Germany, France) to allow carriers from other countries is evident. In such cases, they increase the minimum wage, which effectively reduces the number of carriers from other countries, such as Lithuania and the other Baltic States, and in the absence of choice, the company needs to raise the minimum wage.

The declining oil prices (a decrease of almost 50 dollars per barrel over 2014-2015) [5] have reduced fuel costs, and this is relevant for the transport companies. Now the companies can take shorter routes that had previously been operating at a loss due to the low remuneration and high costs (according to the data analysis of the company, 1 km costs 1.3 €).

Baltic Trucking Logistics, JSC worked profitably throughout the period of analysis (Figure 6).
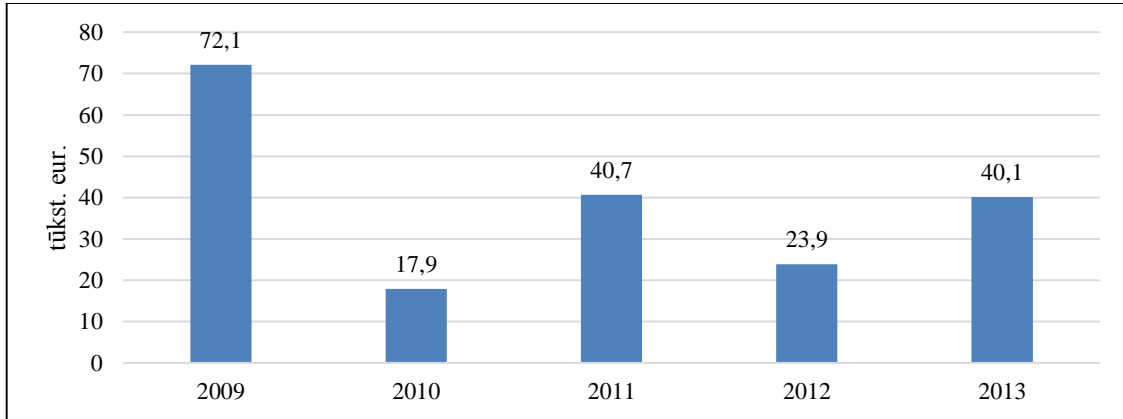
Figure 6. Net profit (thousands of euro) of Baltic Trucking Logistics, JSC

The net profit of Baltic Trucking Logistics, JSC decreased by 44%, compared to the 2009 base year, while operating costs increased by almost 4 times (from €286,000 to €1.44 million) and had the most influence. The most profitable year during this five-year period was 2009, when the company earned €72,100. The worst year was 2010, when the net profit of the company was €17,900.

The financial stability analysis allows determining the state of the company, when all available resources were allocated and exploited in such a way that the company earned a profit under normal conditions of risk.

The balance data of Baltic Trucking Logistics, JSC for 2009-2013 will be used for the calculation of the stability indicator factors being evaluated.

The debt ratio factor was calculated using equation 1 from Table 1.
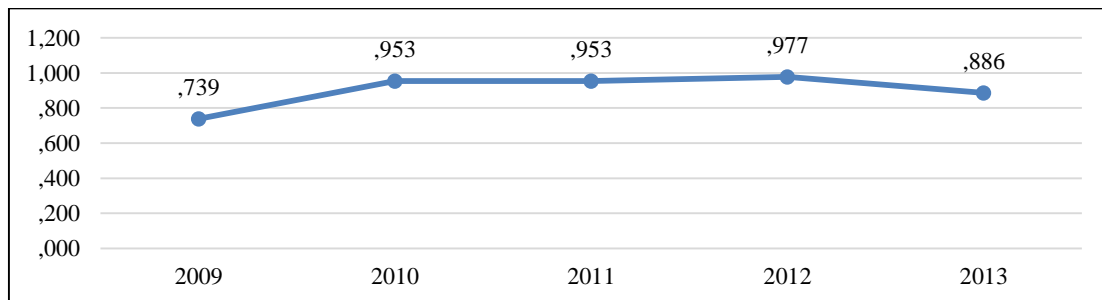
Figure 7. Debt ratio factor

It can be observed that the debt ratio factor during the analysis period, as compared to the base year (2009), had increased with the exception of 2013, when the value of the factor changed from 0.98 to 0.89. The lowest ratio was equal to 0.74 in 2009 and the largest was 0.98 in 2012. It can be argued that the Baltic Trucking Logistics, JSC debt ratio factor is optimal. The most threatening situation for the company was in 2009, when the rate value was 0.74. It was then decided to increase the equity capital by 4 times and it led to an increase in long-term financial resources. This optimal value of financial stability shows the company's viability and financial potential to attract new customers or partners.

The equity ratio describes the ratio of borrowed and owned resources (Figure 8). The rate was calculated using equation 2 from Table 1.
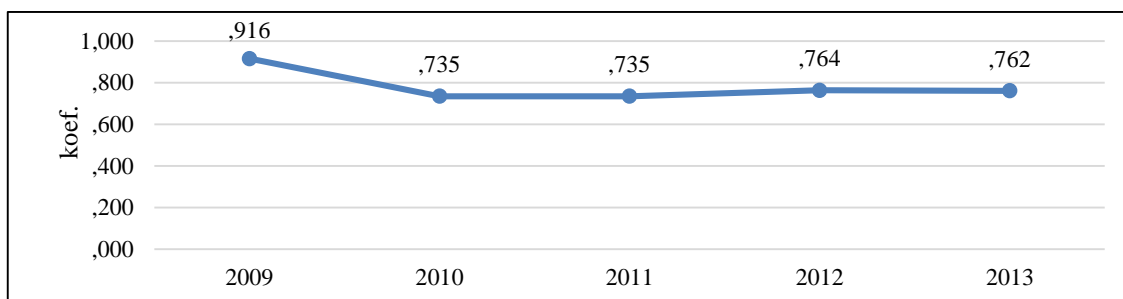
Figure 8. Equity ratio

The equity rate of Baltic Trucking Logistics, JSC is unsatisfactory (Figure 8) and the recommended value is (k ≤ 0.4). The highest value of the ratio was reached in 2009 and was equal to 0.92, and the lowest value was 0.74 in 2010 and 2011. It was found that the company's debt to capital ratio is outside the recommended values, and this means that the company's debt is too high in comparison with the resources at its disposal. Baltic Trucking Logistics, JSC has to increase its assets or reduce its liabilities as soon as possible in order to set the equity ratio to the recommended values.

The leverage ratio must be calculated in order to find out whether the company's short-term liabilities are stable. Equation 3 from Table 1 was used for the calculation.
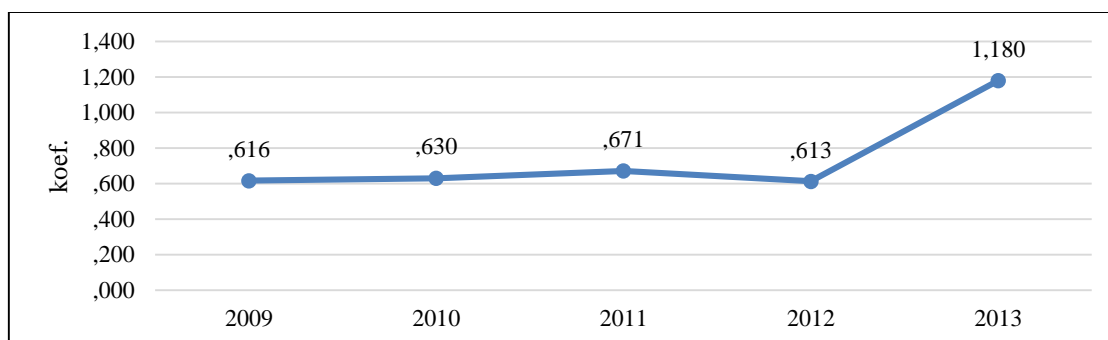
Figure 9. Leverage ratio

The rate value had been stable from 2009 to 2012. A significant change occurred in 2013 when the ratio increased by almost twice from 0.61 (2012) to 1.18 (2013). This can be explained by the fact that the company's receivables increased by almost three times (from €15,000 to €44,900) within 5 years, while its current liabilities only increased by almost twice (from €24,600 to €37,000). The financial leverage ratio reached an almost normative value (k ≤ 1), and the obtained value was 0.6.

Summarizing the estimated coefficients of financial stability, it was found that Baltic Trucking Logistics, JSC is financially stable and has real opportunities for investing in a fleet of trucks.

The interface of service development and financial stability

Baltic Trucking Logistics, JSC has a real opportunity to invest in a fleet of trucks, as it was established that the company is financially stable. Therefore the company should be able to provide better quality services, and at the same time, get profitable orders from customers (VANSPED GmbH & Conk., NTG Nordic A / S., European Cargo Logistics GmbH).

The correlation results were analysed by evaluating them with the correlation coefficient in order to assess whether the results of the company were not accidental, and if they can be connected with the company's service development. The interface of service development and financial stability was evaluated by the Student ratio (Table 3). The evaluation of the correlation between the receivables and short-term liabilities (Table 3) showed that the increase in Baltic Trucking Logistics, JSC receivables increased the company's current liabilities (correlation coefficient equal to 0.5, weak bond). The relationship of assets and liabilities has a direct correlation (correlation coefficient is equal to 1) and it indicates that the company's liabilities will increase immediately after the acquisition of the assets.

Table 3. Student and correlation coefficient values

No.	Indicators of financial performance	Correlation coefficient	Student rate	Conclusion on reliability
1.	Accounts receivable and current liabilities	0.5 (weak bond)	0.08	0.08 > 0.05, statistically reliable linear bond
2.	Assets and liabilities	1 (linear dependence)	0.03	0.03 < 0.05, statistically unreliable linear bond
3.	Profit and reserves	0.5 (weak bond)	0.9	0.9 > 0.05, statistically reliable linear bond

The statistical reliability of the correlation was assessed by the Student factor (Table 3). The value of the coefficient usually used for the comparison of coincidence (p is the Student Ratio) is 0.05, i.e., the correlation between the two variables is statistically unreliable if the obtained coefficient is less than 0.05.

The evaluation of the Student Ratio showed that the Student's rate of the accounts receivable and accounts payable was 0.08 > 0.05. The financial stability coefficient value is favourable to Baltic Trucking Logistics, JSC, and the short-term liabilities level of coverage rate is sufficient for the company. A reliable linear relationship was determined during the analysis of the company profit and stock correlation's statistical reliability (Table 3). The company reserves did not decrease when the company made profits, i.e., the company had not bought additional stock, which would require extra cost at a later period. The financial risk in the financial environment poses new challenges for the company's managers and prevents them from keeping the company profitable.

The risk of losing financial stability due to further development of the factors is the main development risk of the company (Table 4).

Table 4. Development risk factors

Development factor	Risk associated with the development factor
Increase in the truck fleet	Increase in liabilities to creditors Increase in costs Costs will be covered by incomes Increase in costs for the maintenance and repair of trucks
Creation of new job positions	Increase in costs associated with higher wages and taxes Increase in costs because of the difference between the growth of wages in EU countries

The wage issue for long-distance drivers is particularly significant. The law adopted by the Federal Republic of Germany states that the minimum wage (€8.50 per hour) from 1 January 2015 will be validated not only for local employers, but also for motor vehicle drivers going through the country in transit.

The current minimum salary paid by the company to its Lithuanian transport drivers is €1.82 per hour. [4] A driver receives approximately €300-350 (depends on the length of the work period) daily allowance during the month. The minimum wage for the company will increase by more than 4 times (from €1.82 to €8.50 per hour) after the law in question enters into force in Germany [6]. This means that the monthly salary will increase to €1394 - €1632 (comparing the minimum and average amount driven in 48 hours). Taking into account that Baltic Trucking Logistics, JSC carries out its main activities in Germany (its Truck Park is located in Germany), its incurred costs associated with salaries can significantly increase by nearly €1000 for each driver beginning in 2015, and this may affect the company's financial stability.

So, the favourable business strategy of the company to register its business in Lithuania and operate in Germany becomes disastrous with these wage changes. The company should substantially change its business strategy or develop its customer market in other countries.

The company should increase its amount of customers, and it would be especially useful to find new customers in the Nordic countries (Norway, Sweden, Finland) in order to avoid a significant increase in wage costs (Table 5).

Table 5. Wage changes

No.	Situation	€/hour	Average number of hours driven during the week	Average ticket price (Travemunde, DE – Trelleborg, SE), €	Driver's wage, € (without allowance)
1.	At current wage	1.82	48		300-350
2.	After the increase of wages in Germany	8.50	48		1394-1632
3.	After the extension of services to Northern Europe and the use of ferries	4.43	48	250-500	550-850

The company would reduce fuel costs, prevent road taxes, and avoid the raise of the minimum hourly wage, which will be implemented in Germany, if its transport services are provided in Scandinavia through the use of sea transport (ferry from Travemunde to Sweden and Finland).

Summarizing the interface of service development and financial stability, it can be concluded that the correlation and Student ratios are favourable for the company's development, but the business costs can increase due to internal country policy, which leads towards the direction of new development opportunities in other countries and the search for clients there.

Conclusions

Cargo transportation by land remains one of the most popular and least expensive means in the world. The comparison of Baltic Trucking Logistics, JSC with other similar-sized and larger companies showed that this company is the smallest, according the variety of services provided and size of its vehicle fleet. Baltic Trucking Logistics, JSC carries out its activities only in Western Europe, therefore, it cannot compete with the largest companies in Lithuania.

The analysis of the company's main indicators of financial stability shows that Baltic Trucking Logistics, JSC is stable and has real opportunities to invest in its fleet of trucks. The investment in the truck fleet would allow the company to increase the diversity of the services it provides. Its services would improve, and the orders would be more profitable.

There is a high risk of experiencing higher costs related to wages because of the unfavourable situation in Germany. This leads towards the direction of new development opportunities in other countries and the search for clients there.

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THE DIDACTIC MEMOIRS OF SEAFARERS AS AN INFORMAL POSSIBILITY FOR UNIVERSAL DEVELOPMENT OF THE MARITIME MENTALITY AT THE LEVEL OF STUDENTS' CULTURAL SELF-LEADERSHIP

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Abstract
This paper presents a problem of didactic memoirs of seafarers as an informal possibility for universal development of the maritime mentality. This object is theoretically researched at the level of improvement of maritime students' cultural self-leadership. Definition of the self-leadership and characterization of psychological effects of reading memoirs are presented. Scientific essence and development of memoirs are discussed, and informal education is characterized. Universal development of the seafarers' self-leadership is revealed. One example of seafarer's didactic memoirs for universal development of cultural self-leadership is analyzed. Methods such as scientific literature analysis, content analysis, interpretation, classification, systemization and synthesis are used in the research. The methodology of the research is based on the STCW convention, paradigm of the universal upbringing, existentialism and existential phenomenology. The methodological type of the research is theoretically descriptive. Results of the research can be applied to the preparation of seafarers' at the higher maritime education but rather at the level of informal education from the point of view of social-humanitarian maritime studies aimed to achieve personal improvement with reference to cognitive level of the self-leadership competence.
Keywords: *seafarer's memoirs, maritime students, cultural self-leadership, universal development, maritime mentality*

Introduction

It is appropriate to search innovative forms and methods by developing leadership of future seafarers based on requirements of the STCW convention Manila amendments with reference to psychological states of young people and their life forms and various external challenges. However, if a maritime student wishes to become a leader of a ship-crew, it is meant - for others, then he / she must get abilities of the self-leadership firstly related with self-management, self-design and determination of one's own purposes and direct achievement of them by responding to the challenges of life.

Development of leadership is an integral part of the improvement of the entire seafarer's personality. This development needs favorable conditions. An inherent part of universal development of the seafarer's leadership is a cultural education related with the maritime culture as a dimension of maritime mentality development. Adaptation, flexibility, critical thinking and creativity in nonstandard situations at sea characterize the need of the universal development of the seafarer's leadership. EU conventions of the higher education require for development of the critical and creative thinking of students. All this needs universal improvement of physical and spiritual dimensions of the seafarer's personality.

The usual way of the formal education is acceptable and it lets develop an adequate cultural position of maritime students from the point of view of maritime mentality in the broad sense. However, it is appropriate to search new ways for this development and self-improvement. One of the ways is a memoir written by a seafarer. Maritime memoirs are characterized by the didactic form of the story and are distinctively attractive for young people that aim to know maritime life with reference to experienced seafarers' approach, to value critically the experience and decisions of big-colleagues, to motivate unconsciously themselves to aim something like that, or at least identify themselves with the characters of described heroes. The seafarer's cultural and spiritual experience that is described in memoirs can enrich the personality of the maritime student.

However, it can be implemented in informal way of studies. This way is more attractive naturally in the studies process that is characterized by the routine. There is a possibility to ingrate the informal education into the formal preparation of seafarers. Future seafarers can read popularly written book of the maritime culture side-by-side technological studies and technologically managerial leadership. It is important to note that memoirs-book is not only free memoirs but this book can be characterized didactically. The experienced seafarer describes his / her maritime experience with an intention to inform, notify and teach young maritime students about important things that compose a wide spectrum of moments and experiences of the personality's cultural and valuable expression. If the future seafarer is interested in seafarers' memoirs or is promoted by teachers to read them, then he / she knows the memoirs and they become a very important phase of the cultural self-leadership development of the maritime student's personality in the wide context of the maritime mentality self-development.

The grade of the exploration

Seafarer's didactic memoirs as an informal possibility for universal development of the maritime mentality at the level of students' cultural self-leadership are discussed. It is appropriate to note, that more Lithuanian seafarers gradually start to write memoirs and share their memories with society aiming to promote young people to achieve the seafarer's vocation [2, 6, 22, 24, 27].

The new term ego-documentics and its concept are raised in Lithuanian science. Ego-documentary is memories and diaries, letters and travelogues that are traditionally understood as literary genres and researched in works of autobiographic writing and of life stories (oral history) researchers. Teacher of history and poet prof. Dr. Jakob Presser (1899-1970) used this term in 1955 because he lacked of methodological instruments and possibilities of the traditional typology of historical sources by registering and analyzing memories of genocide victims that were relevant for his researches of the traumatic societies' memory [7].

Self-leadership researches are rather separated from the memoirs genre and are presented in the context of technological, psychological mechanisms, managerial development and aggression but not of the peaceful, free and careful memory. More precisely, self-leadership involves specific sets of strategies and normative prescriptions designed to enhance individual performance. Self-leadership is researched from the point of view of a tool in management succession planning, the relationship between self-leadership and personality and a comparison of hierarchical factor structures, the abbreviated self-leadership questionnaire and a more concise measure of self-leadership, the revised self-leadership questionnaire and testing a hierarchical factor structure for self-leadership, self-leadership in organizational teams and a multi-level analysis of moderators and mediators [12, 15, 16, 17, 19, 23].

The cultural self-leadership is more related to the multi-cultural context of the leadership in the science. The purpose of the study was to examine how culture influences the usage of self-leadership strategies [10, 13, 14]. On one hand, researches that directly relate to the self-leadership with personality's general culture and maritime memoirs are a few. However, on the other hand, seafarers that write memoirs that directly or indirectly highlight the cultural level of the self-leadership with reference to the personality's development characterize every maritime nation usually [2, 6, 9, 11, 22, 24, 25, 27, 28].

Goal and tasks of the research

The research goal is an identification of seafarer's didactic memoirs as an informal possibility for universal development of the maritime mentality at the level of students' cultural self-leadership.

Tasks are as follows:
1. Definition of the self-leadership and characterization of the psychological effect of memoirs reading.
2. Discussion of scientific essence of memoirs and characterization of informal education.
3. Revelation of universal development of the seafarers' self-leadership.
4. Characterization of one example of seafarers' didactic memoirs for universal development of cultural self-leadership.

The research object is seafarer's didactic memoirs as an informal possibility for universal development of the maritime mentality. The object is theoretically researched at the level of maritime students' cultural self-leadership improvement.

The research methodology

The methodology of the research is based on the STCW convention, paradigm of the universal upbringing, existentialism and existential phenomenology. Methodological attitudes are as follows:

International Convention on Standards of Training, Certification and Watchkeeping for Seafarers and requirements of Manila amendments highlight an improvement of the shipping safety by developing a leadership of seafarers at the social level of their preparation along other actualities. Technologic education of seafarers, their positive world-view, leadership, creativity, understanding of the constructive philosophy and psychology for a development of own personality, wide intellectual and cultural horizon and development of internal culture influence on the safety at sea. All mentioned components could help develop self-leadership abilities of seafarers that are important as a start of the leadership in general.

Paradigm of the universal upbringing notes a development of full power of the personality. This holistic approach to the maritime education help implement an improvement of the future seafarers' cultural self-leadership, especially at the flexible and creative level of adequate reaction to nonstandard situations when working at sea.

Existentialism refers to the human fear on land and especially at sea. Existential psychology is a 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 the maritime self-leadership expands the horizon and helps people overcome the tragedy of existence, improve the emotional state and find unique comfort. A big help for them is seafarers' memoirs at the level of informal self-education. So, existentialism helps get a valuable basis for the self-leadership and self-regulation in extreme conditions. This valuable basis as a methodological attitude is grounded psycho-educationally.

Existential phenomenology highlights the self-education of valuable attitudes through the existential experience, artistic creativity, imagination, insight and reflection of values. Education through own experience compared it with other experience in regard to seafarers' memoirs is very important developing self-leadership. Human's interests to the maritime affaires with individual features, own experience and psychic condition help culturally enrich entire human's personality and his / her expression.

Methodological type of the research is theoretically descriptive.

Methods and limits of the research

Methods such as scientific literature analysis, content analysis, interpretation, classification, systemization and synthesis are used in the research.

Results of the research can be applied to the preparation of seafarers at the higher maritime education but rather at the level of additionally informal education from the point of view of social-humanitarian maritime studies aimed to achieve a personal improvement with reference to the maritime mentality at cognitive level of the self-leadership competence.

Definition of the self-leadership and psychological effect of memoirs reading

The self-leadership is a process of behavioral and cognitive self-evaluation and self-influence whereby people achieve the self-direction and self-motivation needed to shape their behaviors in positive ways in order to enhance their overall performance. Self-leadership researches are separated from the memoirs genre and are presented in the context of technological, psychological mechanisms, managerial development and aggression but not of the peaceful, free and careful memorie as an effective cognitive work of the personality. More precisely, self-leadership involves specific sets of strategies and normative prescriptions designed to enhance individual performance.

The self-leadership is related with the motto - "Inspiring, Motivating and Transforming!" [4]. We can integrate this motto into effect of seafarers' memoirs on maritime students. Didactic memoirs inspire and motivate future seafarers. Their decisions help transform their aspirations and behavior from the point of view of the vocational development. It is a great transformation of the personality's cultural

development by strengthening possibilities of the maritime mentality expression at the cognitive level. Informal studies of the self-leadership help respond to the question: how to become a more successful, efficient, and effective leader from the inside out with own cultural life at the initial level from the vocational point of view. The maritime leadership begins when young human reads seafarers' memoirs. His / her internal world is enriched by impressions that can be expressed by vocational decisions. So, the academic answer into mentioned question is eventually implemented.

Self-leadership is the practice of intentionally influencing individual thinking, feeling and behaviors to achieve objectives. Self-leaders have a drive for autonomy, can make decisions, and are more creative and persistent, even in the face of adversity. Proactive choice to read the memoirs of seafarers manifests autonomy. Creative solutions and formed attitudes help maritime students avoid surprise and confusion entered into a problematic situation. He / she read about dangers in memoirs and can more surely achieve self-test and experience ineffable feelings of the struggle with vocational challenges.

Some of the intentional behaviors that characterize self-leadership are self-awareness, self-goal setting, self-motivation, positive self-talk, assertive communication and the ability to receive and act on feedback [4]. Self-awareness, self-goal setting, self-motivation and positive self-talk express especially at the level of the psychological effect of seafarers' didactic memoirs. Other characteristics of the intentional behavior need formal training at maritime studies.

Memoirs are rather a good start in general that manifest by self-motivation of the seafarer's profession and maritime studies, more consciousness in studies and personality's maritime mentality in the vocational development. However, self-leadership does not require entirely autonomous behavior without regard to the team or organization. Nor does it require that the identity and value of each individual employee be entirely put aside in favor of the work group or organization. Rather, an effective self-leadership perspective would encourage individuals to find their own personal identity and mode of contribution as part of establishment of a group or organization that produces synergistic performance [23]. So, it is universal development of the personality.

Becoming a self-leader and maintaining self-leadership is a self-development activity and maritime organizations that encourage self-leadership reap the benefit through consciousness of seafarers and other maritime workers that look wider into professional field in an integral context of read seafarers' memoirs, studied theories and skills of own maritime praxis.

It is noted, that it is not easy to find happiness in us and it is not possible to find it elsewhere [23]. A maritime student or seafarer is always in himself / herself from the universal point of view. We can state that the self-leadership is development of the personality's own self for directionally professional activity in regard to the psychology. It is figuratively showed by Dr. P. Butler: "There is a person with whom you spend more time than any other, a person who has more influence over you, and more ability to interfere with or to support your growth than anyone else; this ever-present companion is your own self" [5].

Ideals of life inevitably accumulated from didactic memoirs, communication and informal and formal knowledge and practice etc. are as an internal culture of the personality being in him / her always effect universally - soothes and provides comfort in every tribulation when working at the sea or in life in general. So, the enriched personality expresses adequately and consciously in own academic and professional activity.

It is appropriate to present main moments of psychological effect of the memoirs reading with reference to the communication with the own self, searching answers to existential questions of life, unconscious incarnation of characters and wish to write memoirs for own self-expression.

The effect of the artistic word that is written in didactic memoirs is special. We can state, that a good book and interesting text is like a conversation with a human. Every reader is a social creature. He / she reads the book and communicates intensively with own self that has been mentioned above as an ever-present companion. A writer of memoirs shares his / her own personal experience of his / her life and vocation, is able to perceive the essence of life more deeper, to experience different information more sensitively, and to convey his / her own impressions so clear, that the reader experiences them as his / her own. The work of the high artistical level or book that is written very sensitively forces the reader to reflect about the main questions of life, about the sense of life, and to value the human's behavior respectively.

Didactic memoirs or historical books that express the spirit of great people help reader find answers to many questions and to experience joy and comfort. The human incarnates different characters unconsciously, experiences many lifes emotionally and enriches his / her own deep experiences by reading the book [29].

The reader perceives the spiritual world of heroes, compares, verifies and searches for a validation and justification of his / her thoughts, feelings and behavior. The reader usually forgets the author,

he / she see people that are presented by the author. The reading of a good book is like a conversation with the smart and careful friend that discreetly warns of possible errors, and promotes the expression of the human good nature. The relationship with the book could be a significant method of the learning to spend leisure time meaningfully from the point of view of the seafarers' psycho-prophylactics. It is very relevant the period of experiencing the monotony and stress.

If it is possible, it is important to find time for the interesting book, telecast or Internet site that enriches the seafarer's personality, especially working in conditions of the social isolation. There was observed a phenomenon that some seafarers are experiencing the monotony and trying to create prose and poetry texts.

It is relevant to note, that memoirs rise as a communication of the own self, or a bridge that conveys the vocational understanding of the experienced seafarer's own self to others that form their own self by reading. However, seafarers write memoirs not only to convey own life events and experience for others or teach others. They aim to individually enrich the system of maritime memoirs. The young seafarer who reads the seafarers' memoirs can engage to write memoirs later according to the accumulated own personal maritime experience.

The scientific essence of memoirs and informal education

Memoirs are a literary genre that includes works based on personal experience or observations. This genre is closely related to the diary and autobiography. Writing of the diary psychologically stabilizes the personality, especially if he / she is living and working for a long time in conditions of the social isolation. Events and writing about them are separated by time. It is narrated not only about him-self or her-self. So, we cannot hope for a big scientific confidence from the seafarers' memoirs. Seafarers' memoirs express only subjectively experienced and valued tendencies.

Authors of memoirs usually are witnesses of historical events and aim to really interpret these events. Many of memoirs do not have information about the author. These memoirs are often related to the one separate event. Memoirs are different from the point of view of chronicles that are written by witnesses of historical events. Memoirs are characterized by dominated personal evaluations. Most memoirs are written on the first person [3].

The English Civil Wars of the 17th century produced many similar reminiscences, the most notable of which are the *Memoirs* of Edmund Ludlow and Sir John Reresby. The French have particularly excelled at this genre; one of the greatest memoirists of his time was the Duc de Saint-Simon, whose *Mémoires* (covering the early 1690s through 1723), famous for their penetrating character sketches, provide an invaluable source of information about the court of Louis XIV. Another of the great French memoirists was François-René, vicomte de Chateaubriand, who devoted the last years of his life to his *Mémoires d'outre-tombe* (1849–50; "Memoirs from Beyond the Tomb"). In the 20th century, many distinguished statesmen and military men have described their experiences in memoirs. Notable reminiscences of World War II are the memoirs of England's Viscount Montgomery (1958) and Charles De Gaulle's *Mémoires de guerre* (1954–59; *War Memoirs,* 1955–60) [8].

It is appropriate to note, that for example the famous in all world fleet of Great Britain was characterized by not only economically political power but also intellectually historical in new times. Museums of the English maritime culture possess archives of seafarers' memoirs and publish them nowadays. Enthusiasts of Lithuanian marine journalist club "Marinus" but not national institutions perform similar role in Lithuania. Seafarers of different countries have written memoirs increasingly in recent times. These memoirs were usually influenced by the political ideology and censorship of corresponding period. 19 th and 20 th centuries are characterized by rising of maritime memoirs in great maritime countries, especially France, England, Germany and Soviet Union, that is hereafter enriching by the maritime experience. Seafarers' memoirs are published not only in paper-books but also in e-books as an acceptable form of 21 th century.

The memoirs' genre is popular nowadays that is researched at historical, sociological, psychological and literary levels. It is appropriate to note from the scientific point of view, that memoirs present a lot of materials that are not in official documents. However, it is important to critically value thoughts of memoirs and the role of the author in them because of the mentioned subjective effect. But the subjective factor is directly related to the maritime self-leadership that rises namely in the subjective experience of the own self, and in the professional projection at the level of the personality's internal culture development.

So, fragments of the different seafarers' existence meet together, integrate and repeat in memoirs, and show social, cultural, historical and technological contexts of their epoch. These contexts let reader

comfortably and attractively read about maritime events that are common for each seafarer and future seafarer despite the epoch.

Informal education of the self-leadership is characterized by effects of not only formal teaching but also of entire socio-cultural environment that is composed of components that are as follows:

Museums, monuments of the maritime culture, and close cultural environment;

Libraries, reading rooms and computer rooms characterized by various type of literature and memoirs among them;

Exhibition halls and stands and information centers;

Television, radio shows, newspapers, magazines and other informational materials about the maritime sector.

Young people can use values of the maritime culture, and important information that are stored in mentioned institutions for preparation of seafarers, improvement of their communicational skills and development of their self-expression regarding to possibilities. Informal education applies possibilities of institutions of education, culture and other with reference to opportunities [21]. It is appropriate, that the library of the Lithuanian maritime academy is regularly enriched with Lithuanian seafarers' memoirs that are being published more and more often, and are attractive and interesting to maritime students. It is important to orient the attention of future seafarers to origins of the self-leadership that are found in seafarers' didactic memoirs at the motivational level.

On one hand, future seafarers are coming to the maritime academy being a little bit influenced by the maritime informational culture. However, on the other hand, the educational process in the maritime academy is open to integrate various methods of studies. So, the maritime academy is characterized by the possibility of the informal education, too. This education is characterized by purposeful effect and activity based on more constructive and creative cooperation where vertical (hierarchic dependence) or horizontal (strong difference by groups) relationships that disturb the personality are not imposed [20].

The purpose of the informal maritime education that adds the formal education at the methodical level, at least, is to enable each future seafarer to integrally implement his / her own individual interests and needs of the self-expression, to develop talents and skills that are relevant for the profession and transferable skills by implementing of the formal studies program. So, the system of this education must function including areas of the knowledge development, self-expression and self-development, that the maritime student (in this case - who reads additional literature of didactically prepared seafarers' memoirs) would be able:

To add, enhance and develop the knowledge of maritime affairs;

To implement his / her own socio-psychological interests and needs of the maritime self-expression throught the individually interesting independent activity at initial, cognitive, preparatory and motivational level;

To freely develop the ideas and make the mental decisions because the professional direction and process by means of comfortable relationship to the maritime literature that is available, popularly written and easily to read, and to persons who informally help start the gradual development of the cultural self-leadership;

To mature the maritime self-concept emotionally experiencing the mentality of the maritime culture.

Researches showed, that an individual can better internalize values in the early youth by achieving the level of the conscious internalization that is related to perceiving of the values essence and giving sense to them, especially when cognitive factors operate [1]. So, values of the maritime life that characterize the seafarers' didactic memoirs are easy perceived. The propagation of these values may be of great help to the personality's development of the conscious future seafarer giving sense to the phase of his / her cognitive development, and vocational aspirations.

The universal development of the seafarers' self-leadership

The basic system of the universal development consists of educational values and features. The main educational values are ideal, real and psychic. The main educational features are development of the human nature, intellectual education, practical training and practical upbringing.

Components of the ideal values are as follows:

Personality's features, national consciousness and behavior, and understanding of existence with reference to the development of the human nature;

Wisdom, truth, justice and rationality from the point of view of the intellectual education;

Creativity, autonomy, diligence and intuition in regard to practical training;

Morality, nationality and theistic consciousness at the level of practical upbringing.

Components of the real values are as follows:

Civilization, culture and society with reference to development of the human nature;

Present-day discoveries, special and universal sciences, knowledge of the relationship and competence regarding to the intellectual education;

Modern inventions, art and technologies, working and economics from the point of view of practical training;

Way of nowadays life, customs and morality, consensus and democracy at the level of practical upbringing.

Components of the psychic values are as follows:

Consciousness, needs and instincts with reference to development of the human nature;

Familiar activity, information, research and activity with reference to the intellectual education;

Will, practical activity, self-expression and self-implementation, freedom, spontaneity and self-effectiveness in regard to practical training;

Emotions, motives, tenderness and positive weakness related with the creative and constructive relaxing, and sensitivity at the level of practical upbringing [18].

The universal development of the self-leadership among future seafarers is based on mentioned values that help maritime students to implement their own personal nature that he / she would be able to wisely, creatively and morally work at the sea. It is noted not only managerial function of teachers or mentors but first the nature of the person, its expression and activity developing the self-leadership. Seafarers' memoirs that are freely chosen and consciously and unconsciously valued by reading are relevant for his / her development. The need of the maritime self-expression at cognitive level of the first interesting is implemented by reading of the seafarers' memoirs, especially when mentioned memoirs are didactically prepared.

The goal of teachers that are able to teach regarding to didactics of higher education is to help students around the world at levels of the self-concept, self-confidence and sense of the activity. So, self-leadership is developed by the way of the productive self-development. Future seafarers need teachers not only from the formal point of view but also by the informal help to choose seafarers' memoirs that are written attractively. The main result of the educational and self-educational process highlights an ability of maritime students to formulate their own academic, professional and constructive goals, and to think about the way of achievement of them, and to perform the practical activity implementing them.

It is important that the teacher helps maritime students regarding to their individuality, and that he / she helps them perceive the sense of the direction of their own self-expression, and reality and prospect. When all that is implemented cognitively, then the need rises for the self-education and self-leadership. This need is a directly effective factor of the personality's vocational maturity. Features of the future seafarers' nature are related to the difference of the world, challenges, uncertainty, logics and irrationality, dangers and opportunities etc. The future seafarer, being open to unique and complexity of the maritime profession, can adequately relate to the external world in regard to the cultural values of his / her own internal world in broad sense, if that entire are integrally developed with reference to physical and psychic training, social and cultural development.

The universal development of the seafarer's self-leadership is based on the need of adaptation, flexibility, critical thinking and creativity in nonstandard situations working at the sea in regard to improvement of physical and spiritual culture of the seafarer's personality in general. So, the cultural self-leadership regarding to the universal development is related to improvement of all powers of the personality.

Tutorials are specialized by the one area of the maritime studies. Technological training dominates by the preparation of seafarers. It is difficult to achieve spiritual-cultural powers of the personality. Formal education gives less possibility for them. However, seafarers' memoirs could help develop all powers of the future seafarer's personality because of the content of didactic prepared maritime memoirs including technologic, social, psychological, medical, spiritual and traditional fields of maritime life and their development, and integrate all that. Seafarers' memoirs usually are popularly written and these are easier to understand than special tutorials. So, valuable possibilities of the informal education can enrich formal maritime studies in regard to universally individual improvement of the cultural self-leadership of future seafarers.

One example of seafarers' didactic memoirs for universal development of cultural self-leadership

The book "I have seen the green ray. The notes of the sea captain" [2], written by the Lithuanian sea captain Eimutis Astikas, was chosen as an example of seafarers' didactic memoirs. This book is published by Lithuanian marine journalist club "Marinus" that is engaged in publishing of the maritime lectures. The content of the book includes 180 pages.

Main themes of the book content:

Art of the seafaring,

Sea-miles,

Uproar of coast,

Flash of traditions,

Clutches of element,

Seafarers' linguistics,

Correspondence [2].

Detailing, it is relevant to note, that we find a lot of aspects of the seafaring in the book. The author discusses the responsibility that is highlighted in the International Convention for the Safety of Life at Sea (SOLAS), he criticizes the marine red-tape, discusses the management of the ship, uses sex metaphors for the maritime safety, develops the history of civilizations and cultures, raises moral issues, remembers the conflicts, incidents and relationship to maritime pirates, and protestant seafarers' religious extremes. Allegories of historic sea-travels from the point of view of up-to-date maritime-affairs, psychological moments of the maritime law, discourse of the higher education and practice, vivid expressions of historic personalities and personal events are presented.

The author's personal experience at the sea is related to the Greek mythology, Homer's poem "Odyssey", seafarers' rebellions in the world, psychological states, confrontation of seafarers and sailors, shipping futurology, cultural tradition of seafarers, diplomacy relations to maritime bureaucrats, problems of the maritime state, maritime folklore status, biblical allegories from the nowadays point of view of the seafaring, maritime therapy, navy, "gray cardinals" of the fleet, problem of the communication with the people of poor spirit, maritime economics and extreme economism, smuggling, preparation of seafarers nowadays, technologies and their limits, problem of the confidence in technologies, seafarer's personality, place of dream in the preparation of seafarers.

Archaeology, Vikings' seafaring, relationship of Christianity and paganism, sea tragedies, scientific problems of the Bermuda triangle, ambiguity of Shipwreck evaluations, irresponsibility of captains as a national problem, marine linguistics and status of Lithuanian language in the maritime state are discussed in the book. So, the wide spectrum of the content of extraordinary topics witness to diversity that is adequate for informally universal development of the cultural self-leadership of the seafarer's personality.

The entire book is characterized by the didactic level and educational purpose to convey author's own maritime cultural experience in broad sense to future generations of seafarers. It is an expression of teaching and sharing of the seafarer's experience and erudition. Mentioned memoirs are didactic because firstly these are universal. It promotes the wide approach to the processes of maritime life itself. Chapters of the book are not long, everyone starts with a short summary of them, and the text is enriched with suggestive maxims. Maritime term and historic or rare word are interpreted at the side of the sheet. It is acceptable, that summaries are written in green color that is most natural color in the nature. If a person will look more into the green color, he / she do not get tired quickly from the ergonomically didactic point of view.

Illustrations that help perceive the ideas of the author, and marine- and port-themed photographs characterize the text. The author raises the problems that are relevant to seafaring. He is worried about them and proposes decisions. However, the author maintains open to different positions, shares and details his own maritime experience but makes it not cheeky. The subtle humor is applied. We feel by reading, that every word is given regarding to the context. For example, when the name of the ship is dedicated to the human, then the author shows he not only worked on this ship but also explains her name and way, how this famous human is deserved to the society. The text of the author is constructive always by giving of an attention to the relevance of new generations and new maritime traditions.

The author is cultured. His cultural self-leadership that is conveyed to others highlights and is like an example for the young maritime students that must develop the cultural self-leadership. So, they can become professionals that are related to the competence of the trustworthy human and good specialists. It

is an expression of the old seafarers and teachers decorating the Lithuanian cultural and educational culture at the maritime level. It is important to note that this author was reading in his youth the seafarers' memoirs and from them got maritime wisdom. The author's witness is the mentioned book.

The author discusses almost all possible areas of the life writing about the maritime affairs. The book is characterized by the diversity of topics. It is easy to read. We can feel that this book highlights a method of unbothering moral education related to development of the politeness. It is stated, that this memoir promotes young people to choose more confidently the profession of seafarers [26]. It bases a possibility and need to apply didactic seafarers' memoirs at the process of maritime studies.

Conclusions

1. Self-leadership is characterized by purposeful improvement of the future seafarer's personality by developing relevant features for work at the sea. Development of the self-leadership helps culturally improve the personality of the maritime student's achieving adequate possibilities of the personal integration into productive work of the crew. Main psychological effects of the didactic memoirs reading are characterized by identification of the reader's personality with the role of heroes, by cultural self-development and maturity, by vocational comfort and decision-making as the part of the seafarer's self-leadership improvement.

2. The experience of the author and subjective aspiration to speak up and witness characterize memoirs. It is valid as an additional function and often the only option for the knowledge of history or professional features. The science is recognized by the significance of memoirs nowadays. Seafarers' memoirs that are attractively written promote future seafarers to learn vocational shadings and diversity. Informal education being free meets personality and individuality. If the informal education is based on seafarers' didactic memoirs, then it is valid as a strong motivational factor for future seafarers at the cognitive level of maritime studies, despite the achieved education or psychic states of maritime students.

3. The universal development of the seafarers' self-leadership is based on values that help maritime students implement their own personal nature and be able to work at the sea. It is an improvement of all powers of the personality, implementation of all needs-groups of the personality. Then future seafarer motivates oneself adequately to the vocational self-development, flexible and creative reaction to the diversity of vocational challenges, and nonstandard situations. Seafarers' memoirs help them beyond the field of interest of one academic subject and developing the seafarer's self-leadership with reference to universally vocational culture of the personality.

4. Presented example of seafarers' didactic memoirs for universal development of the cultural self-leadership is characterized by the big diversity of maritime affaires, view to the history of civilizations, achievement of technological science, moral questions, theology and mythology. Educational aspiration to transfer author's maritime culture experience in the broad sense for future generations of seafarers is felt by reading. Memoirs are didactic, universal and promote wide approach and discursive thought, are easy to read and enriched with maxims; terms are explicated, the book is characterized by illustrations; the perception of the text is based ergonomically. The book can help develop the self-leadership with power of the example for non-standard situations. It is unobtrusively moralistic and promotes to become seafarer aimed to be a happy human.

Results of the research can be applied to the preparation of seafarers at the higher maritime education but rather at the level of additionally informal education from the point of view of social-humanitarian maritime studies aimed to achieve a personal improvement with reference to the maritime mentality at cognitive level of the self-leadership competence.

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THE PECULIARITIES IN FORMATION OF EFFICIENCY OF TECHNICAL SHIP SUPPLY COMPANIES

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Abstract
The article analyses one of the largest groups of technical ship supply companies in Klaipeda. The researches of the main aspects of efficiency in technical ship service and supply companies allows conclusions to be drawn about ensuring the efficiency of peculiarities according to certain activity conception. The active development of technical ship supply market stimulates an increase of company's competitiveness capacity by optimization of activity conception. The conception of company activity is one of the main peculiarities of the efficiency formation. The high stability of activity both in the spheres of sales volume and profit formation is peculiar to industrial and technical ship supply companies. The peculiarity of technical trading companies is the high dependence on fluctuations in the market which determines the demand in the technical ship supply market. The amalgamation of technical ship supply companies and activity in group of companies allows companies to balance a wide range of peculiarities of activities in order to achieve the envisaged level of efficiency.
Keywords: *technical ship supply, conception of company activity, level of efficiency.*

Introduction

The technical ship supplying is one of the most important areas of activity in the maritime market. In case of formation of conditions for rapid competition in technical ship supply and service sector, it is necessary for companies to assess the efficiency and its formation peculiarities. There is high variety of systems of efficiency modelling and management in the modern economic science. The efficiency is most commonly understood as different kind of resource usage, which ensures the highest usage level of product [6]. The peculiarities in formation of efficiency are one of the main aspects characterizing company's activity for any market participants that demonstrate adequate management of income and expenses, the use of different resources and assets, efficiency of employees, etc. The complex evaluation depends on dominant conception of company, its strategies, objectives and peculiarities of activity.

Object of research is economic activity of technical ship supply company.

Main objective is to assess conception of technical ship supply company activity impact on peculiarities in formation of efficiency.

Research methods: analysis of Lithuanian and foreign authors' scientific literature, financial analysis of companies, analysis of main indicators of efficiency, data grouping and comparison.

1. Concepts of efficiency

First of all, while analysing formation of activity efficiency it is advisable to distinguish between two concepts: the effect and efficiency. Effect – it is the result obtained from industrial or other activities performance of improved measures, it is measured in physical and monetary form. Efficiency – it is relation between effect and costs to achieve it [10]. Analysis of scientific literature indicates that the most commonly analysed types of efficiency are these: technological efficiency (productivity), which provides the evaluation of all the resources used. The allocative (distribution) efficiency is ensured by combining the resources (rational arrangement of resources). The integrated efficiency is determined by amount of used resources and their rational distribution [4].

In economic literature these dimensions of efficiency are defined as internal and external efficiency. In case of formation of internal efficiency the company has to concentrate more internal resources, i.e. fixed result is achieved by cost reduction. In external efficiency case the result is achieved by using available resources [1, 2, 8, 10].

In respect of analysed period the efficiency could be evaluated in a short and long term, as objectives of efficiency formation are different in dependence on the analysis perspective. One of the main short-term analysis objectives is profitable and high-quality activity, long-term period is characterized by the assurance of competitiveness and activity's development (Table 1).

Table 1. Methods of analysis of company's activity efficiency

The conception of company activity	
↓	↓
Internal evaluation of efficiency	**External evaluation of efficiency**
• Maximization of profit • Quality of service • optimization of Technical supply measures etc.	• Assessment of competitiveness • Environmental Investigation • Controllable market share • Technological changes etc.
↓	↓
Short-term period efficiency analysis	**Long-term period efficiency analysis**

For the analysis of short-term efficiency emergency (express) analysing methodology is used, which is mostly based on national accounting standards. In financial area the short-term efficiency is comprehensible as rational circulation of money in production process, which ensures positive result of production, fast production process cycle, which not only creates a profit, but also the cash flow needed to maintain the continuity of the production process [8]. Long-term period analysis methodology has to combine internal and external efficiency evaluation. Nowadays together with the traditional concepts of efficiency evaluation, which is based on rapid analysis, these conceptions: are used: balanced scorecard conception, the conception of knowledge and other. [8].

Efficiency and productivity assessment can define both quantitative and qualitative parameters of activity and their influence on the degree of integrated rates, for example, the evaluation of efficiency may be used in this dependence (1):

$$E = \int (k_i E_1, E_2, E_3, E_4), \tag{1}$$

where:

E_1 – marketing indicators: market share and activity volume growth rate indicators; qualitative and quantitative indicators of goods or services; marketing level of expenses; reputation and etc.;

E_2 – financial efficiency indicators;

E_3 – development indicators (the volume of investment, research expenses, etc.);

E_4 – internal business process efficiency indicators (productivity of resources, relation between cost of sales and used resources, etc.);

k_i – the significance coefficient of certain groups of indicators.

Significance coefficient can be established depending on the group of indicators, such as., marketing, finance and development indicators significance can reach 22%, internal business process efficiency - 34% [3].

Efficiency level can be set as the average indicator during the analysed period, as compared with the company's target market average indicators, standards etc.

Similarly short-term financial performance efficiency can be assessed (2):

$$e = \int (k_j \lambda_1, \lambda_2, \lambda_3), \tag{2}$$

where:

λ_1 – profitability;

λ_2 – turnover;

λ_3 – solvency;

λ_3 – indicators of level of expenses

k_j – certain group of financial indicators significance coefficient.

Certain financial indicators significance coefficients, first of all, depend on peculiarities of company's activity.

The efficiency of company's activity and it's increasing is the base of the long-term existence of the company [9].Therefore concept of efficiency and its peculiarities of formation vary according to the company's properties. For example, in manufacturing companies cash flow takes more time than in trading companies, in services companies this process is fastest .Depending on the company's activities, i.e. if the company is manufacturing, commercial or just providing services, organizations efficiency is pursued in different ways.

2. The conceptions of technical ship supply business activity

One of the main functional factors of technical ship supply business field is the conception of company activity, which describes the fundamental objective of the organization. The conception defines views, opinions and ideas of the system. Also there is distinguished the company's activity's (or business) conception, which describes the activities and organizational processes of perception way – this is the key to the functioning of the company's behaviour. Therefore, in each company there must be set the basic concept to be followed and implemented in all company's processes, taking into account the organization's goals and opportunities.

Technological technical ship supply companies' conception evaluation is traditionally considered the main in respect of macroeconomic analysis. The technology evaluations of these companies conception are limited by the fact that its role in the economy consists of maritime transport services performance. In case of such evaluation, the company is viewed as a structure that optimizes the cost of the supply of services under the specified volume, which depends primarily on the use of technological peculiarities. Ship technical supply company must take a decision to invest in certain types of technical supply: equipment, mobile control complex of technical ship condition, the operating licenses (certificates), etc. The investment in technology affects the company's capital structure, assets, liabilities, also company's ability to expand its activity, to earn income and to ensure financial stability.

Ship technical supply company must not only obey to certain economic relations, but also participate in their formation. Such a company's conception strategic evaluation is based on that the technical ship supply company is viewed as an active subject in the market. During the formation of strategy, the company has to take into account the whole macroeconomic situation, market conditions, actions of their competitors, the government's position, etc. The company's strategy is made in the form of overall development concept, its preparation demands business and specific actions plans, so business strategy development process is an important vessel equipment market participant.

Technical ship supply company must properly assess its capabilities in all the technological operations, it means that the company has to invest in the service delivery process or cooperate with other specialized companies. The associated group consists of business units, each of which works following its own business conception. In this way, a group of companies can best coordinate their business operations, including creating a synergistic relationship [7]. Therefore, the results of patronizing (or main) company depend on operating characteristics of the individual company of the group, operational strategies and their achieved financial results.

According to appropriate requirements in Lithuania technical ship maintenance is performed surveying the ships and by controlling their technical condition. Ship life-saving appliances, fire-fighting and other safety-related systems technical maintenance are an important part of the ships' overall operation. Human safety depends on them, which is why these systems must be in working order and their constant readiness for use must be assured. The SOLAS Convention and ISM Code state that all systems and equipment aboard a ship should be properly maintained, regularly inspected, replaced at set intervals and serviced by service stations at certain intervals [5].

3. The investigation of efficiency of technical ship supply companies activities

Nowadays in Lithuania there are registered more than 60 technical supply companies. The leading companies are registered in Klaipeda and are operating in the international market, because they can provide their services to ships at any port in the world. The leading companies are operating in groups, that allows diversifying and integrating the company's services, providing both industrial and commercial services. In Klaipeda market companies are competing with each other, the number of major competitors by production services reaches 3-4 companies and in the technical trading area – 10-15. According to the analysis, the degree of competition in the market can have a significant impact on the company's level of efficiency. Main activity of each technical ship supply company is presented in Figure 1.
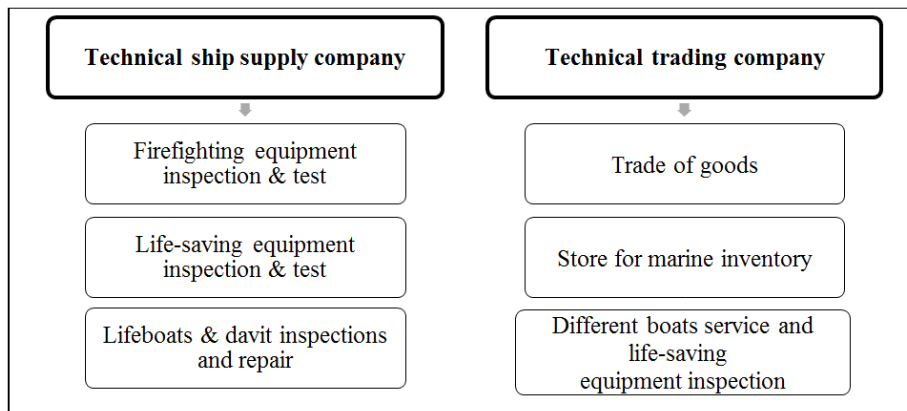
Figure 1. Main activity of technical ship supply companies.

There was accomplished research of the largest group of companies in Klaipeda market. The analysed group of companies was established in 2010 on the basis of technical ship supply companies restructuring. Today the group of companies is specialised in technical ship supply and service spheres. The financial leadership of the corporate generally analyses indicators provided by Lithuania standards, but not always paying attention to the peculiarities of formation of the efficiency. The research allows determining what the peculiarities of the efficiency formation are of manufacturing and trading technical ship supply companies. Trends of the income and expenses of companies' are presented in Figure 2.
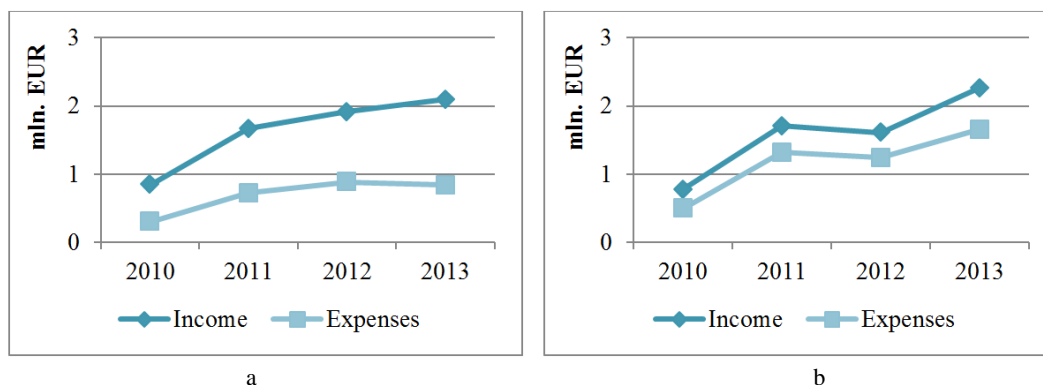

Figure 2. Income and expenses of company
a – technical ship supply company; b – technical trading company

The manufacturing technical ship supply company's sales income regularly increased for 4 years, while the cost of sales changed unevenly (Figure 2a). In 2013, the indicator gained the highest value. Technical trading company's sales income acquired different values (Figure 2b). In 2010 the income was lowest, and in 2011 the value doubled. In 2013 the indicator increased by 40% compared with the previous year. It was the largest value of income during the analysed period.

The dispersion coefficient of technical ship supply company of 4 last years is 0,15 and does not exceed the limit (0,20). Trading company's dispersion rate is 0,17, it is 0,02 more than in manufacturing organization. The overall conclusion of the two companies' dispersion coefficient suggests a lower degree of risk and a higher level of business stability, but technical ship supply company's indicator is higher.

The main profitability, level of expenses, turnover and solvency indicators are presented in Figure 3 and 4. Values of indicators of general profitability of sales during the analysed period were different in both companies. However, the average value of this indicator is higher in manufacturing company (0,59) than in trading (0,27). ROS and ROA values of manufacturing company is better (0,13 and 0,34) than trading company's - 0,02 and 0,07 (Figure 3a).
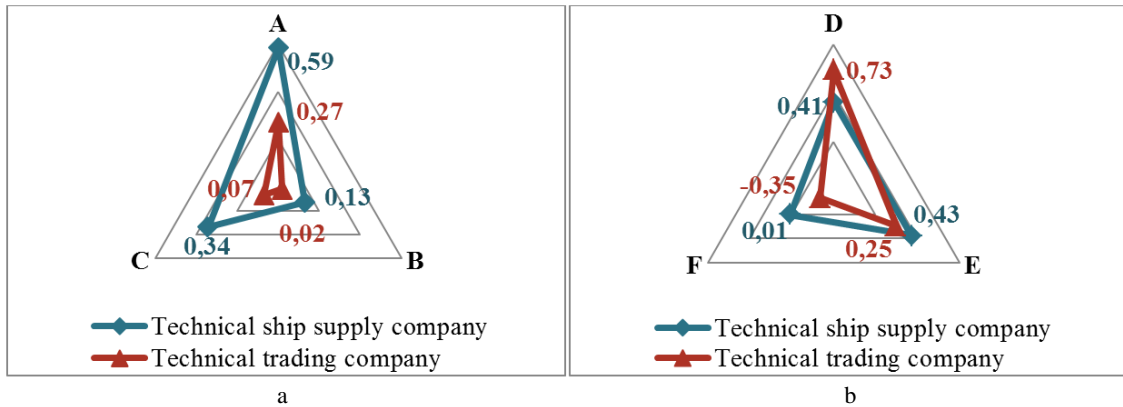
Figure 3. Profitability indicators and indicators of level of expenses of company
a – profitability indicators (A – gross margin, B – net profit margin, C – return of assets);
b – indicators of level of expenses (D – level of expenses, E – Financial and investment activity's expenses for one
euro of sales revenue, F – activity's expenses for one euro of sales revenue)

Indicators of level of expenses in both companies were unevenly distributed. The average level of cost of sales during the analysed period in manufactured company is lower (0,41) than the trading company's (0.73).it means that this organization can manage its' costs better. Technical ship supply company's operating expenses for one euro of sale approximately amounted to 0,43, technical service company's – 0,25 (Figure 3b). Both values are higher than prescribed value of rate (0,17-0,18), which means that company's reduction of cost policy is not appropriate. Financial and investment activity's expenses for one euro of sales revenue in manufactured company are in better control, because the value reaches 0,01, trading company this value of rate is negative (-0,35).
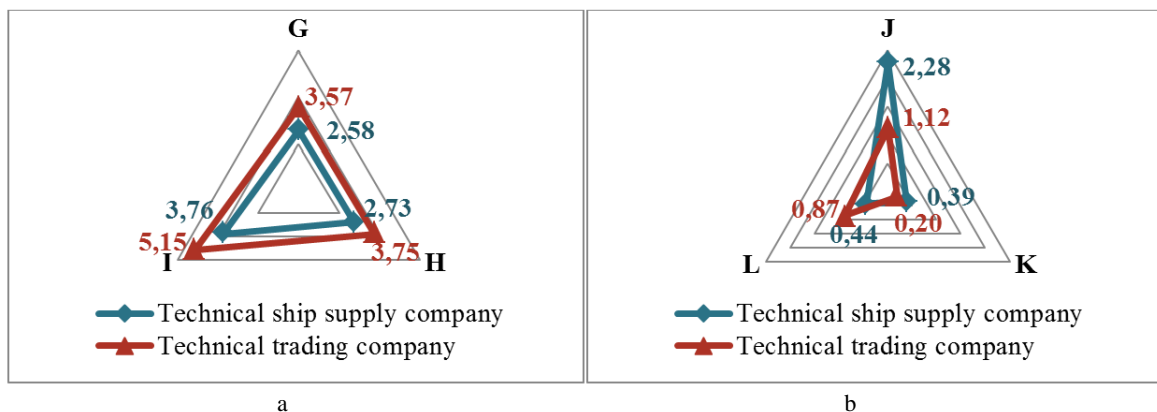
Figure 4. Turnover indicators and solvency indicators of company
a – turnover indicators (G – total asset turnover, H – current asset turnover, I – inventory turnover);
b – solvency indicators (J – current ratio, K – cash ratio, L – equity-to-debt ratio)

Analysis of turnover indicators shows that technical trading company's average values of turnover indicators are higher than technical ship supply company. Trading company's total asset turnover reached 3,57, and in manufacturing 2,58 (Figure 4a). The indicator of trading company's short term asset turnover was higher than of manufacturing company by 1,01 point. The indicator of inventories turnover in trading company (5,15) was higher than the indicator of manufacturing company (3,76).

Trading company's total asset turnover, current asset turnover and inventory turnover indicators are higher than in manufacturing company, because of better and more effectively managing both assets and inventory resources. In addition to that the analysis of the last 4 years showed the trend in decreasing of the indicator of inventory turnover.

The overall short-term solvency ratio of manufacturing company is 2,28 and trading – 1,12 (lower than normal value (1,20)). Value of Cash Rate solvency is higher in the first company too. However, the gross debt indicator of trading company is higher (0,87) than in supplying company (0,44) (Figure 4b).

The analysis of the main indicators of solvency revealed that technical ship supply company fulfils its' liabilities better than technical ship supply company; moreover, the trend of the increase of this indicator was defined in manufacturing company.

Using formula 2 and based on coefficients of financial significance: profitability 30% of importance, other indicators – 20%, conclusion was drawn up that effectiveness level of manufacturing company is higher than the level of effectiveness of trading company.

Similarly it is possible to calculate the efficiency indicators using Formula 1.

Conclusions

- The regular and complex evaluation of efficiency indicators is inseparable from the quality technical ship supply companies' activity assurance.
- The evaluation of company's activity should include both internal and external efficiency.
- The leading companies are operating in groups, that allows diversifying and integrating the company's services, providing both industrial and commercial services.
- The main company's financial efficiency indicators are: profitability, indicators of level of expenses, turnover and financial solvency.
- The risk of receipt of costs of sales in technical ship supply manufacturing company is lower than in trading technical ship supply company.
- Therefore manufacturing company's activity is more stable and less dependent on market fluctuations.

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MARITIME LEADERSHIP
REGARDING PSYCHOLOGICAL DIRECTIONS

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Abstract

This paper discusses a possibility of the relationship between the maritime leadership and main psychological theories. The research goal is a problematical discussion of the maritime leadership in regard to the psychological directions. The relationship between the maritime leadership and behaviorism, psychoanalysis and humanistic psychology is characterized. The methodology of the research is based on the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), the paradigm of the universal upbringing and existentialism. Methods such as scientific literature analysis, interpretation, heuristic and typological methods, comparison, hypothetical applying, classification, systemization and synthesis are used in the research. The methodological type of the research is theoretically descriptive.

Keywords: *maritime leadership, psychological directions, behaviorism, psychoanalysis, humanistic psychology.*

Introduction

Almost all areas of the social life, especially sectors of education and business, involve the leadership in some past decades. International maritime policy is progressive at the level of maritime technologies but conservative at the level of personnel management. It regulates the global maritime business and is changing gradually. It took on a practical idea of the leadership that is relevant for the post-industrial epoch. So called informative society, especially in developed countries, is characterized not only by material but also by non-material working motivation related to the working prestige, importance of its content and form, creative self-expression and psychological working-climate, and prospects of the vocational growth.

The STCW Convention with the Manila amendments requires the maritime leadership training and application to the ship-crew since 2012 [13]. This is a political change to enable the human factor as a personality of the seafarer. The personality greatly impacts on working processes and their quality. So, technological training of seafarers is combined with the psychological one.

The psychological approach to the maritime leadership is relevant because the personality and his/her psyche and behavior are an object of the psychological research regarding to the internal and external factors. However, types of the leadership and their application to the seafarers' work are different. Psychological directions are different as well. Psychological interpretations and evaluations of the psychic phenomena are different, too.

In other words, if the person needs a psychological consultation, he/she chooses such psychotherapist whose investigative direction as a base of values matches the base of values of the client. The maritime leadership and its application would be interpreted differently from the psychological point of view because nature of the leadership would be interpreted differently regarding to the mentioned base of values. Psychology is not clear in general because it depends on a direction that is chosen by the psychologist, and we must know its direction. The psychological direction is related to the special maritime leadership in reference to specific conditions of the seafarers' work.

The grade of the exploration

Relevant trends of the world of maritime industry related to the need of the leadership application are scientifically analyzed from the point of view of:
- Empowering of subordinates, the plight of international seafarers, responding to emerging challenges on board, recognizing of the importance of soft skills, enhancing of inter-personal relationship both on board and ashore;
- Motivation of people to perform effectively, safely and excel in their work and duties;
- The manner in which the global economic competitiveness in the shipping industry is influenced by the transformational leadership;

- Ability to communicate vision and strategies to the crew on behalf of the management;
- Maritime governance, policy-making, leadership of maritime education and training institutions, and psychological evaluation of seafarers;
- Promotion of good safety culture on board;
- Successful occupational career and reduction of health and life hazards in the maritime work environment;
- Physical and psychosocial work factors that are related to the levels of job satisfaction and intentions to remain in the maritime industry [1; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 14; 15; 18].

Problems of the maritime leadership in reference to the psychological directions are not investigated directly and systematically.

Goal and tasks of the research

The research goal is a problematical discussion of maritime leadership in regard to the psychological directions.

Tasks are as follows:
5. Revelation of the relationship between the leadership and behaviorism.
6. Characterization of the relationship between the leadership and psychoanalysis.
7. Discussion of the relationship between the leadership and humanistic psychology.

The research object is a possibility of the relationship between the leadership theories and psychological directions on board.

Methodological attitudes and type of the research

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

The STCW Convention 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 psychology for the development of 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.

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 horizon and helps people overcome the tragedy of existence, improve their emotional state and find unique comfort. Existentialism helps get a base of values for self-leadership and self-regulation in 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 scientific literature analysis, interpretation, heuristic and typological methods, comparison, hypothetical applying, classification, systemization and synthesis are used in the research.

The research is methodologically limited by main modern theories of leadership that are as follows:
- *The great man theory* (leadership is determined only by genes combination - "born to lead");
- *The trait theory of leadership* (some traits must be the best for the leader but all and various traits do leaders need from the holistic and separated point of view; the self-leadership helps develop traits of the leader but he/she must be "born to lead", too);
- *The skills theory of leadership* (there are technical, human and conceptual skills with a wide approach; improvement of self-leadership helps develop skills of the leader);

- *The style theory of leadership* (the best style does not exist because the leader must be able to concern for people and performance in the same time);
- *The situational leadership theory* (the leader must be flexible and able to respect the situation);
- *Transactional leadership* (it is characterized by rewards and punishments);
- *Leader-member exchange theory* (qualitative relationships between the leader and subordinates determinate better results but "lower performance - lower retention");
- *Transformational leadership* (not punishing non-compliance but following the leader's example is most important);
- *The contingency theory* (the leader is more oriented to the people or performance; it is appropriate to change the leader who is not able to flexibly lead, and whose own style does not match requirements of the environment; self-leadership helps match that);
- *Servant leadership theory* (the leader is ready to help subordinates in reference to the trust, cooperation, reciprocal service and higher performance; people follow out on behalf of love and gratitude rather than out of compulsion or fear) [1; 2; 17].

The research is methodologically limited by the main psychological directions that are as follows:
- *Behaviorism* (a human is not a subject but an object; his/her external behavior depends on the experience and environment; internal motivation, thinking and consciousness have lost their sense; the human behavior is like a behavior of an animal that must be trained by applying an award; behaviorism matches McGregor X theory: this theory considers a human as a primitive, lazy, unconscious and irresponsible object that is working because of threats, compulsion and permanent control but not of joyful self-expression);
- *Psychoanalysis* (a human is affected by powers of subconsciousness, conflicts experienced in childhood, and psychological defense mechanisms; consciousness is not a closed area but a part of entire psyche, and it is closely linked to the subconsciousness);
- *Humanistic psychology* (human is a whole and unique personality; he/she has his/her internal world combined with the external ambience; he/she is characterized by the power of the permanent development and self-implementation; he/she is free and freely makes decisions based on his/her perceived values; he/she is naturally active, creative and enjoying the results of his/her meaningful work; humanistic psychology matches McGregor Y theory that considers that a worker is motivated from his/her nature to work well and to consciously engage by decentralization of management, by supporting and conditions allowing a constructive expression of the worker, his/her participation by decision-making at work, and feeling to be important) [16].

The evaluation *criterion* of the relationship between the leadership and psychological direction is the specific work and life of seafarers on board.

The relationship between the maritime leadership and behaviorism

Behaviorism matches the ship-crew management by observing its members in general. It helps affect a confused worker or discipline an irresponsible worker in short-term perspective.

However, behaviorism limits a leader and does not allow him/her to know an internal freedom of each worker and to predict him/her 100 percent. Permanent control does not let make efforts sincerely. General relationship between behaviorism and leadership theories is shown in Figure 1.
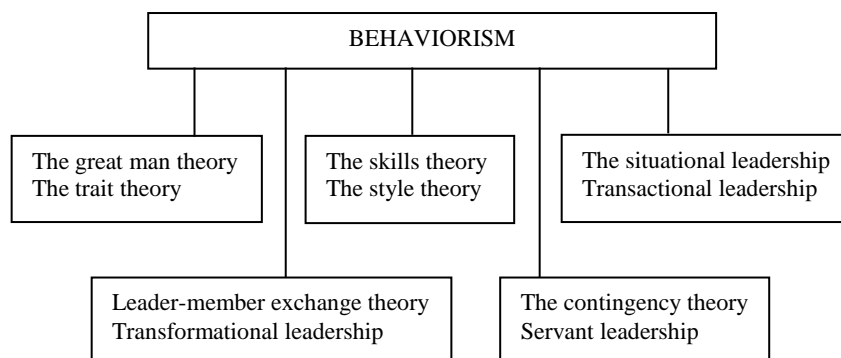

Figure 1. General relationship between behaviorism and leadership theories

The great man and trait theories of leadership are related to the behaviorist leader because of genes and natural traits. He/she perceives a worker that is predictable by observing, influencing, evaluating without expectations of his/her conscious changes. The leader overestimates the influence of his/her traits. The both theories can help develop his/her self-confidence. However, the work on board requires cooperation with the team and flexibility adapting to the non-standard situations at sea.

The skills theory relates to the behaviorist leader regarding to influence. If he/she can combine the technical, human and conceptual skills, it could help him/her change and know the differences of workers and their non-standard needs. Coordination of mentioned skills on board is important. However, application of human skills can be too difficult for the leader at the level of trust.

The style theory relates to the behaviorist leader in extreme conditions. Autocratic management is traditional in the fleet. He/she could be able to apply it. However, the ship-crew needs cooperation and the elements of democracy at relatively normal conditions. It can be too difficult for the behaviorist leader because of his/her tendency to lead but not to the conscious self-management of the crew-member.

The situational leadership theory is related to such kind of a leader more at the level of a technological but not of a human situation. The leader assumes a social responsibility too much because he/she is applying control but not a flexible cooperation with the team.

Transactional leadership relates to the behaviorist leader. It is relevant in extreme conditions at sea but does not let the consciousness of the crew-members grow. Punishment humiliates a human dignity (Z generation perceives a permanent control as a punishment). It does not necessarily promote improvement, especially when the leader does not believe in workers, shouts and is not able to explain intelligently.

Leader-member exchange theory requires not only control but also qualitative relationships.

Transformational leadership would relate to an honest behaviorist. However, a controlling but not cooperating leader does not allow workers to follow the leader's example usually.

The contingency theory relates to such behaviorist who is more oriented to the performance. This theory does not relate to the team-work on board because the team-work requires not only the control of the crew but also a flexible cooperation with them.

Servant leadership theory does not relate to the behaviorist leader. It is difficult to hope that such leader will apply trust, cooperation and reciprocal service by promoting the conscious subordinates.

So, behaviorist leader's worldview and management in extreme conditions at sea, but not for a professional growth of the crew, relate to the great man, trait and style theories and transactional leadership, and partially - the skills theory, situational leadership and contingency theory.

The relationship between the maritime leadership and psychoanalysis

Psychoanalytic leader believes that crew-members are depending on the subconscious conflicts and defense mechanisms. Such leader does not consider the worker as a partner but more as a victim managed by internal conflicts and by the leader who must help the worker understand his/her subconscious problems raised from the childhood negative experience. This task is too difficult for the leader on board. His/her function is not psychotherapy. The leader can help the crew-member, especially the beginner in maritime career, learn his/her own defense mechanisms if it is possible. Such leader recognizes the unique experience of the crew-member and becomes a moral authority by the adequate communication. General relationship between the psychoanalysis and leadership theories is shown in Figure 2.
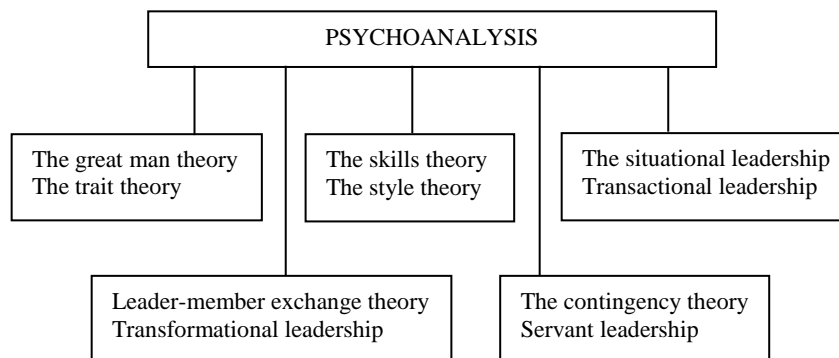

Figure 2. General relationship between the psychoanalysis and leadership theories

The great man and trait theories of leadership do not relate to the psychoanalytic leader. He/she perceives that genes and natural traits are overpowered by the childhood experience at the subconscious level. The responsible psychoanalytic leader is observing his/her own defense mechanisms and does not allow them to manage over him/her fully. Such a quite self-critical leader is useful by working with the team because he/she perceives the complexity of the personality.

The skills theory is related to the psychoanalytic leader because of coordination of the technical, human and conceptual skills. He/she knows about the difference of the worker's experience. Applying of the human skills increasingly relates to the explanation of the worker's experience and his/her internal conflicts. However, it would not be used properly at sea because of the extreme conditions of work.

The style theory relates to the psychoanalytic leader if he/she is able to apply the styles taking into account the effect of worker's subconsciousness. The leader can combine the autocratic style with the democratic at the normal work-conditions promoting the conscious self-management of crew-members.

The situational leadership theory is related to the psychoanalytic leader better than behaviorist. The leader performs more flexibly and he/she is able to respect the human situation. The leader perceives the wide technological and human prospects and not only a simple laziness of the subordinate.

Transactional leadership does not relate to the psychoanalytic leader who knows that punishments already made a negative effect to the maturity of worker's personality. Recognition of the subconsciousness allows the leader to overstep the primitive orientation only to the award or punishment.

Leader-member exchange theory relates to the psychoanalytic leader. He/she perceives the subconscious mechanisms and is cooperating with the crew-members as far as it is possible on board. Psychoanalysis does not let fully trust subordinates. This position is acceptable by working in extreme conditions at sea by the psycho-emotional stress and applying team-work.

Transformational leadership is related to the psychoanalytic leader who is interested in his/her own and worker's experience. Such leader can become a moral authority. However, the extreme conditions do not let conversations, and the worker might be unwilling to talk about himself/herself. The attention to the possible negative effects of the worker's subconsciousness does not let estimate the current conscious efforts of the worker. It limits the leader and does not allow the crew to follow the bothersome leader.

The contingency theory relates to the leader who is more oriented to the people. Work at sea requires combining the orientation to the staff and performance. Psychoanalysis limits the leader who knows the defense mechanisms of the crew and can not see the current constructive efforts well enough.

Servant leadership theory is related to the psychoanalytic leader if he/she is benevolent. This theory does not relate if the leader wishes only to manipulate the weak sides of subordinates. The benevolence condition helps the leader achieve the team-cooperation, reciprocal service and higher performance.

So, the situational leadership and leader-member exchange theory relate to the psychoanalytic leader. Other theories could be related to him/her by additional factors - self-criticism of the leader, combining of effects, non-bothersome benevolence and realism at normal working conditions at sea.

The relationship between the maritime leadership and humanistic psychology

Humanistic leader has noble prerequisites for the respectful cooperation with the ship-crew. This attitude does not guarantee an appropriate management in work processes. Extreme working conditions determine the combining of the benevolence with strictness. Humanism as a principle relates to the leadership. General relationship between the humanistic psychology and leadership is shown in Figure 3.
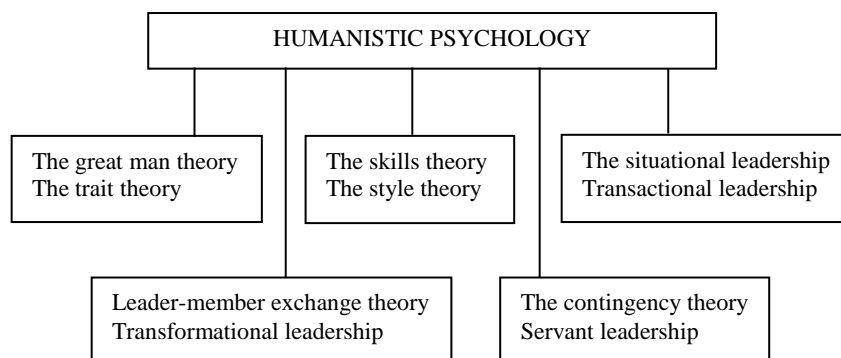

Figure 3. General relationship between the humanistic psychology and leadership theories

The great man and trait theories of leadership do not relate to the humanistic leader who perceives that genes and natural traits are changing in regard to the socio-cultural environment of education in life. The leader pays his/her attention to the possibilities to improve himself/herself and the ship-crew in trainings, and stresses a self-respect and self-expression by working at sea without these both theories.

The skills theory of leadership relates to the humanistic leader if he/she is able to combine the technical, human and conceptual skills. The leader is more related to the human skills. However, the mentioned human skills area could not be used properly because of the extreme working conditions at sea. Humanistic approach to these conditions is too much sensitive.

The style theory of leadership is related to the humanistic leader if he/she is able to apply it regarding to the working at sea. It is possible that humanistic leader is too weak to discipline and to apply autocratic style in extreme working conditions. Democratic style characterizes the humanistic leader. This style is appropriate at normal working conditions by promoting a conscious self-management of crew-members. It mostly relates to the supporting leadership in mentioned conditions.

The situational leadership theory relates to the humanistic leader if he/she is able to adapt to the changing social situations on board. However, it can be difficult for him/her to properly react to the changing technological situations, especially in extreme conditions.

Transactional leadership does not relate to the humanistic leader because he/she does not apply punishments primitively but, instead, is searching to the real cause of the problem. This leader can apply an award after the failure by seeking a long-term psychological effect but also by risking.

Leader-member exchange theory relates to the humanistic leader because he/she fully believes that a qualitative relationship between the leader and subordinates determinates better results. It is an essence of the leadership. The leader being realistic can estimate the failure with fewer awards naturally.

Transformational leadership is mostly related to the humanistic leader who struggles to be an authority for his/her crew allowing them to follow the leader's example. It is a base of the integration of leadership into the seafaring. However, the survival of the authority for a long-term perspective is not easy because of extreme working conditions that require a big maturity of the communication and cooperation, and strength of the leader's personality.

The contingency theory partially relates to the humanistic leader because this leader is more oriented to the people but not to the performance. It is important to combine these both orientations. A mature leader is able to know the crew-members quite at ease and manage them properly. This theory is dualistic - "either, or" but not integral. However, the maritime policy has perceived the idea of sustainability and leadership that can help inspire, motivate, combine and integrate in the maritime sector.

Servant leadership theory is mostly related to the humanistic leader characterized by trust, cooperation, reciprocal service and higher performance. He/she knows that people follow out on behalf of love and gratitude rather than out of compulsion or fear. However, the levels of crew-members' consciousness are different. The humanistic management psychology is limited, especially in cooperating with primitive, immature and demotivated members.

So, humanistic leader mostly relates to the leader-member exchange theory and transformational and servant leadership. He/she does not relate to the great man and trait theories and transactional leadership. The skills, style and contingency theories and the situational leadership are appropriate for humanistic leader if he/she is able to combine different skills and react properly in extreme conditions at sea.

Conclusions

General possibilities of relationship between the maritime leadership and psychological directions are revealed:

1. Behaviorist leader's worldview and management in extreme conditions at sea, but not for a professional growth of the crew, relate to the great man, trait and style theories and transactional leadership, and partially - the skills theory, situational leadership and contingency theory.

2. The situational leadership and leader-member exchange theory relate to the psychoanalytic leader. Other theories could be related to him/her by additional factors - self-criticism of the leader, combining of effects, non-bothersome benevolence and realism at normal working conditions at sea.

3. Humanistic leader mostly relates to the leader-member exchange theory and transformational and servant leadership. He/she does not relate to the great man and trait theories and transactional leadership. The skills, style and contingency theories and the situational leadership are appropriate for humanistic leader if he/she is able to combine different skills and react properly in extreme conditions at sea.

Behavioristic, psychoanalytic and humanistic worldview of the leader and his/her psychological effect on board must be combined according to the working-needs. It is appropriate to know one's own psychological tendency in self-cognition processes. This tendency naturally limits the leader by decision-making and promotes him/her to make a mistake or to achieve the success.

The results of the research can be applied theoretically and methodologically basing experimental researches of maritime leadership, and preparing seafarers at higher maritime education aimed to achieve their personal improvement regarding to the maritime leadership.

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MARITIME SECURITY WITH WEBSITE OF
THE SPANISH ARMADA

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Abstract
Spanish Armada has developed the website named "Collaborative Marine Environment of the Armada" (ENCOMAR) to promote Naval Cooperation and Guidance for Shipping (NCAGS). The use of this system in sea areas of risk for shipping ensures no gaps in maritime traffic, as verified in the Gulf of Aden and today in Guinea. The information provided by this website is an effective tool in maritime security. Students of Maritime Security of the School of Nautical of the University of Cantabria perform simulated maritime security exercises with website ENCOMAR participating online in naval exercises. This is a unique experience in the world, where students practice in a real way all the tools and procedures relating to maritime security together with the Spanish Armada.
Keywords: *maritime security, NCAGS, Spanish Armada, terrorism, piracy*

Introduction

After the attack on the Twin Towers in New York on September 11st, 2001 the security situation in world seaborne trade have changed. It has created an international standard requiring shipping companies and vessels to have a safety plan [1]. These security requirements imply that the captains and officers of the Merchants Marines must know all security protocols. When browsing hostile waters is a tool called NCAGS (Naval Cooperation and Guidance for Shipping) that is essential for the protection of the ship. The Bologna Process and the Manila Amendments [2] to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers Code (STCW 2010 Code). Maritime Safety and Security is one of the activities where a specific level of knowledge and understanding is required, to be able to react and minimize any possible threat on safety or security of the ship. The Manila Amendments design an adequate training scheme and are based on specific competencies among which they maximize security and maritime security [3, 4].

Piracy has existed as long as maritime trade, but in the last decade piracy is associated with international terrorist movements of a religious nature [5]. With the international diffusion of BMP4 (Best Management Practices for Protection against Somalia Based Piracy, Version 4.) published in 2011 [6], the merchant community began to be used widely to the NCAGS system in the area of Somalia. The fishing community, for their particular information reserve fishing areas to avoid competition, has resisted the use of this system of maritime safety. After the kidnapping of Spanish fishing Playa de Bakio in 2008 and Alakrana in 2009, the international fishing industry started giving importance to the NCAGS system. The nautical sports [7] community thought he was oblivious to all these problems, but the global upheaval that generated the approach of a French yacht that ended with the kidnapping of French citizen Evelyne Colombo and the murder of her husband by pirates served to alert sports seafarers.

NCAGS is a tool, which strengthens the security of the ship in risk areas into shipping [8]. Should you require secure naval escorts provide maritime traffic groups. Order to participate in this system must submit a simple form in which real-time information-planned movements by the ship. The merchant community can see all kinds of news and alerts for security in NCAGS Web pages. NATO maintains uninterruptedly operating a headquarter called "NATO Shipping Centre", which is the sole permanent NCAGS NATO in peacetime. In Spain, the Spanish Armada has a Maritime Action Force (FAM) with a Website named "Collaborative Marine Environment of the Armada" (ENCOMAR) [9].

The NCAGS tool is used in Gulf of Aden (Somalia) and Guinea. In 2013, 2014 and 2015 were no problems to shipping in this areas. NCAGS system demonstrates efficiency in maritime security.

1. The NCAGS tool

The history of the NCAGS tool began with the Spanish Empire. From 1566 to 1790 by the West Indies Fleet adopted the navigation in convoy system. These types of navigation in-group allowed to the galleons protect the cargo from piracy. During the First and Second World Wars, the navigation in convoys helped to maintain the safety and security of the fleets. In Spain until 1990 the merchant navy officers studying a course called CONTRAMAR (Vessel Traffic Management), now is derogated, this system was similar to the NCAGS tool.

The protection system NCAGS has been developed mainly by USA Navy in 2003. At the present time is a tool of NATO. This tool was formerly known as NCAPS (Naval Coordination and Protection of Shipping). NCAPS was originally established to meet a Cold War era national need to protect USA merchant shipping against a global open ocean threat. NCAPS policy included escorting and routing of large convoys of merchant shipping [14, 15]. NCAGS is based on globalization and by Internet can be safeguarded through any port or sea area in conflict with very few technical and human resources.

The threat to merchant shipping has changed and so has the naval control of shipping (NCS) mission. The primary threat to USA merchant vessels is no longer considered to be traditional naval vessels under the flag of a known enemy. Nowadays the threat is international terrorism fundamentalist [1, 10]. Shipping is of fundamental strategic interest to nations; indeed, economic wealth depends on the ability to trade, which in turn depends upon freedom of navigation. The Alliance's capability for operations involving merchant shipping is Naval Cooperation and Guidance for Shipping (NCAGS), with its associated tactics, techniques, and procedures [11].
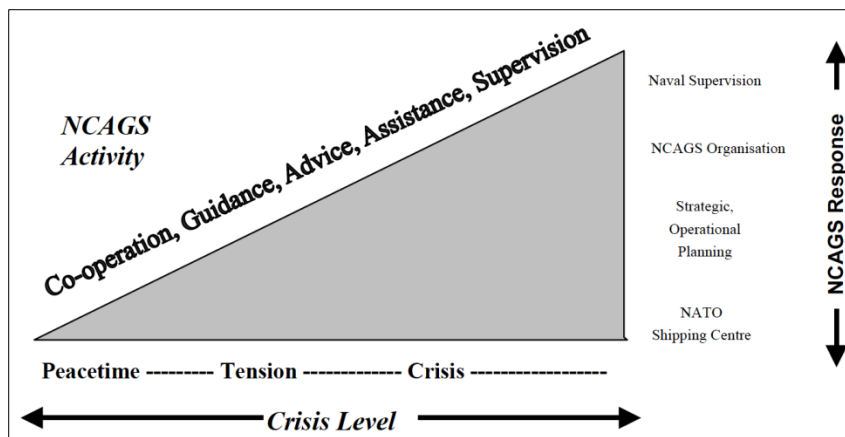

Figure 1. Naval Cooperation and Guidance for Shipping. Source: NATO.

Shipping will usually follow operational guidance or advice on a voluntary basis. Only in specific circumstances, depending on flag-state decisions, will operational commanders be authorized to exercise measures of control over merchant ships [12] as seem in Figure 1. The operational commander will consequently usually rely on two factors to ensure that merchant shipping follows guidance and advice. First, it will often be in the self-interest merchant shipping to do so. Second, merchant shipping can be influenced through building relationship of trust. NCAGS makes an important contribution to build such trust through collaboration, cooperation, and understanding of merchant shipping operations [13]. The principal effects are:

1st. NCAGS is only meaningful when a naval force carries out operations within a geographical area (AOO - Area of Operations), which is transited through by civilian shipping.

2nd. This cooperation system pursues coordinating, synchronizing and de-conflicting the activities carried out within the AOO by both military forces and civilian shipping. NATO has released a non-classified publication, which covers the relationship with civilian shipping.

"NATO Shipping Centre" has NCAGS publications available by Internet. The publication ATP-2 (B) Vol I and Vol II - Naval Cooperation and Guidance for Shipping manual (NCAGS) - Guide to Owners, Operators, Masters and Officers. NATO has established NCAGS to support naval operations, which may influence on civilian shipping. NCAGS will provide support to military commanders and civilian shipping in peacetime, tension, crisis and conflict [14, 15].

NATO´s point of contact with the Maritime Community is the NATO Shipping Centre. The NATO

Shipping Centre is part of Allied Maritime Command (MARCOM) Headquarters at Northwood, U.K. In Spain, the Spanish Armada has in the city of Cartagena the Headquarters Maritime Action Force (FAM). Both Headquarters are operating every day of the year in continuous time. The Admiral of Maritime Action (ALMART) is the Officer in Command of the FAM. He is also the principal executor of the permanent missions of the Spanish Armada, for which he is responsible before the Admiral of the Fleet (ALFLOT). The main of these missions is the surveillance of those waters of national interest, as well as the support to institutions and state-owned organizations with competences at the sea [9]. The COVAM (Maritime Surveillance and Operations Centre) is the tool used by the FAM to fuse and analyse the data received through a wide variety of different sources, and by means of which is able to obtain a near-to real-time image of what is happening within the Spanish waters of interest. This activity is known as Maritime Situation Awareness [9, 13]. The product resulting from this continuous merging and analysing process is known as Recognized Maritime Picture (RMP). The RMP is the final product that the COVAM offers to all Spanish Armada vessels at sea and, under specific request, to those national state-owned agencies with competences at sea.

1.1. NCAGS advantages

The purpose of NCAGS is to create practice of cooperation between naval and civil maritime authorities and agencies and the commercial shipping industry in order to facilitate an uninterrupted flow of shipping in periods of peace and conflict and simultaneously reduce disruption to military processes [14, 15]. The cooperation and frequent exchange of information achieve this goal. An accurate assessment of the shipping picture is critical to the accomplishment of this goal. Masters will be asked voluntarily to provide basic information concerning to the ship, the cargo, and voyage details. In times of increased tension or conflict, additional information may be requested. The response of Masters to information requests is one of the most important aspects of NCAGS. The commercial sensitivity of the information supplied by the merchant shipping community will be respected and protected [14, 15].

The NCAGS organization will in turn ensure that appropriate naval authorities are advised of these details during the maritime traffic. If the circumstances of the shipping deemed necessary, they will provide the merchant Master information concerning the situation and specific information about of maritime traffic [9]. NCAGS is a tool that has benefits to maritime community. The NCAGS benefits are:
– Improved safety and security.
– Minimized disruptions to passages through areas where military operations are being conducted.
– Quicker reaction to terrorism [16, 17].
– Better understanding of naval constraints.
– Minimized disruption to commercial schedules.
The benefits of NCAGS to the naval forces are:
– A more comprehensive picture of merchant activity and positions of merchant ships.
– Deconfliction of merchant ships in military operations.
– Enhanced safety and security of merchant ships.
– Improved effectiveness of military operations.
– A better understanding of commercial constraints.
The fishing vessels may be operating both in and outside the AOO. Therefore, some form of naval/civilian oversight over fishing vessels, both in transit and while actively engaged in fishing may be necessary. Therefore the benefits of Cooperation for the fishing vessel are [9, 14, 15]:
- To keep fishing vessels clear of military sensitive areas such as submarine operating areas and "noise sensitive" areas where towed arrays of underwater listening devices may be employed.
- To avoid areas where enemy forces may be deployed, including mined areas.
- To maintain a plot, as far as practicable and convenient, of all fishing activity.
- To ensure as far as is practical, that NATO's fishing fleets continue to provide for national needs and with minimum disruption.
The principal benefits to the fishing community are [9, 14, 15]:
- Ensuring uninterrupted fishing for as long as possible.
- Maintaining the information flow between the military and fishing authorities.
- Enhancing safety in transit and at fishing grounds.
- Limiting mutual interference between fishing and military activities.

1.2. NCGAS process

The NCAGS system is based on each ship that voluntarily decides navigate NCAGS zone. For this purpose, the NCAGS tool has two documents named "formats", the Format Alpha and Format Bravo [14, 15].

The Format Alpha is a data format that a ship needs to send to NCAGS organization for to enter voluntarily in a NCAGS zone. The Format Bravo is a format of summary data that is used to remind the NCAGS organization that the ship is more than 24 hours in your system. Every 24 hours, participating vessels must send a Format Bravo to NCAGS organization.

All times will be in UTC, also named ZULU Time. This information can be sent over the Internet or by GMDSS. Internet makes information quickly NCAGS be securely shared by all stakeholders involved. This eliminates contamination information for illegal purposes [18, 19, 20]. Another positive aspect is having economic NCAGS operation. NCAGS organization only need a PC, phone or tablet connected to the Internet and follow the procedures NCAGS [14, 15]. This system is very simple but very effective.

The Format Alpha is a principal means by which NATO gathers data regarding shipping [14, 15]. The form is divided into four sections, this sections are:

SECTION A. Ship Data. Covers basic details of the merchant vessel, fishing vessel or nautical craft:
(1) Ship's name.
(2) International callsign.
(3) Type of vessel.
(4) Flag of registry.
(5) IMO number.
(6) Port of registry.
(7) Overall length.
(8) Vessel's width.
(9) Maximum draft for present voyage.
(10) Vessel's gross tonnage.
(11) Speed:
(a) Service speed.
(b) Maximum speed.
(c) Minimum speed.
(12) Significant appearance of vessel for optical recognition.
(13) MMSI (maritime mobile service identity) number.
(14) Name of communication stations being copied.
(15) INMARSAT telephone numbers.
(16) INMARSAT Fax numbers.
(17) INMARSAT telex numbers.
(18) INMARSAT data numbers.
(19) Other communication means, including email.
SECTION B. Voyage Data. Covers details of the current voyage:
(20) Intended movement—description of passage.
(21) Last port/country of call, including actual date and time of departure from last port.
(22) Next port of call, including ETA at next port of call.
(23) Current position.
(24) Date/time and position entering the region. Waypoints of intended track through of NCAGS zone (date/time, latitudes/longitudes).
(25) Position and date/time departing the region.
SECTION C. Operator Data. Covers details of the ship's operator:
(26) Name of ship owner/operator, including address of ship owner, name of charterer (if any) and address of operator/charterer.
(27) Email address of the above.
(28) Telephone number of the above.
(29) Fax number of the above.
SECTION D. Cargo Data. Covers cargo data:
(30) Quantity and nature of main/relevant cargo.
(31) Shippers of main/relevant cargo.
(32) Origin of main/relevant cargo.
(33) Consignee of main/relevant cargo.

(34) Final destination of main/relevant cargo.

(35) Special queries appropriate to current operation such as "State if any cargo/person being carried is subject to UN sanctions, by YES or NO (if the answer to the query is YES, then describe on a separate sheet)."

The Format Bravo, is a daily position report, should be sent when requested by naval authorities every 24 hours after the initial passage report of the Format Alpha [14, 15]. The elements of the Format Bravo are:

(1) Vessels name.

(2) IMO number.

(3) Current position (at time UTC).

(4) Any change to itinerary (waypoints).

2. Basic competence in maritime security

The requirements for security-related training and instruction for all seafarers are in Section A-VI/6 of the Manila amendments to STCW Code [2, 21]. In the case of Spain, the General Directorate of Maritime Affairs has established as standard of competence in security awareness the IMO model course 3.26. This training is given in the School of Nautical Studies of the University of Cantabria to the three degrees in the subjects "Maritime Safety and Security I", the degrees are: Nautical Engineering and Maritime Transport, Marine Engineering and Maritime Engineering (Naval Engineering).

The practical part of this course is complemented by the participation of all students of the subject "Maritime Safety and Security I" in the exercise on Maritime Security that takes place every year by Spanish Armada MARSEC in mid-May. The participation of students is carried out online [3, 8]. Spanish Armada, on its institutional Web page, has a link called "Maritime Collaborative Website of the Spanish Armada (ENCOMAR)" see Figure 2. In this website Spanish Armada has maritime traffic information compromised by terrorist areas and piracy [22]. They make several scenarios for collaborative NCAGS training, to train units of the Spanish Armada and the merchant marine to familiarize themselves with collaborative procedures and establishing cooperation [9, 14, 15].

Figure 2. Web "ENCOMAR" of the Spanish Armada. Source: Spanish Armada.

The Maritime Collaborative Website of the Spanish Armada (ENCOMAR) is staffed every day of the year, continuously by The COVAM (Maritime Surveillance and Operations Centre). It is the tool used by the FAM (Maritime Action Force of the Spanish Armada) to fuse and analyse the data received through a wide variety of different sources, and by means of which is able to obtain a near-to real-time image of what is happening within the Spanish waters of interest [9]. This activity is known as Maritime Situation Awareness. The product resulting from this continuous merging and analysing process is known as Recognized Maritime Picture (RMP). The RMP is the final product that the COVAM offers to all Spanish Armada vessels at sea and, under specific request, to those national state-owned agencies with competences at sea [9].

Figure 3. Students of the School of Nautical Studies of Cantabria University participating online by Web of the Spanish Armada. Source: Communication service of the University of Cantabria.
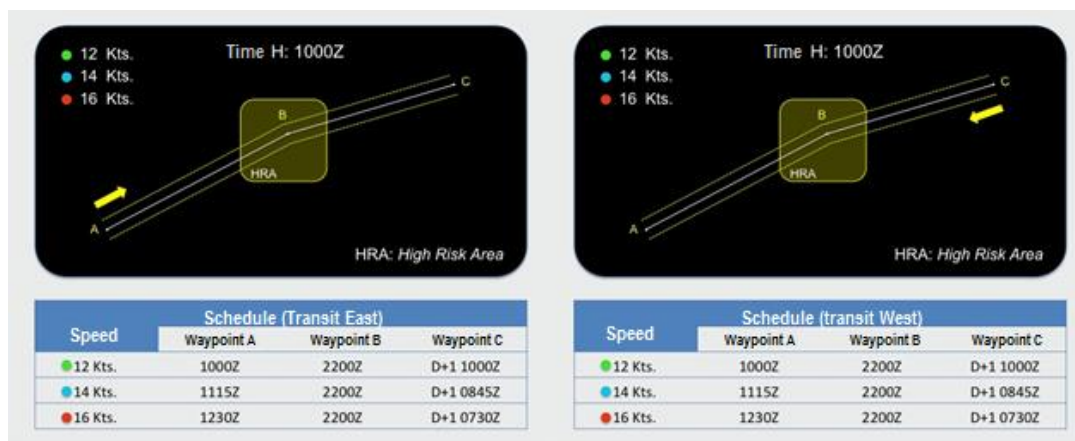

Figure 4. Maritime navigation corridors for School of Nautical School of Cantabria University with ENCOMAR. Source: Spanish Armada.

In this experience the Spanish Armada designs a specific scenario for students of the School of Nautical Studies of the University of Cantabria. Students practice (as seem in Figure 3) with a similar scenario that can be identified in reality. A similar scenario to that found in the Gulf of Aden in Somalia (GOA) or in the Guinean area. With this scenario, the students will practice with the ship security tool NCAGS [14, 15]. The Spanish Armada from its institutional website will also create an access to the exercise for students. From this platform, the Spanish Armada receives requests for traffic of students and simulates cases of ship security. This information is presented in the NCAGS formats Alfa and Bravo, tools to ensure the operation of maritime traffic are guaranteed by a naval force if necessary. Students participate in the exercise operating a vessel with characteristics defined by them. Also, the students participate in this exercise by performing a simulation of a navigation corridor that ensure their security in navigation, speed depending on his ship as seem in Figure 4.

To give more realism to the participation of students, the Spanish Armada sends by e-mail navigation instructions and notices to mariners to the students. This dynamism serves to reinforce the learning of the students as well as to reinforce the concepts and methods of the ship security tool.

Conclusions

- Basic training in Maritime Security has to be part of the Nautical Engineering and Maritime Transport, Marine Engineering and Maritime Engineering (Naval Engineering) degrees, because shipping is influenced by maritime security.

- Participation in the exercise of Maritime Security (MARSEC) of the Spanish Armada in the training of students serves to improve real knowledge on Maritime Security.

- The Maritime Collaborative Website of the Spanish Armada (ENCOMAR) is a tool to fight to piracy and terrorism. This tool ensures maritime protection as happened after diffusion in the merchant community in areas as Somalia and Guinea.

- Students who have participated in the exercises MARSEC have learned to contact with the Naval force, in the case of Spain with the COVAM and other theatres with the NATO Shipping Centre.

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A THEORETICAL METHOD OF PRODUCING THE COOLANT FOR MARINE ENGINES

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Abstract

Based on mathematical simulation the set of thermophysical parameters defined and obtain criteria permitting to pick up theoretically the coolant for internal combustion engine of marine vessels. By means of the suggested method, without resorting to experiments to get a more effective coolant is succeeded. The results of the paper is the basis for development of a complex of measures on improvement of the cooling parameters of the existing and prospective internal combustion, marine engines that have the most significant influence on performance of the vessel.

Keywords: *binary mixtures, boiling, homogeneous mixtures, condensation, liquid, bubble, pressure, thermal diffusivity, diffusion coefficient, density*

Nomenclature

ρ_l, ρ_1, ρ_2 : density of the mixture and components

k : concentration of the first component

R : radius of bubbles

T_l : liquid temperature

w_l : radial velocity of the liquid at the bubble surface

a_l : thermal diffusivity of the fluid

D_l : diffusion coefficient

p_1, p_2 : pressure of vapor components in the bubble

σ, v_1 : coefficients of surface tension and the kinematic viscosity of the fluid

Introduction

The methods for producing coolants intended for the cooling system of marine engines, the motor car engines, agricultural machinery, special equipment are often developed in shipbuilding, chemical engineering, metallurgy and mechanical engineering. The coolants are used as heat transfer agent in various heat exchangers operated at lower and moderate temperatures for hardening products, cooling the units of mills for thin and ultrathin grinding while producing metallic powders, etc.

All known methods for producing coolants are related with high cost, lower efficiency. We cite some of them as an example. So, in the method for cooling the rolling (certificate of authorship of the USSR619524, C21D 1/60) increase of cooling efficiency and economy of the process by the by thermal treatment of rolling is attained by supplying the cooled surface a water-air mixture with its further evaporation. The use of this method provides intensification of the cooling process by increasing the heat transfer coefficient and significant reduction in water consumption at the expense of full use, by the opinion of the authors, of its thermophysical properties. The lack of the method is the absence of opportunities to achieve optimal cooling regimes which may be organized by means of initial supply of water-air mixture to the rolling surface in the first section.

It's a rule, cooling of heat generating surfaces is achieved with the help of influence of fluids. What's more, many component mixtures, in particular binary mixtures (mixture of two fluids) but not pure components are used. At boiling of mixture there hold such processes that don't hold at boiling of pure components, that may be harmful for the system.

At boiling of binary mixture with significantly different volatilities of components, the mass concentration in gas and liquid phases strongly differ. As a result, the heat-transfer coefficient in the mixture may be significantly lower than the heat transfer coefficients of their pure components.

In many cases, the solutions should be frost-proof, i.e. they shouldn't freeze. In the language of mechanics, this means that the liquid should have minimal velocity of phase transformations (for example, boiling, freezing)

The composition and concentration of binary mixture is selected experimentally. The composition is varied so that the velocity of phase transformations were minimal. This requires much time, and great amount of reagents, expensive equipment.

Description of research

In the paper we put a problem of mathematical simulation of the described processes, development of the method of theoretical solution of the stated problem. With the help of the obtained results of the suggested model we put a problem on producing necessary binary solution not resorting to experiment.

Dynamics and heat mass exchange of the porous bubble in binary solution of liquids when thermal, diffusive and inertia effects are significant simultaneously, were studied in the paper [2]. A binary mixture of density ρ_l, consisting of components 1 and 2 with the given densities ρ_1 and ρ_2, respectively, was considered.

The mass fraction of component 1 of the mixture k is the ratio of the mass of the 1-st component m_1 to the mass of the solution $m_1 + m_2$. $k = \dfrac{m_1}{m_1 + m_2} = \dfrac{\rho_1 V}{\rho_1 V + \rho_2 V} = \dfrac{\rho_1}{\rho_1 + \rho_2}$. Since $\rho_1 + \rho_2 = \rho_l$ then $\rho_1 / \rho_l = k$, $\rho_2 / \rho_l = 1 - k$. Here k is a pure variable accepting the values from 0 to 1 or 0 to 100% (in the last case we mean percent concentration by weight).

For simplicity of description, the solution is considered ideal, and the processes around the bubble are considered within the spherical-symmetrical scheme. The parameters inside the bubble are assumed homogenous independent of the space coordinate.

Within the accepted assumptions, the heat influx and diffusion equations in spherical Euler coordinates (r,t) will take the form:

$$\frac{\partial T_l}{\partial t} + w_l \frac{R^2}{r^2} \frac{\partial T_l}{\partial r} = \frac{a_l}{r^2} \frac{\partial}{\partial r}\left(r^2 \frac{\partial T_l}{\partial r} \right) \qquad (1)$$

$$\frac{\partial k}{\partial t} + w_l \frac{R^2}{r^2} \frac{\partial k}{\partial r} = \frac{D_l}{r^2} \frac{\partial}{\partial r}\left(r^2 \frac{\partial k}{\partial r} \right) \qquad (2)$$

Here T_l is the fluid temperature, w_l is radial velocity of fluid on the bubble's surface, $a_l = \dfrac{\lambda_l}{\rho_l c_l}$ is the thermal diffusivity of the fluid, D_l is the diffusion coefficient.

The bubble's dynamics is described by the Reileigh equation [2-6]

$$R \overset{\bullet}{w_l} + \frac{3}{2} w_l^2 = \frac{p_1 + p_2 - p_\infty - 2\sigma / R}{\rho_l} - 4 v_1 \frac{w_l}{R}, \qquad (3)$$

where p_1 and p_2 are the vapor component pressures in the bubble, p_∞ is fluid pressure far from bubble, σ and v_1 are the coefficient of surface tension and kinematic viscosity of fluid.

Consider the condition of conservation of mass at the interface. The mass flow j_i of the i-th component (i=1,2) from the interface surface $r = R(t)$ to the j-th phase per a volume unit area and unit time, and characterizing the phase passage intensity, is determined by the expression:

$$j_i = \rho_i \left(\overset{\bullet}{R} - w_l - w_i \right), \qquad (i = 1,2), \qquad (4)$$

where w - are diffusive velocities of component on the bubble surface.

Relative motion of the solution components near the interphase surface is determined by the Fick law:

$$\rho_1 w_1 = -\rho_2 w_2 = -\rho_l D_l \left.\frac{\partial k}{\partial r}\right|_R \tag{5}$$

If we put together equations of (4), take into account $\rho_1 + \rho_2 = \rho_l$ and attract equation (5), we get

$$\overset{\bullet}{R} = w_l + \frac{j_1 + j_2}{\rho_l} \tag{6}$$

Multiply the first equation of (4) by ρ_2, the second one by ρ_1 and subtract the second equation from the first one following for (5) we get:

$$k_R j_2 - (1 - k_R)j_1 = -\rho_l D_l \left.\frac{\partial k}{\partial r}\right|_R \tag{7}$$

Here k_R is the concentration of the first component on the phase interface.

At the assumption on the homogeneity of the parameters inside the bubble, we can write the change of mass of each component at the expense of phase transformations in the form:

$$\frac{d}{dt}\left(\frac{4}{3}\pi R^3 \rho_i'\right) = 4\pi R^2 j_i \quad \text{or} \quad \frac{R}{3}\overset{\bullet}{\rho_i'} + \overset{\bullet}{R}\rho_i' = j_i, \ (i = 1,2) \tag{8}$$

Express the composition of binary mixture in the mole fractions of the component with respect to total amount of the substance in the liquid phase. The mole fraction of component 1 of the mixture N is the ratio of the number of moles of the first component n_1 to the sum of moles n_1+n_2 of all the components generating a solution, is a pure variable:

$$N = \frac{n_1}{n_1 + n_2} \tag{9}$$

Express the number of the moles of the i-th component n_1 occupying the volume V by its density

$$n_i = \frac{\rho_i V}{\mu_i} \tag{10}$$

Substituting (10) in (9), we get

$$N_1(k) = \frac{\mu_2 k}{\mu_2 k + \mu_1(1 - k)} \tag{11}$$

By Raoult's law, the partial pressure of the component over the solution is proportional to its mole fraction in liquid phase, i.e.

$$p_1 = p_{S1}(T_v)N_1(k_R), \quad p_2 = p_{S2}(T_v)[1 - N_1(k_R)] \tag{12}$$

Equations of the state of the phases are of the form

$$p_i = BT_v \rho_i' / \mu_i, \ (i = 1,2) \tag{13}$$

In equations (12) and (13) B is a gas constant, T_v is temperature of vapor, ρ_i' are the vapor mixture components in the bubble, μ_i are molecular weights, p_{Si} are saturating pressure.

The saturation vapor pressures p_{Si} of the mixture components are determined by integration of Clayperon – Clausius relations:

$$\frac{dp_{Si}}{dT_v} = \frac{l_i \rho_i'}{T_v} = \frac{l_i \mu_i}{B}\frac{p_{Si}}{T_v}, \ (i = 1,2) \tag{14}$$

As a result of integration of (14), we get:

$$p_{Si} = p_{Si0}e^{\frac{l_i \mu_i}{B}\left(\frac{1}{T_{v0}} - \frac{1}{T_v}\right)}, \ (i = 1,2) \tag{15}$$

The saturating vapor pressures p_{si0} of the mixture components at initial temperature T_0 were equal:

$$p_{Si0} = p_0 \exp\left[\frac{l_i \mu_i}{B}\left(\frac{1}{T_{ki}} - \frac{1}{T_0}\right)\right], \ (i = 1,2) \qquad (16)$$

In relation (16) T_{ki} is boiling temperatures of liquids of constituent of the binary solutions at initial pressure p_0.

The boundary conditions for $r = \infty$ and on the movable boundary are written in the form:

$$k\big|_{r=\infty} = k_0, \ k\big|_{r=R} = k_R, \ T_l\big|_{r=\infty} = T_0, \ T_l\big|_{r=R} = T_v$$

$$j_1 l_1 + j_2 l_2 = \lambda_l \frac{\partial T_l}{\partial r}\bigg|_{r=R} \qquad (17)$$

We accept the initial conditions for $t = 0$ as following:

$$R = R_0, \ T_l = T_0, \ k = k_0, \ p_i = p_{i0}, \ \rho_i' = \rho_{i0}', \ T_v = T_0, \ j_i = 0, \ w_l = 0 \qquad (18)$$

According to Dalton's law, the pressure of chemically not interacting ideal gases in the bubble equals the sum of partial pressures: $p_1 + p_2 = p$.

Substituting to the equality $p_{10} + p_{20} = p_0$ the values of the pressures of components (13) at initial pressure p_o : $p_{10} + p_{20} = p_{s10} N_{10}(k_0) + p_{s20}[1 - N_{10}(k_0)] = p_0$ with regard to (15) we define the equilibrium concentration of vapor of component 1:

$$k_0 = \frac{1 - \chi_2^0}{1 - \chi_2^0 + \mu(\chi_1^0 - 1)}, \ N_{10}(k_0) = \frac{\mu k_0}{\mu k_0 + 1 - k_0}$$

$$\mu = \mu_2 / \mu_1, \ \chi_i^0 = p_{Si0} / p_0 = \exp\left[\frac{l_i \mu_i}{B}\left(\frac{1}{T_{ki}} - \frac{1}{T_0}\right)\right], \ i = 1,2 \qquad (19)$$

Having expressed in the equality $c_0 = \dfrac{\rho_{10}'}{\rho_{10}' + \rho_{20}'}$ the values of densities of components of (14) by the

initial pressures p_{10} and p_{20}, we define the equilibrium concentration of vapor of component 1:

$$c_0 = \frac{k_0 \chi_1^0}{k_0 \chi_1^0 + (1 - k_0)\chi_2^0} \qquad (20)$$

The system of equations (1)-(18) is a closed system of equations describing the dynamics and heat exchange of the vapor bubble with binary solution of liquids.

Solution method: The system of equations (1)-(18) may be used for studying evolution of perturbations in medium containing a boiling binary mixture.

In the sequel we'll use the following pure variables and parameters:

$$\delta = R/R_0, \ W = w_l R_0 / a_l, \ P_i = p_i / p_{i0}, \ J_i = j_i R_0 / a_l \rho_l,$$

$$\theta_l = T_l / T_0, \ \theta_v = T_v / T_0, \ K = k/k_0, \ Z_i = \rho_i' / \rho_{i0}',$$

$$\tau = t a_l / R_0^2, \ \xi = r/R_0, \ Le = D_l / a_l, \ L = l_2 / l_1, \ S = c_l T_0 / l_1, \ Re = a_l / 4\nu_1, \qquad (21)$$

$$\alpha_i = p_{i0} / p_0, \ \beta = \frac{p_0}{\rho_l}\left(\frac{R_0}{a_l}\right)^2, \ \Sigma = 2\sigma / R_0 p_0, \ \eta = \frac{\rho_l}{\rho_{10}' + \rho_{20}'}$$

Then equations (1), (2), boundary and initial conditions (17), (18), (19) in the dimensionless form will take the form:

$$\frac{\partial \theta_l}{\partial \tau} + W \frac{\delta^2}{\xi^2} \frac{\partial \theta_l}{\partial \xi} = \frac{1}{\xi^2} \frac{\partial}{\partial \xi}\left(\xi^2 \frac{\partial \theta_l}{\partial \xi}\right)$$

$$\frac{\partial K}{\partial \tau} + W \frac{R^2}{\xi^2} \frac{\partial K}{\partial \xi} = \frac{Le}{\xi^2} \frac{\partial}{\partial \xi}\left(\xi^2 \frac{\partial K}{\partial \xi}\right) \qquad (22)$$

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$$K\big|_{\xi=\infty} = 1, \; K\big|_{\xi=\delta} = K_R, \; \theta_l\big|_{r=\infty} = 1, \; \theta_l\big|_{\xi=\delta} = \theta_v \tag{23}$$

$$J_1 + LJ_2 = S\frac{\partial \theta_l}{\partial \xi}\bigg|_{\xi=\delta} \tag{24}$$

Equations (3), (6), (7), (8), (12), (13) will be written in the form:

$$\delta \dot{W} + \frac{3}{2}W^2 = \beta(\alpha_1 P_1 + \alpha_2 P_2 - 1 + \Sigma - \Sigma/\delta) - \frac{W}{\text{Re}\cdot\delta} \tag{25}$$

$$\frac{d\delta}{d\tau} = W + J_1 + J_2 \tag{26}$$

$$K_R J_2 - \frac{(1 - K_R k_0)}{k_0} J_1 = -Le\frac{\partial K}{\partial \xi}\bigg|_{\xi=\delta} \tag{27}$$

$$\delta \dot{Z}_1 + 3Z_1 \dot{\delta} = 3\eta J_1/c_0 \qquad \delta \dot{Z}_2 + 3Z_2 \dot{\delta} = 3\eta J_2/(1 - c_0) \tag{28}$$

$$P_i = Z_i \theta_v, \; (i = 1,2) \tag{29}$$

$$P_1 N_{10}(k_0) = e^{\frac{l_1 \mu_1}{BT_0}\left(1 - \frac{1}{\theta_V}\right)} N_1(k_R), \;\; N_1(k_R) = \frac{\mu K_R}{\mu K_R + (1 - k_0 K_R)/k_0} \tag{30}$$

$$P_2[1 - N_{10}(k_0)] = e^{\frac{l_2 \mu_2}{BT_0}\left(1 - \frac{1}{\theta_V}\right)}[1 - N_1(k_R)]$$

From equations (24) and (27) we get the dependences of J_1 and J_2 on temperature and concentration gradients in the form:

$$J_1 = \frac{SK_R \dfrac{\partial \theta_l}{\partial \xi}\bigg|_{\xi=\delta} + L\cdot Le\dfrac{\partial K}{\partial \xi}\bigg|_{\xi=\delta}}{K_R + L\dfrac{1 - k_0 K_R}{k_0}}, \;\; J_2 = \frac{S\dfrac{1 - k_0 K_R}{k_0}\dfrac{\partial \theta_l}{\partial \xi}\bigg|_{\xi=\delta} - Le\dfrac{\partial K}{\partial \xi}\bigg|_{\xi=\delta}}{K_R + L\dfrac{1 - k_0 K_R}{k_0}} \tag{31}$$

The initial conditions for $\tau = 0$ will be written in the form:

$$\delta = 1, \; \theta_l = 1, \; \theta_v = 1, \; K = 1, \; P_l = 1, \; Z_i = 1, \; J_i = 0, \; W = 0 \tag{32}$$

We'll look for the solution of the system of equations in the form of the real part of the following complex expressions:

$$\varphi = 1 + \varphi^0 \exp(i\Omega_* \tau), \; J_i = J_i^0 \exp(i\Omega_* \tau), \; W = W^0 \exp(i\Omega_* \tau) \tag{33}$$

In relations (33) $\varphi = \delta$, $\theta_l(\xi)$, θ_v, $K(\xi)$, K_R, P_i, Z_i; $\varphi^0 = \varphi_*^0 + i\varphi_{**}^0$, $\left|\varphi^0\right| << 1$, $\Omega_* = \Omega + i\Omega_{**}$, where $\varphi^0 = \delta^0$, $\theta_l^0(\xi)$, θ_v^0, $K^0(\xi)$, K_R^0, P_i^0, Z_i^0, J_i^0, W^0 defines complex amplitudes of perturbations of displacements, temperature, concentration, pressure, density, intensity of phase transformations and velocity. In this case we have:

$$\varphi^0 \exp(i\Omega_* \tau) = (\varphi_*^0 + i\varphi_{**}^0)\exp(-\Omega_{**} + i\Omega)\tau = (\varphi_*^0 + i\varphi_{**}^0)\exp(-\Omega_{**}\tau) \times [\cos\Omega\tau + i\sin\Omega\tau],$$
$$\text{Re}\,\varphi^0 \exp(i\Omega_* \tau) = \exp(-\Omega_{**}\tau)\left|\varphi^0\right|\sin(\Omega\tau + \Psi) \tag{34}$$

Here: $\left|\varphi^0\right| = \sqrt{\varphi_*^{0\,2} + \varphi_{**}^{0\,2}}$, $\Psi = arctg\left(-\varphi_*^0/\varphi_{**}^0\right)$.

Thus, the solution of type (33) is an analog of free oscillations, a sinusoidal and for $\Omega_{**} > 0$ exponentially damping in time perturbation. Here $\Omega_{**} > 0$ is the damping decrement of oscillations in time, Ψ is the initial phase. The logarithmic damping decrement equals the ratio of amplitudes $A(\tau)$ lagging in the time by the period $T = 2\pi/\Omega$:

$$\Lambda = \ln \frac{A(\tau)}{A(\tau+T)} = \ln e^{\Omega_{**}T} = 2\pi \frac{\Omega_{**}}{\Omega} \tag{35}$$

The system of equations (22), (23), (25), (26) - (31) linearized with respect to (33) takes the form:

$$i\Omega_* \theta_l^0 = \frac{1}{\xi^2} \frac{d}{d\xi}\left(\xi^2 \frac{d\theta_l^0}{d\xi}\right)$$

$$i\Omega_* K^0 = \frac{Le}{\xi^2} \frac{d}{d\xi}\left(\xi^2 \frac{dK^0}{d\xi}\right)$$

$$K\big|_{\xi=\infty} = 0, \quad K^0\big|_{\xi=1} = K_R^0, \quad \theta_l^0\big|_{r=\infty} = 0, \quad \theta_l^0\big|_{\xi=1} = \theta_v^0$$

$$i\Omega_* \delta^0 = W^0 + J_1^0 + J_2^0$$

$$i\Omega_* W^0 = \beta\left(\alpha_1 P_1^0 + \alpha_2 P_2^0 + \Sigma\cdot\delta^0\right) - \frac{W^0}{Re}$$

$$i\Omega_*\left(Z_1^0 + 3\delta^0\right) = 3\eta J_1^0/c_0, \quad i\Omega_*\left(Z_2^0 + 3\delta^0\right) = 3\eta J_2^0/(1-c_0)$$

$$P_1^0 = Z_1^0 + \theta_v^0, \quad P_2^0 = Z_2^0 + \theta_v^0$$

$$P_1^0 = S_3\theta_v^0 + \frac{N_{10}}{k_0\mu^2}\cdot K_R^0, \quad P_2^0 = S_3 L\mu\theta_v^0 - \frac{N_{10}}{\mu(1-k_0)}\cdot K_R^0, \quad S_3 = \frac{l_1\mu_1}{BT_0}$$

$$J_1^0 = \frac{k_0}{M_{10}}\left[S\frac{d\theta_l^0}{d\xi}\bigg|_{\xi=1} + L\cdot Le\frac{dK^0}{d\xi}\bigg|_{\xi=1}\right], \quad J_2^0 = \frac{1}{M_{10}}\left[S(1-k_0)\frac{d\theta_l^0}{d\xi}\bigg|_{\xi=1} - Le\cdot k_0\frac{dK^0}{d\xi}\bigg|_{\xi=1}\right],$$

$$M_{10} = k_0 + (1-k_0)L$$

At linearization of (30) the following transformations were made:

$$N_1(k_R) = \frac{\mu K_R}{\mu K_R + (1-k_0 K_R)/k_0} \approx N_{10} + \frac{k_0 K_R^0 e^{i\Omega_*\tau}}{(\mu k_0 + 1 - k_0)^2}$$

$$e^{\frac{l_i\mu_i}{BT_0}\left(1-\frac{1}{\theta_V}\right)} \approx e^{\frac{l_i\mu_i}{BT_0}\cdot\theta_v^0 e^{\Omega_*\tau}} \approx 1 + \frac{l_i\mu_i}{BT_0}\cdot\theta_v^0 e^{i\Omega_*\tau}$$

The solution of differential equations (36) at the given boundary conditions is written in the form:

$$\theta_l^0 = \theta_v^0 \frac{e^{\sqrt{i\Omega_*}(1-\xi)}}{\xi}, \quad K^0 = K_R^0 \frac{e^{\sqrt{\frac{i\Omega_*}{Le}}(1-\xi)}}{\xi} \tag{41}$$

The derivatives with respect to ξ from θ_l^0 and K^0 for $\xi=1$ contained in (40), are determined from (41) and are of the form:

$$\frac{d\theta_l^0}{d\xi}\bigg|_{\xi=1} = \left(1 - \sqrt{i\Omega_*}\right)\theta_v^0, \quad \frac{dK^0}{d\xi}\bigg|_{\xi=1} = \left(1 - \sqrt{\frac{i\Omega_*}{Le}}\right)K_R^0 \tag{42}$$

Having substituted (42) in (40), we get:

$$J_1^0 = \frac{k_0}{M_{10}}\left[S\left(1 - \sqrt{i\Omega_*}\right)\theta_v^0 + L\cdot Le\left(1 - \sqrt{\frac{i\Omega_*}{Le}}\right)K_R^0\right],$$

$$J_2^0 = \frac{1}{M_{10}}\left[S(1-k_0)\left(1 - \sqrt{i\Omega_*}\right)\theta_v^0 - Lek_0\left(1 - \sqrt{\frac{i\Omega_*}{Le}}\right)K_R^0\right] \tag{43}$$

Using (38), exclude Z_1^0 and Z_2^0 from (38) :

$$J_1^0 = \frac{i\Omega_* c_0}{3\eta}\left(P_1^0 - \theta_v^0 + 3\delta^0\right), \; J_2^0 = \frac{i\Omega_*(1-c_0)}{3\eta}\left(P_2^0 - \theta_v^0 + 3\delta^0\right) \tag{44}$$

Allowing for (39) exclude from (44) and from the second equation of (37) P_1^0 and P_2^0:

$$J_1^0 = \frac{i\Omega_* c_0}{3\eta}\left[3\delta^0 + (S_3 - 1)\theta_v^0 + \frac{N_{10}}{k_0\mu^2}\cdot K_R^0\right],$$

$$J_2^0 = \frac{i\Omega_*(1-c_0)}{3\eta}\left[3\delta^0 + (S_3 L\mu - 1)\theta_v^0 - \frac{N_{10}}{\mu(1-k_0)}\cdot K_R^0\right] \tag{45}$$

Equating relations (43) and (44), we get a system of equations with respect to θ_v^0 and K_R^0:

$$\begin{cases} G_1\theta_v^0 + G_2 K_R^0 = G_5\delta^0 \\ G_3\theta_v^0 - G_4 K_R^0 = G_6\delta^0 \end{cases},$$

$$G_1 = \frac{k_0 S\left(1 - \sqrt{i\Omega_*}\right)}{M_{10}} - \frac{i\Omega_* c_0(S_3 - 1)}{3\eta}, \; G_2 = \frac{k_0 L \cdot Le\left(1 - \sqrt{\dfrac{i\Omega_*}{Le}}\right)}{M_{10}} - \frac{i\Omega_* c_0 N_{10}}{3\eta k_0\mu^2},$$

$$G_3 = \frac{(1 - k_0)S\left(1 - \sqrt{i\Omega_*}\right)}{M_{10}} - \frac{i\Omega_*(1 - c_0)(S_3 L\mu - 1)}{3\eta}, \tag{46}$$

$$G_4 = \frac{k_0 \cdot Le\left(1 - \sqrt{\dfrac{i\Omega_*}{Le}}\right)}{M_{10}} - \frac{i\Omega_*(1 - c_0)N_{10}}{3\eta(1 - k_0)\mu},$$

$$G_5 = \frac{i\Omega_* c_0}{\eta}, \; G_6 = \frac{i\Omega_*(1 - c_0)}{\eta}$$

The solution of (3.69) is written in the form:

$$\theta_v^0 = \frac{G_4 G_5 + G_2 G_6}{G_1 G_4 + G_2 G_3}\cdot\delta^0 = \Psi_1\delta^0, \; K_R^0 = \frac{G_3 G_5 - G_1 G_6}{G_1 G_4 + G_2 G_3}\cdot\delta^0 = \Psi_2\delta^0 \tag{47}$$

Allowing for (46), we get the dependences of J_1^0 and J_2^0 on δ^0:

$$J_1^0 = \frac{i\Omega_* c_0}{3\eta}\left[3 + (S_3 - 1)\Psi_1 + \frac{N_{10}}{k_0\mu^2}\cdot\Psi_2\right]\delta^0 = \Psi_3\delta^0,$$

$$J_2^0 = \frac{i\Omega_*(1 - c_0)}{3\eta}\left[3 + (S_3 L\mu - 1)\Psi_1 - \frac{N_{10}}{\mu(1 - k_0)}\cdot\Psi_2\right]\delta^0 = \Psi_4\delta^0 \tag{48}$$

Having substituted (47) and (48) in equation (37), we get a characterized equation with respect to Ω_*:

$$\left(i\Omega_* + \frac{1}{Re}\right)(i\Omega_* - \Psi_3 - \Psi_4) = \beta\left[(\alpha_1 + \alpha_2 L\mu)S_3\,\Psi_1 + \left(\frac{\alpha_1}{k_0\mu^2} - \frac{\alpha_2}{(1 - k_0)\mu}\right)N_{10}\Psi_2 + \Sigma\right] \tag{49}$$

Results: We can simplify equations (49) due to the fact that the density of liquid phase exceeds by three orders the gas density $\rho_l \gg \rho_{i0}'$, $(\eta \gg 1)$. Then we can suppose that $i\Omega_*\delta^0 \approx W^0$ (see equations (37)). If we neglect also the viscosity and capillary effects, then the characteristic equation (49) takes the form:

$$\Omega_*^2 + \beta\left[(\alpha_1 + \alpha_2 L\mu)S_3\,\Psi_1 + \left(\frac{\alpha_1(1 - k_0)}{\mu} - \alpha_2 k_0\right)\frac{N_{10}\Psi_2}{\mu k_0(1 - k_0)}\right] = 0 \tag{50}$$

Presence of the first summand in square brackets is caused by the thermal conductivity and the second summand - diffusion.

Having substituted in equation (50) the values of Ψ_1 and Ψ_2 from (47) and making simplifying transformations, we get

$$\frac{\Omega_*^2}{\beta}\left[\gamma_1 F_1 F_2 - i\Omega_* \gamma_2 F_1 - i\Omega_* \gamma_3 F_2 - \gamma_4 \Omega_*^2\right] + i\Omega_* \gamma_5 F_2 +$$

$$+ \gamma_6 \Omega_*^2 + i\Omega_* \gamma_7 F_1 k_0 (1-k_0) - \gamma_8 \Omega_*^2 c_0 (1-c_0) = 0 \tag{51}$$

$$F_1 = 1 - \sqrt{i\Omega_*} \ , \quad F_2 = 1 - \sqrt{\frac{i\Omega_*}{Le}}$$

$$\gamma_1 = \frac{Le \cdot S}{k_0 + (1-k_0)L}$$

$$\gamma_2 = \frac{S\left[\mu k_0 \chi_2^0 + (1-k_0)\chi_1^0\right]}{3\eta\mu\left[k_0 + (1-k_0)L\right](\mu k_0 + 1 - k_0)\left[k_0\chi_1^0 + (1-k_0)\chi_2^0\right]}$$

$$\gamma_3 = \frac{Le\left[c_0(S_3 - 1) + L(1-c_0)(S_3 L\mu - 1)\right]}{3\eta\left[k_0 + (1-k_0)L\right]}$$

$$\gamma_4 = \frac{1}{9\eta^2\mu} \cdot \frac{\chi_1^0}{\left[k_0\chi_1^0 + (1-k_0)\chi_2^0\right](\mu k_0 + 1 - k_0)}\left[\frac{\mu k_0 \chi_2^0(S_3 - 1)}{k_0\chi_1^0 + (1-k_0)\chi_2^0} + (1-c_0)(S_3 L\mu - 1)\right]$$

$$\gamma_5 = \frac{S_3\mu}{\mu k_0 + 1 - k_0} \cdot \left[k_0\chi_1^0 + (1-k_0)L\chi_2^0\right]\frac{Le \cdot \left[c_0 + (1-c_0)L\right]}{\eta\left[k_0 + (1-k_0)L\right]}$$

$$\gamma_6 = \frac{\chi_1^0 \cdot \chi_2^0 S_3 \mu\left[k_0\chi_1^0 + (1-k_0)L\chi_2^0\right]}{3\eta^2\mu(\mu k_0 + 1 - k_0)\left[k_0\chi_1^0 + (1-k_0)\chi_2^0\right]^2} \tag{52}$$

$$\gamma_7 = \frac{S\left(\chi_1^0 - \chi_2^0\right)^2}{\eta(\mu k_0 + 1 - k_0)^2\left[k_0 + (1-k_0)L\right]\left[k_0\chi_1^0 + (1-k_0)\chi_2^0\right]}$$

$$\gamma_8 = \frac{S_3\left(1 - L\mu\right)\left(\chi_1^0 - \chi_2^0\right)}{3\eta^2(\mu k_0 + 1 - k_0)^2}$$

Let's consider special cases for the characteristic equation.

1. Assume that liquid consists only of the first component $k_0 = 1$. According to formula (19), the volatility of this component of liquid equals a unit $\chi_1^0 = 1$ and the boiling temperature of the binary mixture equals the boiling temperature of the first component: $T_0 = T_{k1}$. Then from formula (20) it follows that the vapors of the boiling fluid consist of the vapors only of the first component: $c_0 = 1$. Then coefficient (52) of equation (51) take the form:

$$\gamma_1 = Le \cdot S \ , \ \gamma_2 = \frac{S\chi_2^0}{3\eta\mu} \ , \ \gamma_3 = \frac{Le(S_3 - 1)}{3\eta} \ , \ \gamma_4 = \frac{\chi_2^0(S_3 - 1)}{9\eta^2\mu} \ , \ \gamma_5 = \frac{S_3 Le}{\eta} \ , \ \gamma_6 = \frac{\chi_2^0 S_3}{3\eta^2\mu} \ ,$$

$$\gamma_7 = \frac{S\left(1 - \chi_2^0\right)^2}{\mu\eta} \ , \ \gamma_8 = \frac{S_3\left(1 - L\mu\right)\left(1 - \chi_2^0\right)}{3\eta^2\mu^2}$$

2. Assume that liquid consists only of the second component: $k_0 = 1$. According to formula (19) the volatility of this component of the liquid equals a unit $\chi_2^0 = 1$ and the boiling temperature of the binary mixture equals the boiling temperature of the first component $T_0 = T_{k2}$. From

formula (20) it follows that the vapors of the boiling liquid also consist of the vapor only of the second component: $c_0 = 0$. Then the coefficient (52) of equation (51) take the form:

$$\gamma_1 = \frac{Le \cdot S}{L}, \; \gamma_2 = \frac{S\chi_1^0}{3\eta\mu L}, \; \gamma_3 = \frac{Le(S_3 L\mu - 1)}{3\eta}, \; \gamma_4 = \frac{\chi_1^0(S_3 L\mu - 1)}{9\eta^2\mu}, \; \gamma_5 = \frac{S_3 Le\mu L}{\eta},$$

$$\gamma_6 = \frac{\chi_1^0 S_3 L}{3\eta^2}, \; \gamma_7 = \frac{S(\chi_1^0 - 1)^2}{L\eta}, \; \gamma_8 = \frac{S_3(1 - L\mu)(\chi_1^0 - 1)}{3\eta^2}$$

3. Assume that the volatilities of the components of the binary solution are approximately identical

$\chi_1^0 \approx \chi_2^0$. Since according to (19) , $\chi_1^0 = \exp\left[\dfrac{l_1\mu_1}{B}\left(\dfrac{1}{T_{k1}} - \dfrac{1}{T_0}\right)\right]$,

$\chi_2^0 = \exp\left[\dfrac{l_2\mu_2}{B}\left(\dfrac{1}{T_{k2}} - \dfrac{1}{T_0}\right)\right]$ and $T_{k1} \le T_0 \le T_{k2}$, then χ_1^0 and χ_2^0 may not be

simultaneously greater or less than a unit , i.e. only two cases are possible: $\chi_1^0 > 1$, $\chi_2^0 < 1$ and $\chi_1^0 < 1$, $\chi_2^0 > 1$. Therefore, the condition $\chi_1^0 \approx \chi_2^0$ is feasible only in the case if simultaneously $\chi_1^0 \approx 1$ and $\chi_2^0 \approx 1$. Then according to (19), $k_0 \approx c_0 \approx 1/(1+\mu)$. At the same volatility of components, the component concentration on liquid and gas phase are identical.

The coefficients of equation (52) and equation (51) will be equal to

$$\gamma_1 = \frac{(1+\mu)Le \cdot S}{1 + L\mu}, \; \gamma_2 = \frac{(1+\mu)S}{3\eta\mu(1 + L\mu)}, \; \gamma_3 = \frac{Le[S_3 - 1 + L\mu(S_3 L\mu - 1)]}{3\eta(1 + L\mu)},$$

$$\gamma_4 = \frac{S_3(L\mu + 1)/2}{9\eta^2\mu} - 1, \; \gamma_5 = \frac{S_3 Le(1 + \mu L)}{2\eta}, \; \gamma_6 = \frac{S_3(1 + L\mu)}{6\eta^2\mu}, \; \gamma_7 = 0, \; \gamma_8 = 0$$

Comparison of the coefficients in the considered three cases and the form of the obtained characteristic equation shows that equation (51) at each case passes to the equation for one component system with some effective thermophysical parameters. Diffusion doesn't influence on the characteristics of oscillations of Λ и Ω_{**} (formula (35)).

For analyzing influence of diffusion of components on damping decrement of oscillation Ω_{**} and logarithmic damping decrement Λ we consider a case when the volatility of the components χ_i^0 differ from each other.

As the density of the liquid phase is much more greater than the density of gas components in the mixture, then the parameter $\eta \gg 1$. Therefore, we simplify the characteristic equation by ignoring the members of order $1/\eta^2$. Then $\gamma_4 \approx 0$, $\gamma_6 \approx 0$ and $\gamma_8 \approx 0$, and equation (51) is written in the form:

$$\frac{\Omega_*^2}{\beta}\left[\gamma_1 F_1 F_2 - i\Omega_*\gamma_2 F_1 - i\Omega_*\gamma_3 F_2\right] + i\Omega_*\gamma_5 F_2 + i\Omega_*\gamma_7 F_1 k_0(1 - k_0) = 0 \tag{53}$$

Comparison of the structure of equations for all the considered cases shows that influence of diffusion on thermal and mass exchange processes is significant if the condition $\gamma_7 \ge \gamma_5$ is fulfilled. Allowing for relations (19) and (20) we can reduce this inequality to the form:

$$\xi \ge \varsigma$$

$$\xi = \frac{S_{12}}{\mu\eta} \cdot \frac{(1 - \chi_2^0)(\chi_1^0 - 1)[1 - \chi_2^0 + \mu(\chi_1^0 - 1)][1 - \chi_2^0 + c_{l21}\mu(\chi_1^0 - 1)]}{[1 - \chi_2^0 + L\mu(\chi_1^0 - 1)][\chi_1^0(1 - \chi_2^0) + \mu\chi_2^0(\chi_1^0 - 1)]}, \tag{54}$$

$$S_{12} = c_{l1} T_0 / l_1, \; c_{l21} = c_{l2}/c_{l1},$$

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$$\varsigma = \frac{S_3 Le}{\eta} \cdot \frac{\left[\chi_1^0\left(1-\chi_2^0\right)+L\mu\chi_2^0\left(\chi_1^0-1\right)\right]^2\left[1-\chi_2^0+\mu\left(\chi_1^0-1\right)\right]}{\left(\chi_1^0-\chi_2^0\right)\left[1-\chi_2^0+L\mu\left(\chi_1^0-1\right)\right]\left[\chi_1^0\left(1-\chi_2^0\right)+\mu\chi_2^0\left(\chi_1^0-1\right)\right]}$$

Conclusions

As an example we consider a binary solution of water and ethylene glycol.
Write the values of all necessary thermophysical parameters of water (with low indices "1") and ethylene glycol (with lower indices "2") from reference books, i.e. from [8]:

$$T_{k1}=373^0 K,\ T_{k2}=470^0 K,\ B=8300\frac{J}{\kappa mol^0 K},\ \mu_1=18\frac{q}{mol},\ \mu_2=62\frac{qr}{mol},$$

$$l_1=2,26\cdot10^6\frac{J}{\kappa q},\ l_2=0,943\cdot10^6\frac{J}{kq},\ c_{l1}=4200\frac{J}{\kappa q\cdot g},\ c_{l2}=3100\frac{J}{\kappa q\cdot g},\ \eta=1000,$$

$$Le=0,01.$$

There we define the parameters $\mu=\mu_2/\mu_1$, $L=l_2/l_1$, $c_{l21}=c_{l2}/c_{l1}$.

For all the values of temperature T$_0$, starting from $T_{k1}=373^0 K$ to $T_{k2}=470^0 K$ ($T_{k1}\le T_0\le T_{k2}$) with the step $\Delta T=1$ (step ΔT is selected arbitrarily depending on the required accuracy) we successively calculate the parameters:

$$\chi_i^0=\exp\left[\frac{l_i\mu_i}{B}\left(\frac{1}{T_{ki}}-\frac{1}{T_0}\right)\right],\ S_{12}=c_{l1}T_0/l_1,\ S_3=l_1\mu_1/BT_0$$

And finally, we calculate the value of $\frac{\xi}{\varsigma}(k_0)$ for all T$_0$ (or the same for all k$_0$).

The dependences $\frac{\xi}{\varsigma}(k_0)$ from which the value of k$_0$ is determined at which the maximum $\frac{\xi}{\varsigma}(k_0)$ is attained, are depicted in figure 1.

From the results of calculations given in figure 1 it's seen that the dependence $\frac{\xi}{\varsigma}(k_0)$ in the range of the concentrations $k_0\le0,4$ exceeds a unit, and has a strongly marked maximum for $k_0\approx0,03$ (this corresponds to mole fraction of water $N_{k_0}\approx0,2$). Thus, the solution will have maximum small boiling ability. On the whole, such a solution possesses the property of minimum boiling velocity and condensation. The composition of the binary solution (liquid components of the binary solution) and concentration of components should be chosen from the conditions of attaining the maximum value of the parameter $\frac{\xi}{\varsigma}(k_0)$ and $\frac{\xi}{\varsigma}(k_0)\gg1$, characterizing relative influence of heat exchange and mass exchange on dynamics of bubbles of this solution.
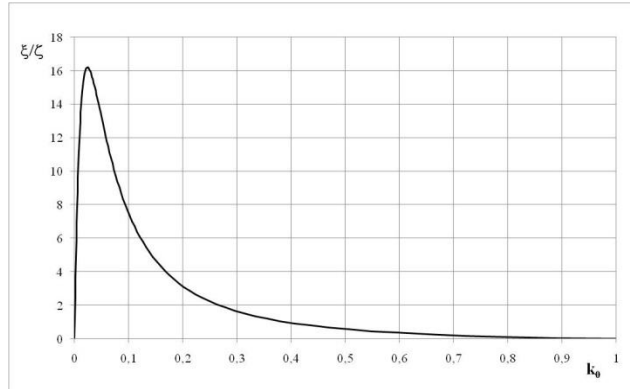
Figure. 1. Dependence of the parameter ξ / ς on the concentration k_0.

Let's consider the second solution, water and ethanol.
Thermophysical parameters of water are the same as in the previous example, the ethanol has the following properties[8]:

$$T_{k2} = 351,3^0\,K, \quad \mu_2 = 46\,\frac{g}{mole}, \quad l_2 = 0,963 \cdot 10^6\,\frac{J}{kg}, \quad c_{l2} = 3029\,\frac{J}{kg \cdot grade}$$

From the results of calculations given in figure 2 it's seen that the dependence $\dfrac{\xi}{\varsigma}(k_0)$ in the range of

concentration k_0 much less a unit. Thus, the dependence $\dfrac{\xi}{\varsigma}(k_0)$ from k_0 has the form of a parabola with

the vertex at the point $k_0 = 0,6$. For the water solution of ethylene glycol $\dfrac{\xi}{\varsigma}(k_0) \gg 1$, and this

dependence has a strongly marked maximum for $k_0 \approx 0,03$. Such a solution is characterized by minimal intensity of phase transformations that agrees well with experimental data of the paper [7].
As the results of calculations show, when the pressure in the solution changes (overheating or supercooling of the liquid) the phase transformations, accordingly the diffusion doesn't appear significantly in water solution of ethanol. Because of approximate equality of k_0 and c_0, the smallness of $\dfrac{\xi}{\varsigma}(k_0)$ for any concentration of solution all calculation dependence (dependence of pressure, temperature of vapor, bubble radius, intensity of phase transformations, etc on time) lie between the limit curves for the case of one-component constituents of the solution.
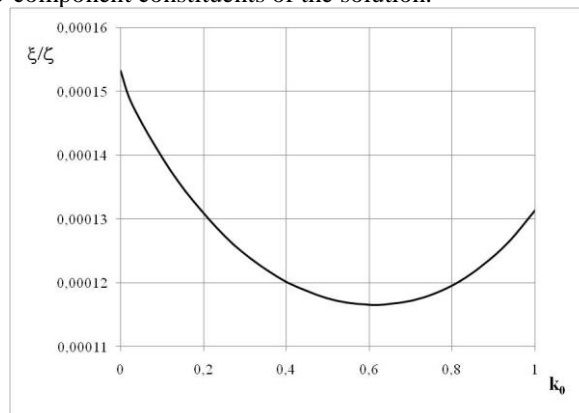

Figure 2. Dependence of the parameter ξ / ς on the concentration k_0.

But in the water solution of ethylene glycol because of $\frac{\xi}{\varsigma}(k_0) >> 1$ for $0,01 \le k_0 < 0,4$ and essential

difference between k_0 and c_0 (especially for $0,01 \le k_0 < 0,4$, figure1) the efficiency of diffusive braking promotes significant retardation of mass exchange intensity. In particular, with the growth of bubbles the growth rate in the solution is significantly lower than in pure component, in water and ethylene glycol. Moreover the maximal efficiency of retardation of phase transformations is attained for

maximum value $\frac{\xi}{\varsigma}(k_0)$, when $k_0 \approx 0,03$. The calculations show that for $0,4 \le k_0 < 1$ (according to

figure 1 for such solutions $\frac{\xi}{\varsigma}(k_0) << 1$)the retardation of phase transformations doesn't happen, and the

curves of radius bubble – time lie between parallel limit curves for the case of one-component constituents of the solution.

Let's consider the third solution- water and propylene glycol.

The thermophysical parameters of propylene glycol are the followings [8]:

$$T_{k2} = 460^0 K, \ \mu_2 = 76\frac{g}{mole}, \ l_2 = 0,645 \cdot 10^6 \frac{J}{kq},$$

$$c_{l2} = 2483\frac{J}{kg \cdot grade}, \ c_{p2} = 1510\frac{J}{kg \cdot grade}, \ c_{Vv2} = 1400\frac{J}{kg \cdot grade}, \ a_{l2} = 0,88 \cdot 10^{-7}\frac{m^2}{sec}$$

The results of calculations in figure 3 show that dependence $\frac{\xi}{\varsigma}(k_0)$ for such a solution has a strongly

marked maximum for $k_0 \approx 0,02$, moreover $\frac{\xi}{\varsigma}(k_0) >> 1$. Therefore, the water concentration should be

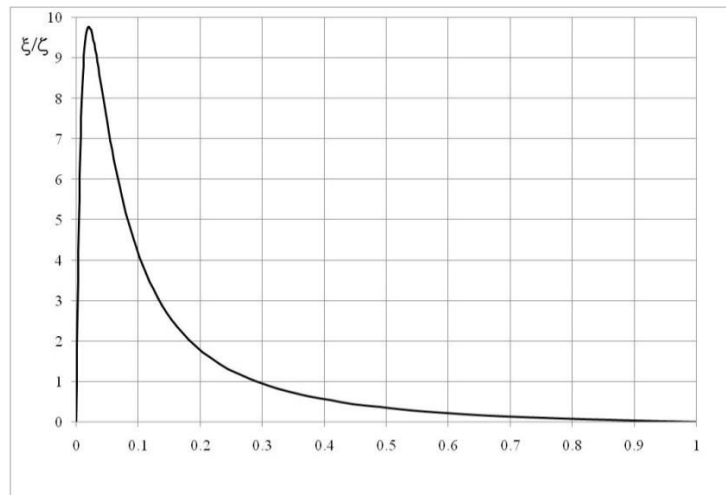chosen from the condition $k_0 \approx 0,02$.

Figure 3. Dependence of the parameter ξ/ς on the concentration k_0.

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INFLUENCE OF CHARACTERISTICS OF MARINE AUXILIARY POWER SYSTEM IN THE ENERGY EFFICIENCY DESIGN INDEX

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Abstract
Actually the total Green Houses Gases (GHG) emissions related to shipping were approximately 949 million tons of CO_2 accounting for 2.2% of global CO_2 emissions (2.1% in CO_2 equivalent). As is known, anthropogenic GHG emissions contribute to global warming. International Maritime Organization (IMO) adopted Annex VI of the MARPOL Convention 73/78, which entered into force in 2005, to regulate and reduce atmospheric emission of gaseous pollutants from ships. Through the adoption of Resolutions of the Maritime Environment Protection Committee and guidelines for calculation of the Energy Efficiency Index (EEDI) are introduced with the aim of achieving a reduction in the emission CO_2 and fuel consumption during ship operation. To determine the value of CO_2 emissions from the auxiliary energy system and the potential influence on the EEDI, an analysis of balance electric load is carried out and technical criteria is used for selecting the auxiliary power engines. These aspects are defining an efficient ship with low emissions and low fuel consumption.
Keywords: *greenhouse gas emissions, energy efficiency, maritime pollution, MARPOL, EEDI.*

Introduction

In 2012, total GHG emissions related to maritime transport [1] were approximately 949 million tons of carbon dioxide (CO_2) representing 2.2% of global CO_2 emissions (2.1% CO_2 equivalent). CO_2 is the most important anthropogenic greenhouse gas. It has increased its overall concentration in the atmosphere since pre-industrial value of 280 to 379 ppm (mg/Nm). The current trend of accelerating GHG emission rates would double the pre-industrial CO_2 levels in the atmosphere in 2050 [2].

In 1997, IMO adopted Annex VI of MARPOL 73/78 [3, 4]. With the entry into force in 2005, limits in the atmospheric emission of gaseous pollutants from ships were set without setting limits on GHG emissions.

In 2013, IMO adopted Resolution MEPC.203 (62) [5] modifying again Annex VI and including Chapter IV "Rules on energy efficiency for ships". The introduction of terms of energy efficiency raises the rational use of energy, which is closely related to the emission of GHG. In Chapter IV new regulatory concepts related to energy efficiency in a ship are described; The Energy Efficiency Design Index [6], enforceable in new ships, and the Ship Energy Efficiency Management Plan [7] mandatory on all ships. For existing ships, which are not subject to compliance with the EEDI, the Marine Environment Protection Committee, adopted guidelines for the voluntary use of operational efficiency indicator energy of the ship (EEOI) in resolution MEPC.1/Circ.684 [8]. All these measures implemented, whose final objective is to achieve a reduction in fuel consumption and CO_2 emissions during ship operation.

1. Energy Efficiency Design Index (EEDI)

The energy efficiency index is defined as the measure of the energy efficiency of a ship. It is the first mandatory global measure to improve the energy efficiency of new vessels and to limit GHG emissions from international shipping. The Energy Efficiency Design Index required for a ship, allows the definition of a baseline or threshold of CO_2 emissions, upgradable by a reduction factor depending on the implementation phase. A new ship with EEDI value above the threshold, don't be approved. This measure provides a tool that helps ship builders to calculate the value of energy efficiency. The EEDI will help to reduce GHG emissions by 25-30% in 2030, compared to the current scenario. EEDI is a measure of CO_2 efficiency of ships and it is calculated by Equation (1) [9].

$$EEDI = \frac{MCO_2}{Transport\ Work} \qquad\qquad [gCO_2/t.nm] \qquad\qquad (1)$$

Table 1. Potential reductions of CO2 emissions by using existing technology and practices

DESIGN (New ships)	Saving of CO_2/tonne-mile
Concept, speed and capability	2% to 50%
Hull and superstructure	2% to 20%
Power and propulsion systems	5% to 15%
Low-carbon fuels	5% to 15%
Renewable energy	1% to 10%
Exhaust gas CO_2 reduction	0%
OPERATION (All ships)	
Fleet management, logistics & incentives	5% to 50%
Voyage optimization	1% to 10%
Energy management	1% to 10%

Source: Second IMO GHG Study 2009

$$M_{CO2} = E_{HCO2}M + E_{HCO2}A - E_{HA} \qquad [gCO_2/h] \qquad (2)$$

In Equation (2), are representing total emissions of CO_2 emitted per unit of time of the main propulsion system, auxiliary electrical energy system and the potential saving of energetic technologies. The Table 1 shows Assessment of potential reductions of CO_2 emissions from shipping by using known technology and practices [10]. In operation and in the design phase of ships, the specific term emissions from the auxiliary electrical system can be reduced by performing proper management in the following areas: reducing the hotel load, efficient lighting, increasing performance of power generation system, promoting alternative energy or energy management systems and using fuels with lower carbon content.

2. Analysis of CO_2 emissions from auxiliary power system

The calculation of emissions from auxiliary power system is given in Resolution MEPC.212 (63) [6], determined according to Equation (3).

$$E_{HCO2}A = P_{AE} \cdot C_{FAE} \cdot SFC_{AE} \qquad [gCO2/h] \qquad (3)$$

SFC_{AE} is the certified specific fuel consumption engine, measured in g/kWh to 75 or 50% of MCR, depending on the type of engine certification. C_{FAE} or C_{F_OMI} is the conversion factor of the fuel mass in CO_2 mass depending on the carbon content of fuel (as seen Table 7). P_{AE} is the required auxiliary engine power to supply normal maximum load at sea, including the power required for machinery and propulsion systems and accommodation spaces, but excluding unused for machinery/propulsion power.

In the resolution is defined by approximation, the calculation of P_{AE} for cargo ships. However, for the types of ships, where power calculated differs significantly from the total power used during normal navigation at sea (eg. passage), it is necessary calculate the P_{AE} according to the electric power consumed.No doubt that determining the P_{AE} analytical and comprehensive way in all cases (cargo ships and passenger), with the balance of electric load, can be estimated with less uncertainty, CO_2 emissions produced by the auxiliary power system. In this way, you can determine more precisely the influence on the calculation of EEDI.Therefore, the aim of this work is to determine the value of CO_2 emission of auxiliary electric power, analysing the balance of electric load and using technical criteria for the selection of power of auxiliary engines. Additionally, CO_2 emission factor [11] and carbon footprint for auxiliary power system of a ship are determinate. A comparison, with the emission factors of industrial power generation systems in Spain, is completed.

2.1. Required auxiliary engine power to supply normal maximum sea load P_{AE}

P_{AE} is the sum of the power required for the load, divided by the weighted average efficiency of the generator or generators. Appendix II of Resolution MEPC.212 (63) [6] are listed the guidelines for the development of balance electric load tables to determine the EEDI. This study isn´t calculating the parameters for calculating the balance electric load, so to determine P_{AE}, we take the example the balance

electric load of the Appendix II of Resolution MEPC.212 (63) and calculating the sum of the power required by the electric load P_{LOAD}. To calculate the efficiency of the generator, it is necessary to calculate the maximum active electric power supplied by the generator, using the data of Table 3.

$$P_{Em} = cos\emptyset \cdot S \qquad [kW] \qquad (4)$$

$$\eta_G = \frac{P_{Em}}{P_m} \qquad [\%] \qquad (5)$$

$$P_{AE} = \frac{\sum P_{LOAD}}{\eta_G} \qquad [kW] \qquad (6)$$

Table 2. Summary data calculated paragraph 3.1.

Source	Data	Value	Unit
Appendix II of Resolution MEPC.212 (63)	$\sum P_{LOAD}$	3.777,83	kW$_e$
Equation 4	P_{Em}	2.250,4	kW$_e$
Equation 5	η_G	95,5	%
Equation 6	P_{AE}	3.976	kW$_e$

Source: authors

2.2 Criteria and dimensioning of auxiliary power system

Generating sets selection is based on a configuration (2+1). With this configuration, two generating sets are in service and one on standby. The arrangement has as main advantage, versatility and high system availability as well as low investment costs. The power required by each generating set in service P_{GEN_I} is determined according to Equation (7).

$$P_{GEN\_I} = \frac{P_{AE}}{N^º GEN\_S} \qquad [kW] \qquad (7)$$

$$P_{GEN\_C} = \frac{P_{GEN\_I}}{\eta_D} \qquad [kW] \qquad (8)$$

Table 3. Main technical characteristics of the electric generator group

Generating Set Model	2250W8L26/50Hz IMO TIER 2	
Engine speed	1000	rpm
Engine output	2356	kW
Fuel System		
Fuel consumption 100% Load	190	g/kWh$_m$
Fuel consumption 85% Load	194	g/kWh$_m$
Fuel consumption 75% Load	198	g/kWh$_m$
Fuel consumption 50% Load	208	g/kWh$_m$
Generator Data		
Rated output	2813	kVA
Frecuency	50	Hz
Rated current	4.059	A
Power factor	0,8	

Source: Wärtsilä

The design of generating set in service, must consider the energy losses due to transmission and distribution of electricity. These losses will depend on the intrinsic characteristics of the electrical system of each ship, in this case are estimated at 5%. Therefore, according to Equation (8) and η_D being 95%, the minimum power corrected be required by generating set is P_{GEN_C}. After determining the minimum power

corrected, required by generating set, should make the selection of equipment, based on that criterion. It is recommended that the maximum active electric power of each generating set in service, is close to the minimum power corrected, required by each generating set. Thus, the internal combustion Diesel engines coupled to the electric generator will be operating close to the point of maximum load. As seen in the Figure 1, the points with lower specific fuel consumption, corresponding to high loads operation regimes.

Table 4. Summary data calculated paragraph 3.2.

Source	Data	Value	unit
Equation 7	P_{GEN_I}	1.988	kW_e
Equation 8	P_{GEN_C}	2.093	kW_e
-	P_{Em}	2.250	kW_e
-	η_D	95	%
Equation 9	P_{TIP}	6.750	kW_e
Equation 10	P_{MEPS}	4.500	kW_e

Source: authors

To select the generating set, we used a catalogue of Wärtsilä [12] where the technical specifications of generating sets for marine installations are listed. The selected generating set has been a Wärtsilä 2250W8L26/50Hz, IMO TIER 2. This equipment has a maximum active electric power of 2250 kWe, ensuring high system load and a backup electrical power to support an expansion of electrical installation capacity. The main technical characteristics of the generating set are detailed in Table 3.
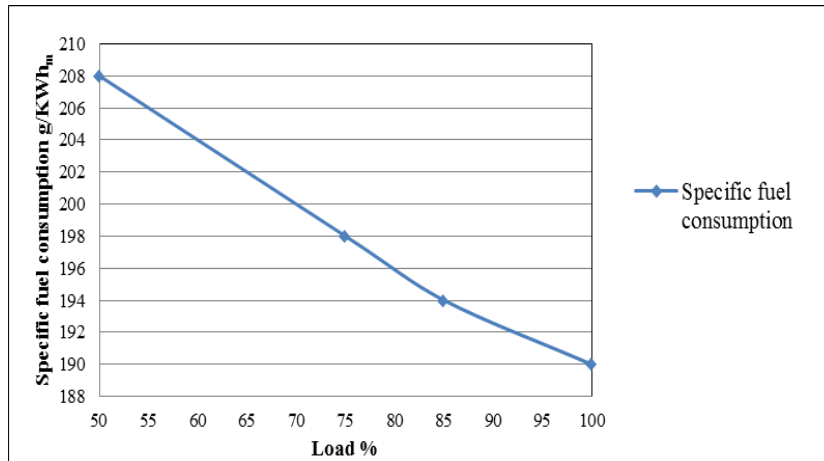

Figure. 1. Specific fuel consumption Wärtsilä 2250W8L26/50Hz.
Source: authors

Dimensioning of auxiliary power system with the generating set model selected.

$$P_{TIP} = P_{Em} \cdot N^{\underline{o}}\ GEN\_S \qquad\qquad [kW] \qquad\qquad (9)$$

$$P_{MEPS} = P_{Em} \cdot N^{\underline{o}}\ GEN \qquad\qquad [kW] \qquad\qquad (10)$$

2.3. Daily energy consumption

Consumption of installation electrical, Equation (11), is determined by required auxiliary engine power to supply normal maximum sea load (P_{AE}) and the system operation time. It is necessary to indicate that the calculations are based on the NMSL electric load. Therefore, the calculations are valid during the operation of the auxiliary power system with the Normal Maximum Sea Load.

$$C_{ED} = P_{AE} \cdot 24\frac{h}{d} \qquad\qquad [kWh_e/d] \qquad\qquad (11)$$

70

Table 5. Summary data calculated paragraph 3.3.

Source	Data	Value	Unit
Equation 11	C_{ED}	100.463	kWh$_e$/d

Source: authors

2.4. Daily fuel consumption

As shown in Figure 1, the internal combustion Diesel engine has variable specific fuel consumption depending on the operating system load. Therefore it is essential to calculate the operating system load to meet the specific fuel consumption of the Diesel engine. Operating system load (R_F), represents the electrical load percentage on the generator with respect to the maximum load.

$$R_F = \frac{P_{Em}}{P_{GEN\_C}} \qquad [\%] \qquad (12)$$

We must select, from Table 3, the specific fuel consumption of the internal combustion engine, corresponding to operating system load. The operating system load is between 100% and 85% of MCR, so it is necessary to interpolate between these two specific fuel consumptions to get the value. SCF$_m$ value obtained is significantly lower than the value provided by the IMO [10] for the calculation of global GHG emission estimates from Diesel engines of auxiliaries systems.

It is necessary to apply specific performance by converting mechanical to electrical energy (SFC$_e$), Equation (13). The electricity distribution losses (5%), Equation (14). Daily fuel consumption, Equation (15).

$$SFC_e = \frac{SFC_m}{\eta_G} \qquad [g/kWh_e] \qquad (13)$$

$$SFC_d = \frac{SFC_e}{\eta_D} \qquad [g/kWh_e] \qquad (14)$$

$$C_{CD} = N^\circ\, GEN \cdot SFC_D . C_{ED} . 10^{-6} \qquad [t.comb/d] \qquad (15)$$

Table 6. Summary data calculated paragraph 3.4.

Source	Data	Value	Unit
Equation 12	R_F	93,12	%
Table 3	SCF_m	192,16	g/KWh$_e$
Equation 13	SFC_e	201,21	g/KWh$_e$
Equation 5	η_G	95,5	%
-	η_D	95	%
Equation 14	SFC_d	211,8	g/KWh$_e$
Equation 15	C_{CD}	42,5	t.comb/d
Equation 16	V_D	47,81	m^{3}comb/d
Equation 17	O_{CD}	22.397,5	$/d

Source: authors

The engine manufacturer allows the use marine fuels MDF (Marine Diesel Fuel) according to ISO 8217: 2012 [13]. Marine distillate fuel DMA is selected. It is a high quality distillate, generally designated MGO (Marine Gas Oil).

Considering the density (ρ) of marine distillate fuel DMA, 890 Kg/m3. Daily fuel volume consumed. Equation (16). DMA fuel prices in the international market $527/t. (Rotterdam, 27/03/2015) [14], it is possible to calculate the daily cost of operating of the generating set. Equation (17).

$$V_D = \frac{C_{CD}}{\rho} \qquad [m^3/d] \qquad (16)$$
$$O_{CD} = C_{CD} . P_B \qquad [\$/d] \qquad (17)$$

2.5. CO_2 emission factor

The conversion factor mass of fuel consumed in mass emissions carbon dioxide (C_{F_OMI}), is specified in Table 7 of IMO Resolution MEPC.212 (63) [6].

The calculated C_{F_C} value is about 3% lower than C_{F_OMI} value. Therefore, using this value for calculations, it is necessary to note that the results related to CO_2 emissions will be slightly more conservative. CO_2 emission factor refers to the mass of CO_2 emitted in the production of an energy unit [11]. In Power generation systems usually relates the mass of CO_2 emitted into the atmosphere with the energy generated (kWh_e). CO_2 emission factors care calculated for the auxiliary power system on ships. The factors are estimated at generator terminals ($EF_{CO2}E$) Equation (22) and the point of consumption ($EF_{CO2}D$) Equation (23). The CO_2 emission factor is an important parameter to make objective comparisons concerning the direct emission of greenhouse gases electrical equipment and production systems that run on fossil fuels.

$$C + O_2 \rightarrow CO_2 \qquad (18)$$

$$C_{F\_OMI} = \%C \left(\frac{44.01}{12.01} \right) \qquad (19)$$

Table 7. Summary data calculated paragraph 3.5.

Source	Data	Value	Unit
Equation 17	C_{F_C}	3,115	$t.CO_2/t.comb$
Equation 22	$EF_{CO2}E$	626	gCO_2/kWh_e
		0,626	$t.CO_2/ MWh_e$
		7,28	$t.CO_2/ TOE$
		5,10	$t.CO_2/ TCE$
Equation 23	$EF_{CO2}D$	659	gCO_2/kWh_e
		0,659	$t.CO_2/ MWh_e$
		7,66	$t.CO_2/ TOE$
		5,37	$t.CO_2/ TCE$
Note: 1 MWh / 0,086 TOE / 0,1228 TEC			

Source: authors

Table 8. Factor mass of fuel consumed in mass emissions carbon dioxide

ID	Fuel kind	Reference	Carbon content	C_{F_OMI} ($t.CO_2/t.comb$)
1	Diesel/Gasoil (MGO)	ISO 8217-Grados DMX/DMC	0,8750	3,2060
2	Fuel oil Light (MDO)	ISO 8217-Grados RMA/RMD	0,8600	3,1510
3	Fuel oil Heavy	ISO 8217 Grados RME/RMK	0,8500	3,1144
4	GLP	Propano C_3H_8	0,8190	3,0000
5	GLP	Butano C_4H_{10}	0,8270	3,0300
6	LNG	-	0,7500	2,7500

Source: Maritime Environment Protection Committee (OMI)

$$C_{16}H_{34} + \frac{49}{2}O_2 \rightarrow 16CO_2 + 17H_2O \qquad (20)$$
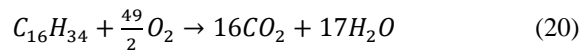
$$C_{F\_C} = \left(\frac{16 \cdot PmCO_2}{1 \cdot PmC_{16}O_{34}} \right) \qquad (21)$$

$$EF_{CO_2}D = SFC_d \cdot C_{F\_C} \qquad \text{[gCO2/kWh}_e\text{]} \qquad (23)$$

$$EF_{CO_2}E = SFC_e \cdot C_{F\_C} \qquad \text{[gCO2/kWh}_e\text{]} \qquad (22)$$

In the Table 9 and Figure 2, are shown the CO_2 emission factors of some systems of industrial electricity generation in Spain [16] and the CO_2 emission factor of auxiliary power system with greater presence on ships (Diesel generating set). Although all data may be partially extrapolated if specific consumption data and fuel carbon percentage are considered. A comparative analysis with respect to industrial power generation systems in Spain presents the following results:

- Due to low efficiency of Rankine cycle, the CO2 emission factor for coal fuel power plants operating, is significantly higher than CO2 emission factor of auxiliary marine power generation system (Diesel Genset).

- CO_2 emission factor of auxiliary marine power generation system (Diesel Genset) is similar to CO_2 emission factor produced in fuel power plant. Presumably, although it is not specified in the document of IDAE [16], the fuel power plant, equip Diesel engines. However, also the operation of these plants by Rankine cycle would be possible.

- CO_2 emission factors of cogeneration power plants are significantly lower due to the high thermal and electrical efficiency. The cogeneration power plant generates and also recovers part of the waste heat generated in the work cycle. The heat is used in other thermal processes, preventing additional fuel consumption. In Spain, these facilities, must obtain, a minimum overall performance by legislative requirements. On some ships may find WHR [17] systems. These systems use thermal energy of the exhaust gases of diesel engines, constituting a cogeneration system.

- The combined cycle power plants have a CO_2 emission factor similar to cogeneration power plants. In these installations, the full potential of fuel is used in a thermal cycle consisting of gas turbine and steam turbine. They are high efficiency cycles. This technology, though with little references, has been implemented in the naval sector using different variants of the propulsion system with the name of COGAS or COGES [18].

- Gas power plant has a lower CO_2 emission factor compared to coal and fuel power plants, using the same technology, due to the low carbon percentage of natural gas (See Table 9).

- The CO2 emitted during combustion of biomass in power plants are considered neutral emissions, since first, has been previously absorbed from the atmosphere. The use of biomass is generally associated with energy recovery facilities by fluid bed combustion and waste heat Rankine cycles. Recent studies, advocate the transformation of biomass from oleaginous plants into liquid fuel called (PVO) to replace partially o totally the marine residual fuels [19].

- There is no CO_2 emission factor for renewable and nuclear energy since it does not use fossil fuels for power generation.
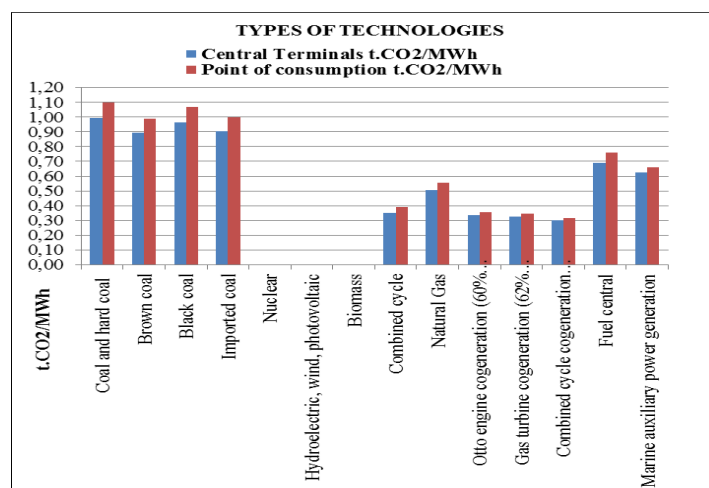

Figure 2. Comparison of CO2 emission factors of industrial power plants in Spain
Source: authors

Table 9. CO2 emission factors of industrial power plants in Spain

Technology	Emission CO$_2$ Factors	
	Central Terminals t.CO2/MWh	Point of Consumption t.CO2/MWh
Coal and hard coal	0,993	1,098
Brown coal	0,896	0,991
Black coal	0,965	1,067
Imported coal	0,905	1,001
Nuclear	0	0
Hydroelectric, wind, photovoltaic	0	0
Biomass	0	0
Combined cycle	0,353	0,390
Natural Gas	0,504	0,557
Otto engine cogeneration (60% REE)	0,336	0,356
Gas turbine cogeneration (62% REE)	0,325	0,344
Combined cycle cogeneration (67%REE)	0,301	0,318
Fuel	0,689	0,762
Marine auxiliary power system	0,626	0,699

Source: IDAE

2.6. Carbon footprint from auxiliary power system

Daily emission CO$_2$ from auxiliary power system also called carbon footprint is determined by Equation (24).

$$E_{DCO2}A = C_{CD} \cdot C_{F\_C} \qquad [\text{t.CO}_2/\text{d}] \qquad (24)$$

Table 10. Summary data calculated paragraph 3.6.

Source	Data	Value	unit
Equation 24	E$_{DCO2}$	132,54	t.CO2/d

Source: authors

Discussion

The guidelines provided by the IMO for the specific consumption data SFC$_{AE}$ in Resolution MEPC.212 (63) [6] are pessimistic, prescribes the selection of specific fuel consumption for an engine, certified to 75 or 50% of MCR, depending on the type of engine certification. In these MCR loads, as shown in Figure 1, and as a general rule in all diesel engines, is where the specific fuel consumption having significantly higher value. The justification can be found at the operating to low load of auxiliary power generation system due to oversizing in the design phase.

Conversion factor mass of fuel consumed in mass emissions carbon dioxide provides by IMO is slightly higher than conversion factor mass of fuel consumed in mass emissions carbon dioxide empirical calculated. Therefore, the carbon footprint and CO$_2$ emission factors may be, on this basis, significantly lower. Although IMO, attributes the same percentage of carbon to marine distillate fuels in grades DMX/DMC [13], these may have different physical and chemical compositions, then it is possible that the chemical composition of the DMA fuel type selected, differs from the chemical composition of distillate fuels adopted by the IMO.

The use of fuels with lower carbon content reduces the emission of CO$_2$. There are references in the naval sector, use in fuel gas carriers LNG propulsion systems DFDM and DFDE [20]. However, the trend of implementation of LNG fuel for marine use is increasing in all types of ship due to tougher regulatory requirements of Annex VI of MARPOL 73/78 [3, 4] in SECA areas.

The increasing use of biofuels and the implementation of renewable energy technologies in the naval sector represent a very interesting solution to limit or reduce emissions of carbon dioxide.

Data obtained from CO$_2$ emission factor for the auxiliary power system are in the same range of similar technologies. From the technical point of view, without the need to replace the model of power

generation, it is possible to obtain better values in CO_2 emission factor, studying the possibility of installation of a WHR system. The installation of these systems increases efficiency, since it uses a part of the residual energy of the flow of exhaust gases from the engines that represents approximately 25% of the energy supplied to the engine with fuel or 40-60% of the energy produced by the engine [21].

The implementation of more efficient energy systems, as the combined cycle, in specific ships, would achieve higher thermal efficiency [18] reducing operating costs and CO_2 emission factor. However, this system involves higher cost of investment that is necessary to conduct a depreciation study.

Conclusions

Correct dimensioning of the system auxiliary power generation to assume the electric charge "Normal Maximum sea load" at a MCR close to full load is critical to reduce specific fuel consumption and to limit emissions of carbon dioxide from the auxiliary power system

Calculate the EEDI parameter it's important for determining the CO_2 emissions of marine auxiliary power system. Although IMO allows in some cases, to get the data by estimation, its desirable quantify these emissions with less uncertainty, therefore is critical, the calculations with real balance electrical load.

It's about time that the naval sector bets permanently renewable energy technologies or residual thermal energy. Installation requires studies of investment and payback period of investment is directly dependent on oil prices but reducing CO2 emissions are undeniable. Another techniques like, changes of kind of fuel or management techniques and energy optimization are directly related to the emission of GHG.

Determine the EEOI and CO2 emission factor of auxiliary power system, although it is not required by the IMO, allows comparisons and environmental assessments with other electrical systems, allowing "also" make an objective assessment of the potential measures improvement implanted.

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THE EFFECT OF WEAR OF PLUNGER PAIR DETAILS ON FUEL SUPPLY OF PUMP

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Abstract
The effect of the quantity of wear of plunger pair details on the pump's supply of fuel is studied in the article. It was revealed that wear of connection of "plunger base – bottom plate" of precision surfaces seriously affects the fuel supply of pump. Therefore, it is very important to restore these details by diffusion metallization.
Keywords: *pump, fuel, plunger pair, wear, detail, warp, layer*

Introduction

The effect of wear of the surfaces of precision and transmission pairs on the supply of fuel and fist of all, circuit supply and phases (start and end angles of fuel supply) has been studied in the literature until modern times. Determination of this dependency is interesting both for factories- manufacturers, and also repair facilities. As,this enables us to choose the method for the restoration of the wear surfaces of the details of this plunger pair on the grounded basis.

Discussion of results

Reporting program was developed in ECM for the determination of the regularities and principles of wear of precision and transmission surfaces of the details of plunger pair. It enables to model the indicators of fuel supply of the pump depending on these factors. Mathematical description of working process of fuel supply of distribution type fuel pump is presented based on the program. Working process of plunger pair of fuel pump consists of three bars: filling, working progress and empty progress. Filling bar begins with the opening of thimble's launcher windows with upper part of plunger and ends in the beginning of upper movement of BDP (Bottom dead point) of plunger. When engine operates in nominal regime, upper plunger space fills up in a part of second with fuel. So, the fuel consumption determined with pressure in pipeline that transmits fuel and flowing through filling windows, and their opening quantity plays an important role.

The scheme of plunger pair and the position of plunger in relation to thimble in the filling tact in BDP is given in the below figure. It is seen from the figure that upper edge of plunger is located $y_0^l = 0{,}66 km$ (constructive parameter) below from the center of filling windows. So, plunger passes through two areas in working regime (filling with pressure) in new plunger pair: working area of the quantity y_0^l from the axle of filling windows to central bottom point and from the moment of close of permeability windows till TDP (Top dead point) (1). The profile of filling window and zone closed with plunger in at TDP in initial period of the work of new pair (11) is shown in the Figure b. When plunger moves upwards, it prevents ellipse-shaped filling windows. The area of open part of ellipse shape is changed by the following law:

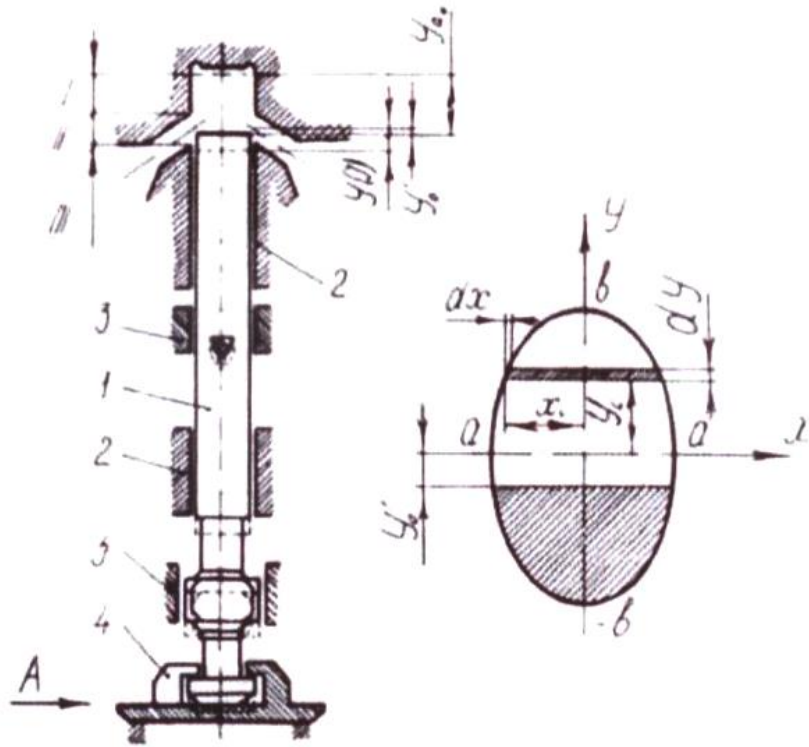$$F_{di} = \int_{y_i}^{b} f(y)dy \int_{0}^{a\sqrt{b^2 - y_i}/b} dx \; , \qquad (1)$$

Figure 1. Schemes of plunger pair (a) and its filling windows (b)
y_{ao}- full turn of plunger from BDP to TDP;
y_0^I- constructive quantity, Y(J) –wear in A junction;
I – active turn zone of plunger, II – zone of permeability windows;
III- plunger's turn zone till to additional windows; 1 – plunger
2 – plunger's cavity, 3 – dispenser (distributive means)
4 – bottom plate, 5 – gear carve.

Here, $x = a\sqrt{b^2 - y_i}\ / b$ - is the ellipse equation;

a, b- are respectively small and large axles;

y_i- current value of ellipse's coordinate.

We get the following by integrating (1) expression:

$$F_{di} = ab\left(\frac{\pi}{2} - \arcsin\frac{y_i}{b}\right) - \frac{ay_i}{b}\sqrt{b^2 - y_i^2} \quad, \tag{2}$$

when $y_i = -b$, the full area of open filling windows will be as follows:

$$F_d = \pi ab$$

the consumption of the filled fuel is found from the empiric expression:

$$Q_{di} = Q_{d\max} - Q_{d\max}\cdot\sqrt{1 - \frac{F_{di}^2}{F_{d\max}^2}} \ , \tag{3}$$

According to the plunger pair, maximum consumption of fuel is experimentally determined with the following expression:

$$Q_{Hmax} = P/(0{,}00000354 + 0{,}0000046P), \tag{4}$$

Here P- pressure on stamping trunk, kg/cm^2.

In A junction – the condition of upper edge of plunger in the process of wear of the connection of "plunger's base – bottom plate" changes in relation to filling windows. Plunger goes down as the quantity of total wear of two details. In this case, it is not possible that the third area appears when the plunger moves from BDP to bottom edges of filling windows (1). Filling tact will be implemented in fully open filling windows, and this improves the process of filling fuel.

Upper edge of plunger's going down to a certain quantity reduces the active progress of plunger up to the same quantity:

$$y_a = y_{a_0} - y(J) , \qquad (5)$$

Here, y_{a_0} – is the constructive quantity of active progress. The current value of fuel's circuit supply will be determined with the following equation:

$$V_{d_i} = \frac{\pi d_p^2}{4}(y_a(\varphi) - y(J))\eta_H , \qquad (6)$$

Here, d_p - is the diameter of plunger;

$y_0(\varphi)$ – is the law of ascension of plunger with cam;

η_H - coefficient that takes into consideration the loss of fuel.

It can be concluded from the expression (6) that,while the wear of base and bottom plate of plunger in the joining point increases, in this case, the circuit supply of fuel will decrease. Decrease in the circuit supply of fuel is the sign of wear of the surfaces of details and it is taken into consideration with the coefficient nH. The theoretical determination of the quantity of coefficient nHis difficult, as the decrease in the supply of fuel depends on local wear distributed non-equally. Therefore, it is found on empirical method:

$$\eta_H = 0{,}682 - 0{,}0045T^2 - 0{,}0034T , \qquad (7)$$

Here, T- is the operation of plunger pair, a thousand of working hours.

The modeling of the process of supply of fuel in ES 1022 ECM shows that circuit supply reduces 18% in the wear up to 1,0 mm of "plunger base – bottom plate" of A junction. In this case, the angle of beginning of geometric transmission is late as 3,5°. 0,09 decrease in nH coefficient (when T= 4000 working hours) 13 % decreases or reduces the fuel supply with pump. The effect of wear of working surfaces of cam, details of propellant and integral that brings plunger into turning movement has not been taken into consideration in the reports, as this article is the concern of independent study [1].

Theoretical study shows that wear of working surfaces of details of precision and propellers also affects the values of supply of fuel with pump during operation. Preferable effect of this or that wear will depend on the resistance of these surfaces to wear.

So, the theoretical analyses of the possibilities of restoration of precision details by the method of diffusion metallizing shows that change in their line sizes should compensate their warp in the restoration (metallizing) process of local wear of details, it should provide the part for mechanical processing and keep the thickness of diffusion layer that excludes pressing and collapse of diffusion layer with abrasive particles [2].

Conclusions

Along with the wear of precision surfaces, great impact on the indicators of supply of fuel with pump is observed with the wear of junction of "plunger base – bottom plate". So that, working surfaces of details of plunger pair should be strengthened along with restoration. It is required to conduct the following experimental studies related to initial theoretical conditions set forth:

~ Determination of the effect of repletion   modes on the quantity of warp of plunger pair;

~ Determination of resistance of working surfaces which are restored and load-bearing capacity of diffusion covers to abrasive wear;

~ Determination of the effect of precision and transmission convergence of plunger pair in separate on the characteristics of fuel supply.

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REFINANCING OPTIONS ASSESSMENT
OF JSC "LITHUANIAN SHIPPING COMPANY"
BY OPTIMIZING FINANCIAL MANAGEMENT POLICY

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Abstract
Lithuanian Shipping Company is one of the oldest shipping companies in Lithuania, which has 40 years' experience carrying wide range of cargoes: bulk, timber, general cargoes and containers. Lithuania has a long tradition as a maritime country, and Lithuanian Shipping Company exists to maintain that tradition. Shipping companies usually brings a lot of revenue to the state budget, but Lithuanian Shipping Company, despite that it is Joint Stock Company and 56,66% of the corporation shares are owned by the government, is working at a loss and cannot bring income to the country. Recently, enterprise is working at a loss because it suffers from large costs, which are loan payments to SEB bank for in the past bought ships. 45,9 million LTL (13,3 million EUR) debt threatens to the company's business continuity which is very negative not only for private shareholders, but Lithuania as well. So, to maintain company, it is worth to analyze refinancing possibility, which is one of the optimized financial management policy tasks. By refinancing a company's loan will be seeking for smaller loan interest costs and loan term delay.
Keywords: *refinancing, debts, loan, liabilities*

Introduction

Nowadays, business rarely manages without loans, especially shipping business. One of the most important factors of shipping companies is age of ships. Old ships are unsuitable for operations so shipping company to be prosperous, must periodically update its fleet. However, ship investments insist large funds, which companies mostly do not have, so they have to borrow. Borrow is needed, but sometimes loan puts a heavy burden on business, for which is not reached a positive financial result.

Financial management policy includes investment and financing decisions. Not estimated and excessive debts does not let companies to earn profits, so sometimes they have to consider a refinancing possibility, which is seeking for a smaller interest costs. This problem especially relevant to companies with large debts – including JSC "Lithuanian Shipping Company", because the main part of costs compose loan interest expenses. To earn profits, first of all need to thoroughly investigate company's liabilities, understand the debt financing and also to seek their cost reduction. This can be done by used one of the financial management policy optimization techniques – refinancing.

The paper aims to assess refinancing possibilities of JSC "Lithuanian Shipping Company" loan by choosing the most valuable. The tasks of research are:

1. to describe the shipping companies' financial debts in approach of shipbuilding market;

2. to analyze the 2010-2014 JSC "Lithuanian Shipping Company" indebtedness;

3. to assess refinancing possibilities of JSC "Lithuanian Shipping Company" loan in approach of interbank offered rates.

To achieve research tasks were used the following methods: analysis of scientific literature, horizontal and vertical analysis of financial statements, graphical analysis methods (graphs, charts), correlation, prediction, optimistic and pessimistic model.

Shipping companies' financial debts in approach of shipbuilding market

Shipping role is becoming more and more significant, because production practically lost national "check-in" and increasing number of people, production demand increases as well. World maritime traffic potential is enormous, it can provide all the vital maritime communications. In addition, in the area of intercontinental traffic, maritime fleet is the main means of transport, i.e. monopoly over other modes of transport [11].

Marine transportation in comparison with land transport is much cheaper, so maritime transport covers up to 90% of world trade. For marine transportation services annually earned about 500 billion USD, which represents approximately 5% of the world economy [2]. Two thirds of marine transportation consists of dry bulk cargo and third – liquid cargo transportation [6]. New vessels earn more income to the company, which ensures not only the return on investment, but further growth and development of the enterprises as well [1].

Shipping companies are the companies executing offshore orders and carrying consignments to various countries of the world. To maintain a high position in the shipping market, enterprises must regularly renew their fleet, so it complies with the technical and safe condition rates of ships. Too old vessels are delivered to scrap metal and instead of them are acquired new and modern ships. However, fleet financing insists more money than derived from scrap metal. Therefore, there are also taken bank loans and the consequence of this – are formed long-term liabilities of shipping companies.

Requirement to buy a new ship appears on the aging company's fleet and the growing demand for maritime trade [4]. Also there are more reasons, for which enterprises are investing to the vessels, for example:

- Freight traffic increase
- Revenue increase waiting in freight market
- The company's development
- The company's competitiveness
- Renovation and replacement of the fleet
- Further ships resale

Container ships and tankers can cost up to 150 million USD per vessel and liquefied natural gas tankers, which are regarded as the most precious vessels, even up to 225 million USD per ship [10]. New vessel price directly depends on its construction costs, which means that the shipbuilding market has a big impact on the obligations of the shipping companies. Shipbuilding market practice states that a new ship building cost about as much as the ship freight revenue will be earned throughout her lifetime [3].
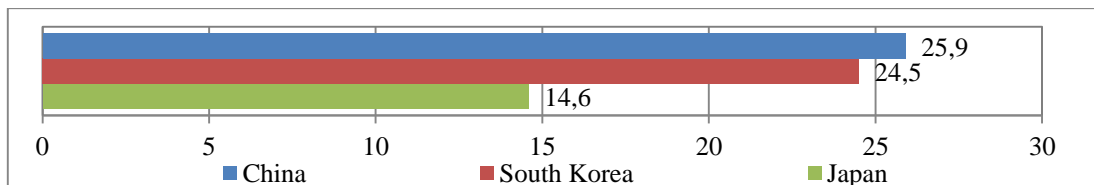

Figure 1. The largest shipbuilding industrial countries in 2013 by GT, millions registers tons [9]

The leader in the global shipbuilding market is China. By the showing of 2013 years, Chinese shipbuilding companies built vessels with a gross tonnage amounted to almost 26 million register tons. The gross tonnage of the ship is an index related to a ship's overall internal volume except ancillary rooms. Gross tonnage is expressed in register tons, 1 register ton = 2,83 m^3.

Not far behind from China by shipbuilding is South Korea – 24,5 million register tons. Japan ranked third – 14,6 register tons. In fourth place by shipbuilding is Philippines which built only 1,3 million register tons, so it can be claimed that only China, South Korea and Japan are the main shipbuilding industry leaders.

Very important indicator in the world shipbuilding market is Clarkson's new shipbuilding price index, whose growth shows that shipbuilding prices are rising. This indicator is calculated by averaging USD per dwt values of the various ship types. The base of 100 is taken as the average index value.
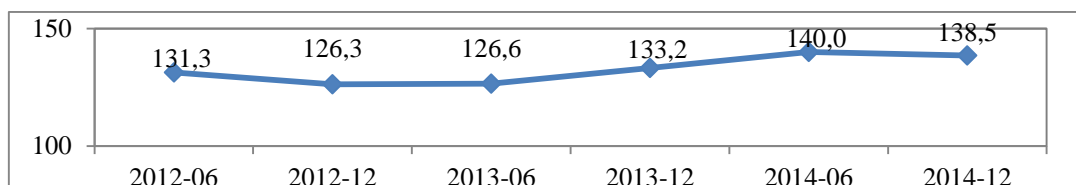
Figure 2. Clarkson's new shipbuilding price index in 2012-2014 [5]

Clarkson's new shipbuilding price index in the period of 2012-2014 increased. Recommended average of this indicator is 100, but the whole time it exceeded the norm. In the June of 2012, this index reached 131,3 and December of 2014 it rose 7,2 and reached 138,5. It means that prices of building tankers and dry cargo ships are increasing, and as a consequence – liabilities of shipping companies will become bigger, because buying more expensive new ships will insist bigger credit.

In summary, it can be said, that because of the rising shipbuilding prices, investments to the ships will cost more money, so shipping companies will have to take bigger bank loans. Excessive shipping companies' liabilities are reducing their solvency, liquidity and it can even lead to bankrupt. Consequently, in the shipping as well as any other company having big financial liabilities is necessary a proper financial management policy.

JSC "Lithuanian Shipping Company" 2010-2014 years indebtedness

JSC "Lithuanian Shipping Company" 7 years already is working at a loss. One of the reasons for this – are too large company's obligations for which to cover are wasted most of the revenue. Enterprise's payables and liabilities in a broad sense include long-term and short-term payables and liabilities.
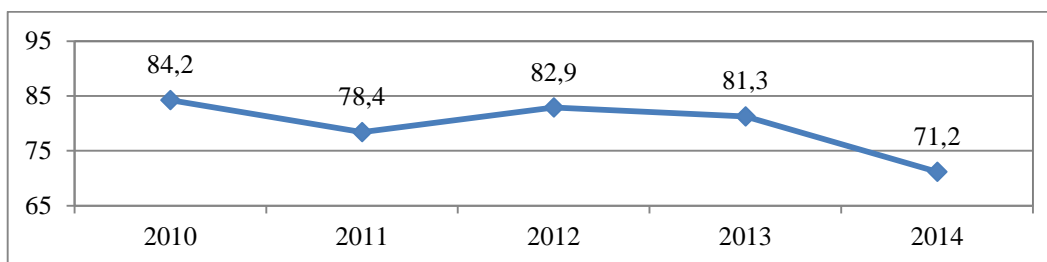

Figure 3. The graph of JSC's "Lithuanian Shipping Company" payables and liabilities 2010-2014, millions LTL [8]

JSC's "Lithuanian Shipping Company" payables and liabilities throughout the investigation period decreased by 13 million LTL. In 2010 years, company's debts amounted to 84,2 million LTL and 2014 years – 71,2 million LTL. The greatest impact of changes of payables and liabilities had changes of SEB bank loan (correlation – 66%). It is also worth to mention that in 2012 years debts of enterprise increased by 4,5 million due to the threefold increased liabilities to suppliers.

In the strict sense, company's liabilities consist of liabilities to credit institutions, liabilities to suppliers and other liabilities which include labor related liabilities, received prepayments, corporation tax liabilities, delay of pensions and other payables and liabilities.
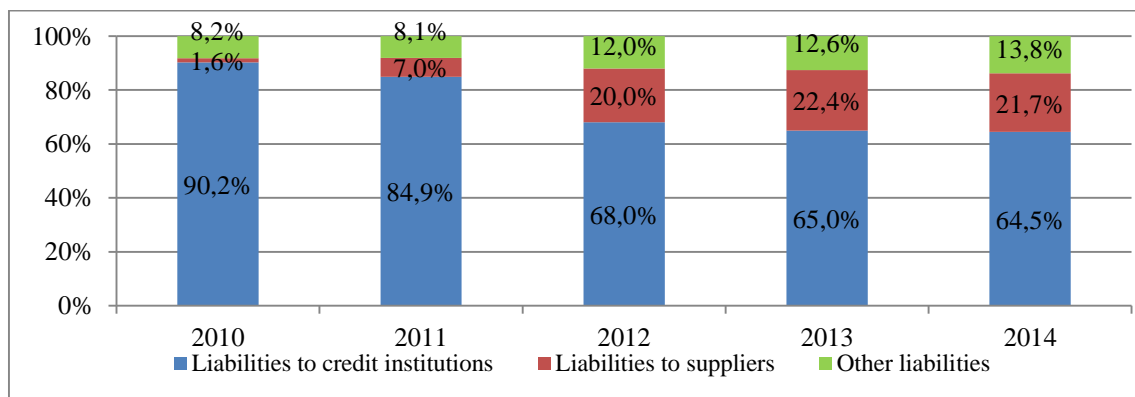

Figure 4. JSC's "Lithuanian Shipping Company" payables and liabilities in 2010-2014, % [8]

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Other liabilities during the investigation period were the lowest part of JSC's "Lithuanian Shipping Company" liabilities. In 2010 years, it composed 8,2% of all debts (6,9 million LTL) and in 2014 years – increased to the 13,8% (9,8 million LTL). The basis of the other liabilities in 2014 years formed labor related liabilities (6,6%) and received prepayments (4,7%).

Liabilities to suppliers during the investigation period increased 12 times. In 2014 years it composed 21,7% of all debts (15,5 million LTL) of which: 6,6 million LTL – for fuel, 3,8 million LTL – debts for ship repairs and technical supply, 1,2 million LTL – debts for agents, 0,6 million LTL – debts for ship lubricants and other debts for ship insurance, maintenance, etc.

The largest from all of JSC "Lithuanian Shipping Company" debts are liabilities to credit institutions. Actually, it is only SEB bank loan for in the past bought company's ships. In 2010 years this debt compose 90,2% of all enterprise's liabilities (76,2 million LTL) and in 2014 years – 64,5% (45,9 million LTL).
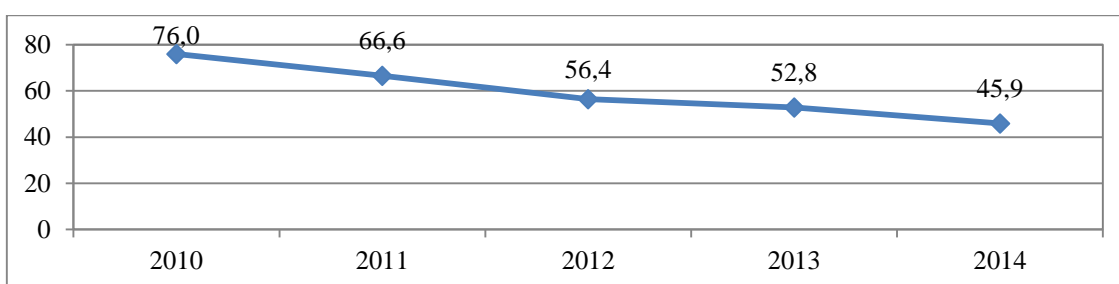

Figure 5. JSC's "Lithuanian Shipping Company" SEB bank loan in 2010-2014, millions LTL [8]

Throughout the whole investigation period company reduced SEB bank loan. Especially it rapidly decreased 2010-2012 years when enterprise returned 10 million LTL to SEB bank annually. In 2014 years, compared to the base years, credit was reduced 40% and it was equal to 45,9 million LTL. The biggest part of the company's loan composes debt for "Venta" ship, which before the combination of loan amounted 44,4 million LTL (exactly two thirds of the total debt). However, although the company was able to pay credit contributions, it was done too slowly. 2015 years' February 27 was the final maturity day, but the credit is still not covered and at the moment is considered how to do it without bankrupt.

Due to the declining shipping market significantly worsened company's cash flow, so the loan was promised to be covered by the sale of the ships and main business income. However, in order to maintain the fleet, enterprise will likely have to refinance its loan by postponing the repayment term in SEB bank or refinance in another bank.

One of the reasons why JSC "Lithuanian Shipping Company" did not have enough time to fulfil its obligations is negative USD exchange rate, which increased the company's credit base. By the increase of the enterprise's credit, SEB bank service charges and interest payments became bigger as well, because they are calculated and paid by a certain percentage from the rest of the credit base.

Table 1. USD exchange rate influence on JSC's "Lithuanian Shipping Company" credit 2010-2014, millions LTL

Stages of changes in debt	2010	2011	2012	2013	2014
Loan balance at the beginning of the year	73,5	76,0	66,6	56,4	52,8
Debts returned	-3,6	-10,3	-8,8	-1,5	-12,4
Exchange rate for converting USD to LTL	2,61	2,67	2,61	2,51	2,84
The change of debt due to exchange rate changes	6,1	0,9	-1,4	-2,1	5,5
Loan balance at the end of the year	76,0	66,6	56,4	52,8	45,9

Source: JSC's "Lithuanian Shipping Company" financial statements, 2010-2014

Exchange rate for converting USD to LTL is fickle. At the end of the 2009 years, when JSC's "Lithuanian Shipping Company" financial statements of 2010 years were making, 1 USD was worth approximately 2,40 LTL and at the end of 2010 years – 2,61 LTL. This accession of USD in approach of LTL, increased credit by 6,1 million LTL. Therefore, although during the 2010 years company returned

3,6 million LTL to SEB bank for obtained ships, credit still increased by 2,5 million LTL. In 2011 years due to exchange rate changes, loan decreased 0,9 million LTL less – 9,4 million LTL.

At the end of 2012 and 2013 years exchange rate for converting USD to LTL was dropped and it reduced company's obligations by 3,5 million LTL. However in 2014 years USD in approach of LTL strengthened again by reaching 2,84, which 5,5 million LTL increased the company's credit. In 2014 years JSC "Lithuanian Shipping Company" paid to SEB bank 12,4 million LTL, but due to the changes of USD exchange rate loan fell only 6,9 million LTL. If since 2010 years exchange rate for converting USD to LTL would have remained stable, company's credit in 2014 years would have been not 45,9 million LTL, but 36,9 million LTL. Thus, it can be said that USD exchange rate had a negative impact on the JSC "Lithuanian Shipping Company" credit service charges and interest payments.
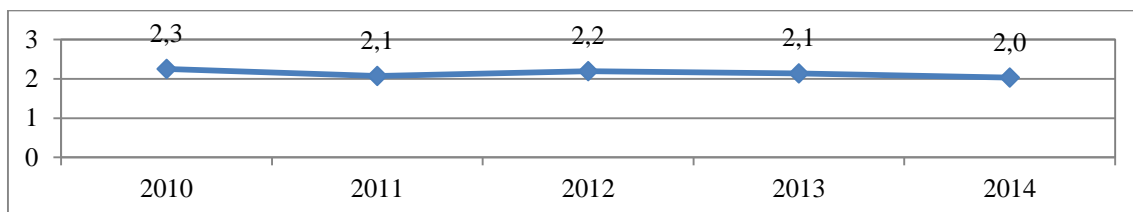

Figure 6. JSC's "Lithuanian Shipping Company" interest expenses in 2010-2014, millions LTL [8]

Every year JSC "Lithuanian Shipping Company" must pay over 2 million LTL interest for taken credit. Although the loan interest rate at the same time increased, interest expenses a little decreased. This happened due to the fact that by paying credit contributions base of credit, from which interest costs are calculated, has become less. However, due to increasing USD exchange rate, interest expenses were decreasing too slowly. 2 million LTL annual interests is a big burden for the company which directly reduces its financial result.

Refinancing possibilities of JSC "Lithuanian Shipping Company" loan

Interbank offered rates – are the average percentage rate for which banks lend funds to other banks in USD, EUR or other major world currencies. The most common variable interest rates are associated with these interbank offered rates:

- EURIBOR – loans in EUR;
- LIBOR – loans in USD, EUR and other major world currencies.

Recently, JSC's "Lithuanian Shipping Company" loan interest rate is tied to the 3 month LIBOR (USD) and 4% net interest margin. The loan is repaid on a monthly partial payment of contributions and accrued interest, which may change only every 3 months (despite margin changes). After repayment of the loan term – 27 day of February, 2015, the company did not return credit to SEB bank and currently is paying late payment charges.

Credit terms of the contract in each case are done individually and it is commercial bank secrecy. Therefore refinancing possibility can only be considered through LIBOR, EURIBOR forecasts and by making assumptions on stability or change of margin by seeking the minimum loan interest rate. First of all, it is important to review by the various periods of time determined variable interest rates tied to the LIBOR, EURIBOR rates.

Table 2. Interbank offered rates' averages in 2014 years, %

Rate	1 night	1 week	1 month	3 month	6 month	1 year
LIBOR (USD)	0,09230	0,12200	0,15513	0,23380	0,32951	0,56105
LIBOR (EUR)	0,05129	0,07493	0,11555	0,18071	0,27148	0,43443
EURIBOR	0,09727	0,10061	0,13131	0,20926	0,30831	0,47582

Source: Interbank offered rates

All interbank offered rates increases, by increasing to the period they are set. This is related with the risk that bank may incur by lending money to other banks. According to this tendency, every company would like to associate its loan with the short-term interbank offered rate, but to cover long-term loans, for commercial banks are not worth to borrow for 1 week or 1 month. Usually long-term credits are covered by a not shorter period than 3 months.

Table 3. Interbank offered rates' LIBOR and EURIBOR 3 month averages in 2010-2014, %

Rate	2010	2011	2012	2013	2014
LIBOR USD (3 month)	0,34	0,34	0,43	0,27	0,23
LIBOR EUR (3 month)	0,75	1,34	0,49	0,15	0,18
EURIBOR (3 month)	0,81	1,39	0,57	0,22	0,21

Source: Interbank offered rates

In 2014 years the lowest 3 month interest rates were LIBOR (EUR) – 0,18% and biggest – LIBOR (USD) – 0,23%. In the investigation period, LIBOR (USD) decreased by 32%, LIBOR (EUR) – 76% and EURIBOR – 74%. Because rates of LIBOR (USD) are decreasing slowest and interest rate is biggest, it is worth to analyze possibility of changing the loan currency into EUR and refinancing credit from 3 month LIBOR (USD) to 3 month LIBOR (EUR).
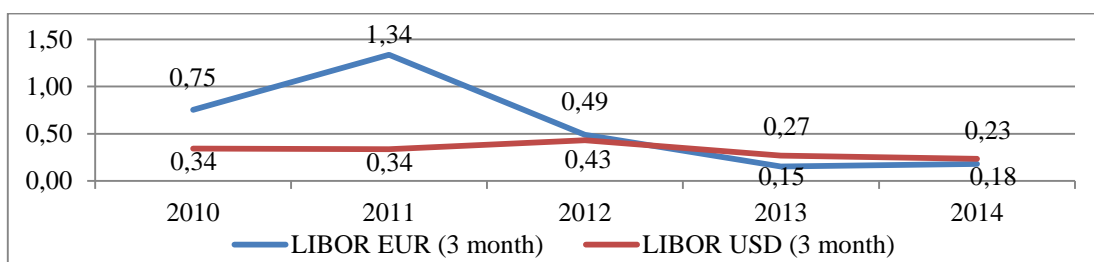

Figure 7. 3 month LIBOR (USD) and LIBOR (EUR) rates in 2010-2014, % [7]

Selection of credit to LIBOR (USD) led not only the fact that most of the income company earns in USD but also, that LIBOR (USD) rates were lower than LIBOR (EUR) at that time. However, in August of 2012 years, LIBOR (EUR) rate has fallen dramatically and after that LIBOR (USD) rate has become bigger. By refinancing a loan is very important to seek lower interest rate. Such large fluctuations in recent years say about the interbank offered rates' volatility. Therefore predicting a further period must be chosen such exponential, linear, logarithmic or power function, which would have the lowest error.
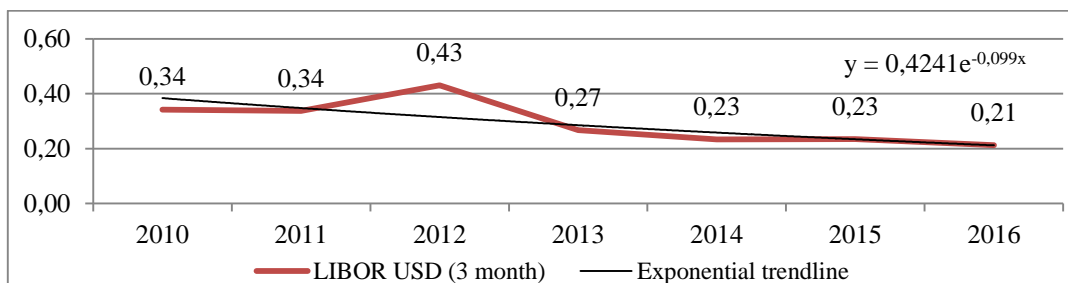

Figure 8. 3 month LIBOR (USD) rates and exponential trendline in 2010-2016, % [7]

According to a forecast of the exponential function, 3 month LIBOR (USD) rates are expected to decrease more. In 2015 years it almost will not change (0,0007% change). However, in 2016 years it will change by 0,02% and the rate is predicted to be about 0,21%. Exponential trend function was the most accurate of all the trends, which error was only slight above the recommended 10% rate – 12%. Anyway, because of the minor error, 3 month LIBOR (USD) may not decrease as much as planned.
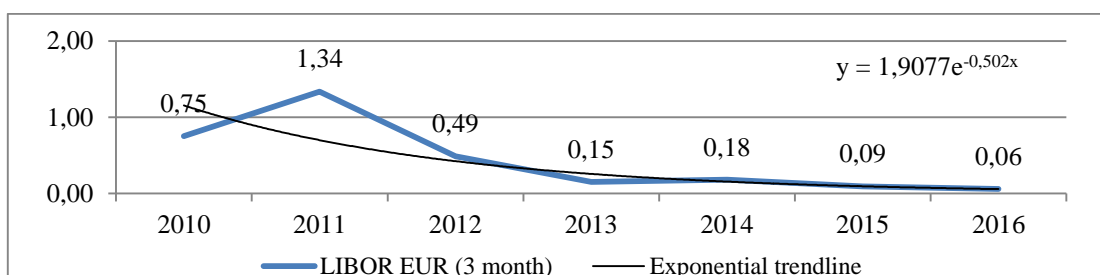

Figure 9. 3 month LIBOR (EUR) rates and exponential trendline in 2010-2016, % [7]

According to a forecast of the exponential function, 3 month LIBOR (EUR) rates are expected to decrease further as well. In 2015 years it is predicted that the rate will reduce to 0,09% and in 2016 years even to 0,06%. However, the exponential function prediction error is too high, which is 39%, even though it is the most accurate of all trends. So, for such a high error rate, the 3 month LIBOR (EUR) may not decrease as much as planned or even not decrease at all. So, to refinance debt and change the interbank offered rate to 3 month LIBOR (EUR) is risky because of the possible rate increase. Anyway, for not a very long term refinancing of credit is a good chance to win lower interest paid with the condition that margin will not change.

By presenting optimistic and pessimistic JSC's "Lithuanian Shipping Company" interest rate model associated with 3 month LIBOR (EUR), are forecasting interest costs due to 1% reduced or 1% increased net interest margin in 2015 and 2016 years.

Table 4. Interest rates' of JSC "Lithuanian Shipping Company" tied to 3 month LIBOR (EUR), optimistic and pessimistic model in 2015-2016, millions LTL (EUR)

Years	Annual interest rate			Annual interest expense		
	Optimistic (-1%)	Actual	Pessimistic (+1%)	Optimistic (-1%)	Actual	Pessimistic (+1%)
2015	3,09%	4,09%	5,09%	1,22 (0,35)	1,61 (0,47)	2,00 (0,58)
2016	3,06%	4,06%	5,06%	0,84 (0,24)	1,11 (0,32)	1,38 (0,40)

Source: Interbank offered rates

Predicting expenses in the next years is very important to evaluate money in EUR also, because in 2015 years Lithuania changed her currency from LTL to EUR with exchange rate 1 EUR = 3,4528 LTL.

By refinancing loan to 3 month LIBOR (EUR), in 2015 years annual interest expense is predicted to be 1,61 million LTL (0,47 million EUR) and in 2016 years – 1,11 million LTL (0,32 million EUR). In recent years, JSC "Lithuanian Shipping Company" has paid about 2 million annual interests, so this refinance would save a lot of money to the company. However, annual interest rate ranged from the margin as well. Therefore, it is really important to evaluate its possible changes: 1% decrease or 1% increase. From optimistic attitude, in 2015 years enterprise can pay 1,22 million LTL (0,35 million EUR) and in 2016 years – 0,84 million LTL (0,24 million EUR) interests. However, it is important to note that when company's LIBOR rate was decreasing, margin of loan was increasing, so it is more likely pessimistic attitude, which claims that in 2015 years interest expense may not decrease and reach about 2 million LTL, but even from the pessimistic attitude, in 2016 years interest costs will reduce significantly and probably will reach about 1,38 million LTL (0,40 million EUR).

Managed to reach an agreement with SEB bank for credit refinancing, it is relevant to examine the JSC's "Lithuanian Shipping Company" taxes for loan contract's creation and maintenance in 2015 years.

Table 5. JSC's " Lithuanian Shipping Company" taxes for loan refinancing in SEB bank 2015, millions LTL (EUR)

Tax	Rate	2015 m.
Administration fee	0,4% – 1,5% base of credit	0,18 – 0,69 (0,05 – 0,20)
Analysis of credit project	50% of administration fee	0,09 – 0,35 (0,03 – 0,10)
Commitment fee	0,5% – 1% remaining amount of credit	0,23 – 0,46 (0,07 – 0,13)

Source: SEB bank fees for credit for investments and business development

Administration fee for refinancing a loan, credit term extension would vary from 0,18 to 0,69 million LTL (0,05-0,20 million EUR). Price of analysis of credit project, which include bank certificate's, preparation and approval would compose 50% of administration fee, i.e. 0,09-0,35 million LTL (0,03-0,10 million EUR). Then commitment fee would reach 0,23-0,46 million LTL (0,07-0,13 million EUR).

Also loan can be refinanced in other commercial banks, for example: JSC "DNB", JSC "Swedbank". However, to do it, company must create an attractive vision by renewing its fleet, increasing revenues or by other means which help to gain the confidence of creditors.

In order to maintain business, JSC "Lithuanian Shipping Company" must refinance its loan. At the end of 2014 years credit was 45,9 million LTL, and it is too excessive amount of money to compensate by sale of 1 or 2 ships. Credit should be postponed for at least several years with the hope that over these years company will be able to earn more income. It is also important to reduce its costs, starting from interest expense. According to forecasts, interests, by refinancing to 3 month LIBOR (EUR), would be the lowest. Assuming that the company will succeed in a year to pay 12 million LTL (3,48 million EUR) credit and net interest margin will not change, interest expenses in 2015 years can decrease by 20% and reach 1,61 million LTL (0,47 million EUR), and in 2016 years – 1,11 million LTL (0,32 million EUR).

Even from the pessimistic attitude, margin increased by 1%, refinancing would be useful. In this case, interest expense in 2015 years would not change and reach 2 million LTL (0,58 million EUR), but in 2016 years it would decrease by 45% and reach 1,38 million LTL (0,40 million EUR).

Conclusions

Financial debts of shipping companies mostly consist of loans for ship investments. By taking a credit, enterprise must assess whether it will be able to return it in time. All these and other questions about the company's investment and financing decisions compose its financial management policy. Growth of Clarkson's new shipbuilding price index claims that shipbuilding prices are rising, so investments to the ships will cost more money and shipping companies will have to take bigger bank loans. Excessive shipping companies' liabilities are reducing their solvency, liquidity and it can even lead to bankrupt. Consequently, in the shipping as well as any other company having big financial liabilities is necessary a proper financial management policy.

JSC's "Lithuanian Shipping Company" payables and liabilities throughout the investigation period decreased by 13 million LTL. Enterprise's liabilities in 2014 years were equal to 71,2 million LTL, which composed: 4,7% – received prepayments, 6,6% – labor related liabilities, 21,7% – liabilities to suppliers and 64,5% – SEB bank loan for in the past bought ships, which over the years decreased by 27,6 million LTL and in 2014 years was equal to 45,9 million LTL. Although the company was able to pay credit contributions, it was done too slowly. 2015 years' February 27 was the final maturity day, but after that the credit is still not covered and enterprise is paying late payment charges.

In order to maintain business, JSC "Lithuanian Shipping Company" must refinance its 45,9 million LTL loan. Credit should be postponed for at least several years with the hope that over these years company will be able to earn more income. It is also important to reduce interest expense. According to forecasts, interests, by refinancing to 3 month LIBOR (EUR), would be the lowest. Assuming that the company will succeed in a year to pay 12 million LTL (3,48 million EUR) credit and net interest margin will not change, interest expenses in 2015 years can decrease by 20% and reach 1,61 million LTL (0,47 million EUR), and in 2016 years – 1,11 million LTL (0,32 million EUR). Even from the pessimistic attitude, margin increased by 1%, refinancing would be useful. In this case, interest expense in 2015 years would not change and reach 2 million LTL (0,58 million EUR), but in 2016 years it would decrease by 45% and reach 1,38 million LTL (0,40 million EUR).

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EVALUATION OF JSC "LIMARKO MARITIME AGENCY" ASSETS MANAGEMENT IMPACT ON COMPANY'S FINANCIAL RESULTS

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Abstract
There are more than 60 ship agencies and more than 80 freight forwarding companies in Klaipeda. One of them is JSC "Limarko maritime agency", main activities of which are freight forwarding services.The main part of maritime business company's assets contain the current assets which affect the result of activities. Therefore, the aim of this paper is to identify JSC "Limarko maritime agency" current assets management methods. Through detailed analysis, it was found out that the current assets management is based on three basic methods: current assets policy, management of buyers debts and management of cash.
Keywords: *ship agency, freight forwarding, assets, correlation between the assets and financial result, current assets management methods*

Introduction

As maritime freights are constantly increasing (Figure 1), it is necessary to ensure that their transportation would take place as smooth as possible and as quickly as possible. Each vessel arriving to the Port of Klaipeda requires some maintenance and provision services. In order for the vessel to enter or to leave the port, it must pay the port dues set by the Order No. 3-525-(E) of the Minister of Transport and Communications of the Republic of Lithuania of 18th December 2014 "Regarding approval of the regulations for application of the Klaipeda State Seaport dues" (TAR, 18-12-2014, No. 20004), as well as it should be able to load and unload the cargoes, to perform embarkation and disembarkation of passengers and receive other services necessary for the ship and its crew. All the formalities relating to the entry of a vessel into the port, and presence of the vessel in the port can be handled by the master of the vessel, charterer or manager on their own. Ship agency companies established in the port can also assist in sorting out these formalities.
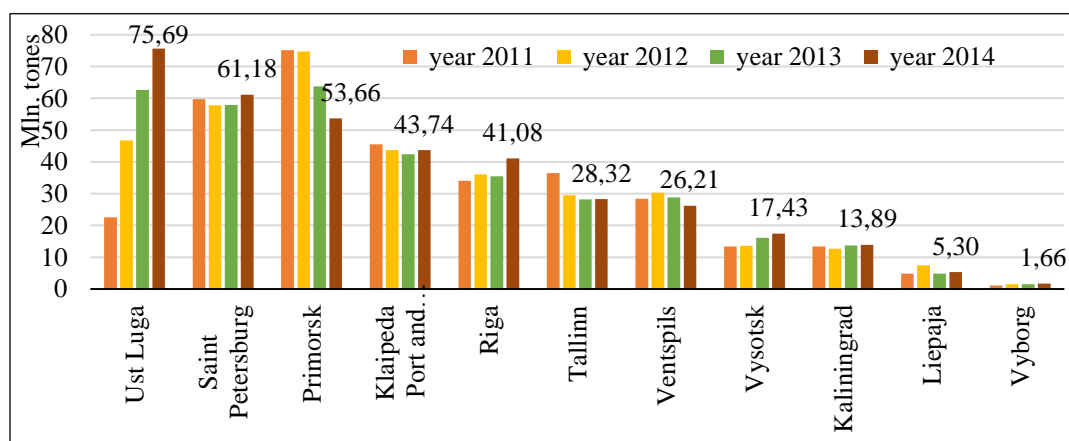

Figure 1. Cargo turnover of the Baltic eastern coast seaports 2011-2014
Source: Annual Klaipeda State Seaport Authority Cargo Handling Reports 2011-2014

Thus, ship agency business is the provision of services related to the shipping under the contract with the owner, charterer, operator or manager of the vessel, including representation of their interests in the port, state or law enforcement institutions; mediation in the acquisition and transfer of vessels; brokering of the charter agreement and the charter agreement enforcement execution; collection and payment of freight, port charges and other fees and charges; clearance of cargo and customs documents and other related activities; organization of the vessel's arrival and departure, as well as organization of stevedoring, the vessel's supply and servicing in the port. The ship agency's activity is a licensed activity, i.e., economic entities wishing to provide these services at the port of Klaipeda, must be certified according to an appropriate procedure and must acquire necessary license or assessment certificate. Companies providing ship agency services mostly practise freight forwarding too. Freight forwarder is a company that has a contract with the shipper or the consignee (buyer or seller) and is committed to send or receive, at the expense of the client, the cargo belonging to the client; to perform other related actions (to accompany the goods, to execute documents for the transport, goods acceptance and transfer, payment for the shipment and other documents).

According to the Ministry of Transport and Communications of the Republic of Lithuania, there are about 70 ship agency and more than 80 freight forwarding companies in Klaipeda. Ship agency and freight forwarding services are opposite in nature, as the ship agent represents interests of the shipowner (carrier), while freight forwarder – interests of the cargo owner (charterer). Compatibility between these services is quite complicated, but in most cases they are both provided by one company.

An excellent example of how to combine the opposite activities could be JSC "Limarko maritime agency" that is operating since 2005. As this is a brokering company, its main assets – money, so it is necessary to use it properly. Certain changes of the maritime business company's assets affect its financial performance, therefore it is expedient for the company to choose the right asset management methods.

This research aims to provide JSC "Limarko maritime agency" financial performance-enhancing asset management methods. The main tasks of the research are:

1. To define correlation between the assets structure and profit of a ship agency/freight forwarding company.

2. To analyze changes of assets and profits of JSC "Limarko maritime agency" for 2010-2014.

3. To distinguish assets management methods affecting financial results of JSC "Limarko maritime agency".

The following methods were used to reach the aim: analysis of scientific literature, analysis of the statistical and financial data based on the horizontal and vertical analysis methods, interpretation of the analysis results, visualization and synthesis.

Assets structure of ship agency/freight forwarding companies

Ship agency and freight forwarding companies are brokering companies representing interests of the shipowner (carrier) and cargo owner (charterer). Acting at the expense of carrier, ship agents provide comprehensive maintenance of vessels, services for the crew and passengers, clearance of the customs and freight documents, and pay the charges and fees. Freight forwarders are practising the opposite kind of activity. Acting at the expense of the charterer, freight forwarders are engaged in the search of the carrier, they organize an optimal cargo transport route, providing customs intermediation, insurance and services of execution of any other necessary documents [5,11].

Activities of ship agency and freight forwarding companies are expressed through the processes of provision of services and sales of services. For the maritime business company to be able to pursue these processes, certain economic resources are required. The company's assets are considered to be such resources. Assets – tangible, intangible, financial resources and values, which are owned and used, and/or which are disposed by the entity in order to obtain economic benefits, by providing services or producing goods [3,4,6,9]. Based on the classic structure of the balance sheet, the company's operating assets consist of fixed and current assets.

Ship agents are not a shipping company, which requires fixed assets such as vessels; and freight forwarders are not a stevedoring company the main assets of which consist of stevedoring mechanisms. Activities of the ship agency and freight forwarding companies are related to the provision of services, accordingly the current assets amount to the major part of the companies' assets [10,11]. Change of the current assets affects not only the change in total assets, but also the maritime business company's financial result – the profit. In order to figure out how it affects the financial result, impact of each

component of current assets on the total assets and the company's financial condition should be established. To achieve this objective, analysis of the structure of current assets was conducted, the results are presented in Figure 2 [1,3,4,9].
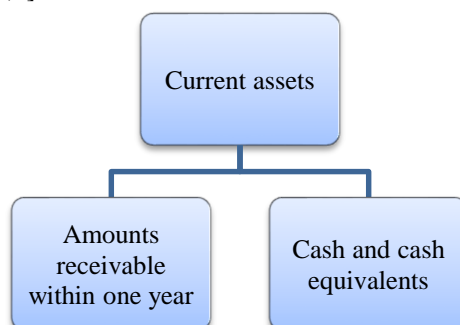

Figure 2. Current assets structure of a service sector company [3,4,6].

In ship agency and freight forwarding companies, there is a very small percentage of current assets such as stock, sometimes it does not exist at all, because for the provision of services it is not necessary. In maritime business companies the major part of current assets consists of amounts receivable within one year, cash and cash equivalents. Proper evaluation of importance of each part allows us to make conclusions and to adopt the necessary asset management methods that would improve the financial result.

Without the effective control and management of current assets it is difficult to imagine achievement of the main objective of the maritime business company – the pursuit of profit. Properly managed current assets can not only ensure a better financial result, but also a competitive advantage. The maritime business company's financial result depends on many factors, the main ones are distinguished in Figure 3.
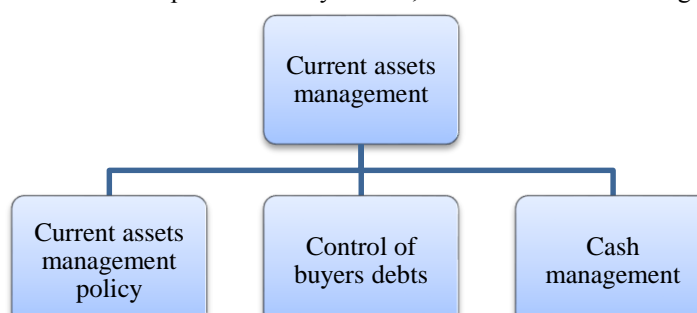

Figure 3. Current assets management factors [3].

For the maritime business company to ensure efficient management of current assets, first of all, it is important to choose a suitable current assets management policy. According to the opinion of V.Alekneviciene and other authors of scientific literature, there are three types of such policies: aggressive, conservative and moderate (Table 1).

Table 1. The features of current assets management policies

Aggressive	Moderate	Conservative
1. Small amount of cash	1. Medium amount of cash	1. Large amount of cash
2. Small amount of stocks	2. Medium amount of stocks	2. Large amount of stocks
3. Small amount of buyers' debts	3. Medium amount of buyers' debts	3. Large amount of buyers' debts

Source: [1, 3, 7, 10].

Aggressive policy of current assets management is characterized by a small amount of money, which can affect the company's liquidity. If the company pursues production, a small amount of stock may indicate that the production may soon be confronted with difficulties. A small amount of buyers' debts in a service company may indicate a slowdown in the volume of sales or the fact that there is a very small circle of service users.

The opposite of this policy is the conservative policy of current assets management, according to which the maritime business company is characterized by a large amount of cash – which shows that the company executives have not taken timely business development decisions. If the company holds overly large amount of stocks for the production of products, they may be not used at all, and in this case this

would mean operational inefficiency of the company. A large amount of buyers' debts in a service company implies an intensive activity, increased extent of consumers, but the company must give extra attention to the control of buyers' debts.

Moderate current assets management policy is exceptional in the fact that strictly large (or small) amount of cash, stocks and buyers' debts is not necessary. This type of policy is intermediate between the other two already mentioned policies. It can be found in companies where there is no established specific current assets management policy.

In order to maintain competitive position in the market, ship agency and freight forwarding company has to apply certain preferences for service users. Providing services for the payment in instalments, the company's executives must strictly control that the buyers would pay their debts. Effective control of buyers' debts affects the expected quantity of money. When the buyers pay the debts, it is important to choose the right amount of money, which will be kept for the continuation of the company's business. The most important is to choose the amount of cash, which would preserve the company's liquidity.

To obtain the best financial result, for the ship agency and freight forwarding company it is important to choose the proper current assets management policy, and to apply strict control of buyers' debts and cash management. Only comprehensive application of these methods of current assets management may positively affect the company's financial result.

JSC "Limarko maritime agency" assets structure

JSC "Limarko maritime agency" provides ship agency and freight forwarding services. The financial result of this activity depends on how rationally the assets are managed. During the research period, JSC "Limarko maritime agency" assets averaged about 2 million euros per year. By 2013, the assets were growing and reached 2.33 million euro, while in 2014 it has decreased by 7%. As a result, over the whole period only 37% of total assets growth was recorded (Figure 4).
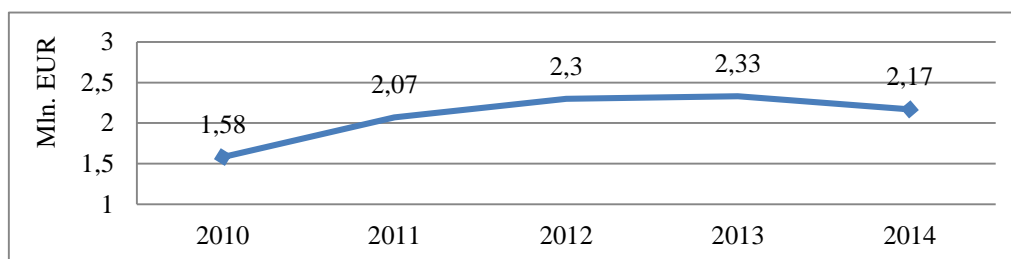

Figure 4. JSC "Limarko maritime agency" assets in 2010-2014

In companies involved in production and sales, the major part of the assets consists of fixed assets. In companies that provide services, current assets constitute the major part of the total assets. Since JSC "Limarko maritime agency" provides ship agency and freight forwarding services, the main part (about 74%) of the assets consists of the current assets (Figure 5).
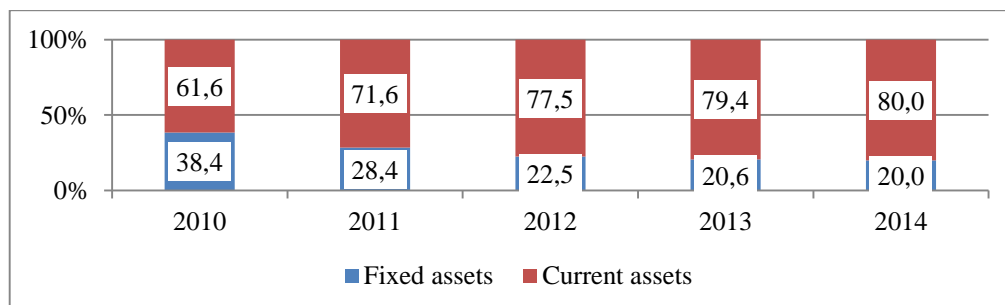

Figure 5. JSC "Limarko maritime agency" asset structure in 2010-2014

During the period under analysis, the current assets increased by 77.6%, the maximum was reached in 2013 (1.85 million EUR per year). However, in 2013-2014, a 6% decline was recorded – this happened because JSC "Limarko maritime agency" has repaid its debts to the subsidiary company (Figure 6).
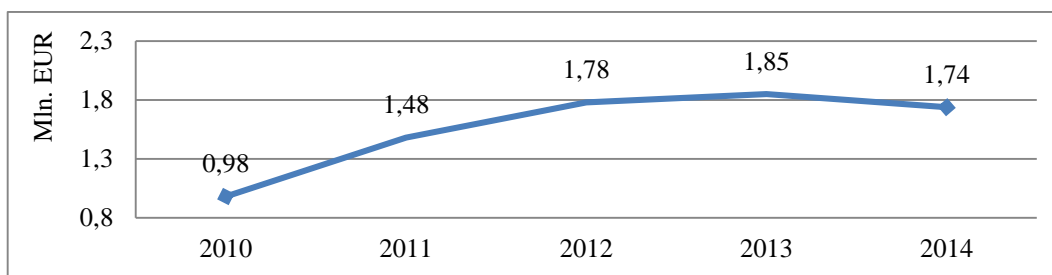
Figure 6. JSC "Limarko maritime agency" current assets in 2010-2014

In order to find out what had influenced the change in current assets, structural analysis of the current assets was performed. According to the results, JSC "Limarko maritime agency" current assets consist of: amounts receivable within one year (about 65.1%), almost 29% - cash and cash equivalents (Figure 7).
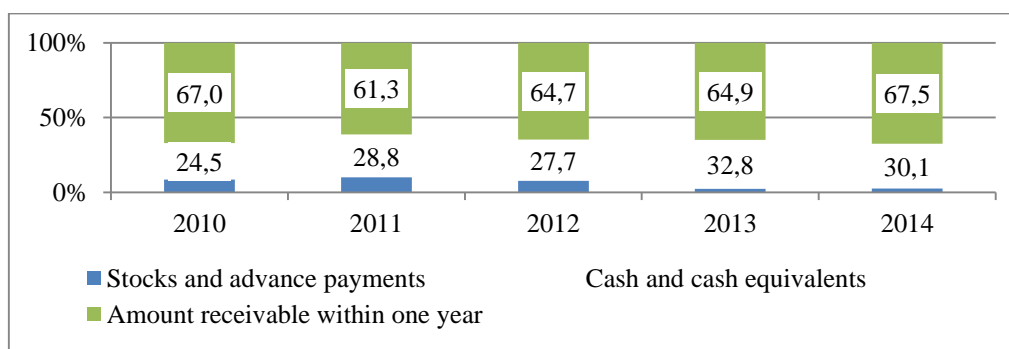

Figure 7. JSC "Limarko maritime agency" current assets structure in 2010-2014

Providing ship agency and freight forwarding services, JSC "Limarko maritime agency" offers favourable payment terms for the service users. In this case, they can use the services immediately, and pay for them only after the agreed term. This produces the amounts receivable within one year. This kind of current assets is particularly important because it shows whether the business of the company is active, and what is the income expected in the future. The dynamics of amounts receivable within one year are shown in Figure 8.
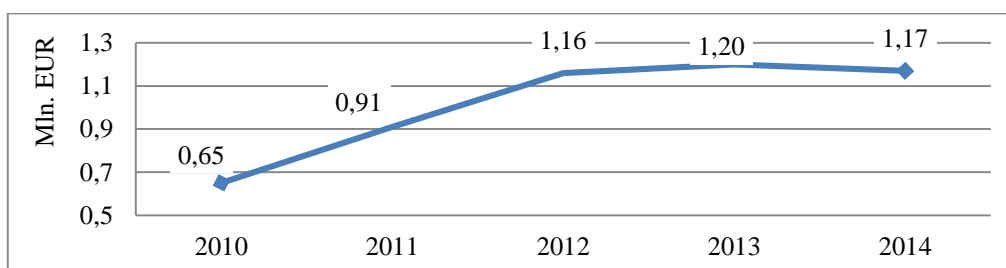

Figure 8. JSC "Limarko maritime agency" amounts receivable within one year in 2010-2014

During the five-year period the amounts receivable within one year increased by as much as 80% and averaged about 1 million euros per year. However, in 2013-2014, their decrease by 2.5% was noticed. This means that some customers had repaid the debts before the end of the agreed term. High indebtedness of the buyers means that there is a substantial risk that the debts may remain outstanding, but this way it is expected to reach the best possible financial result.

The amounts receivable within one year is an important source of cash. During the research period, cash and cash equivalents belonging to JSC "Limarko maritime agency" amounted to an average of 0.44 million EUR per year. The maximum was reached in 2013 – when compared to the base year, these assets increased by more than 2 times and reached 0.61 million EUR. Though in 2014, the 15% decline of these assets was noticed, but during the entire period it still increased by about 2 times (Figure 9).
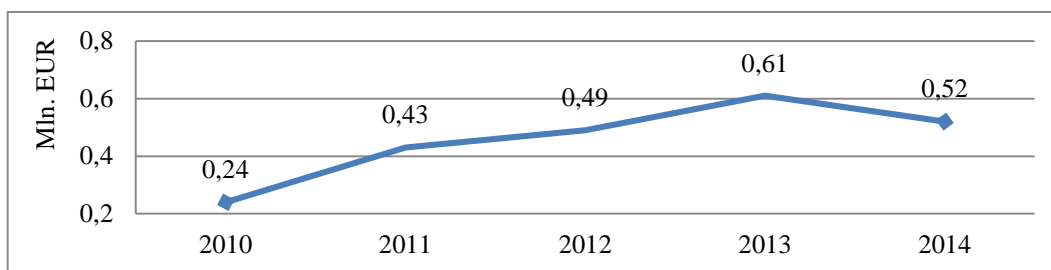
Figure 9. JSC "Limarko maritime agency" cash and cash equivalents in 2010-2014.

Increase of cash in the cash- and bank accounts of the maritime business company indicates that the sale of services has slowed down, or payments occur before the scheduled time. Since amounts receivable within one year with cash and cash equivalents are the main part of the current assets and the total assets, their changes influence the maritime business company's financial result (i.e. net profit). The dynamics of this result are presented in Figure 10.
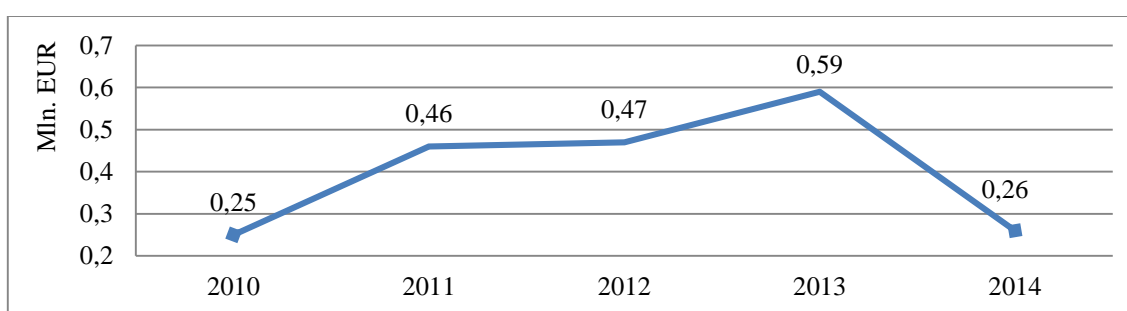

Figure 10. JSC "Limarko maritime agency" net profit in 2010-2014.

During the reporting period, JSC "Limarko maritime agency" annually earned about 0.41 million EUR net profit. In 2013, net profit reached the maximum – 0.59 million EUR. Compared with 2010, this value had increased more than double. At the end of the analysed years, the largest decline (60%) was observed, when the company earned only 0.26 million EUR net profit. This negative change could be caused by a slowdown in sales or an increase in financial and investment operating expenses.

Net profit represents only a temporary result of the maritime business company's activity, which can change very rapidly. The result of the maritime business company's activity depends on how properly the JSC "Limarko maritime agency" leadership manage its current assets.

JSC "Limarko maritime agency" current assets management

The choice of an effective current assets management policy is one of the three steps which help to achieve the proper current assets management and optimize the financial result. Based on the current assets management policies (aggressive, conservative and the moderate) discussed in the theoretical part, and having evaluated the financial data of JSC "Limarko maritime agency", the current assets management policy of this ship agency and freight forwarding company is presented in Table 2. The symbol "+" means that the assets compared with the previous year have increased, the symbol "-" indicates that the assets compared with the previous year have decreased.

Table 2. Evaluation of JSC "Limarko maritime agency" current assets management policy

	2010	**2011**	**2012**	**2013**	**2014**
Stocks	+	-	+	-	-
Buyers' debts	+	+	+	+	+
Cash	+	+	+	+	-

Considering the fact that the essential features of the current assets management policy are certain amount of stocks, buyers' debts and cash, it was identified at what point during the research period the

company had the biggest change in assets. Therefore, it can be said that in 2010 and 2012, conservative current assets management policy prevailed in the company, because an increase in these assets was noticed during those years. An increased amount of buyers' debts and cash in 2011 and 2013 means that the company applied the same conservative current assets management policy. However, the decreased amount of stocks and cash at the end of the research period reveals that the company used an aggressive current assets management policy.

During the analyzed period certain amount of company's stock, buyers' debts and cash has shown that the JSC "Limarko maritime agency" does not have a prevailing current assets management policy. The company's executives each year select the best current assets management policy according to the company's financial situation and volume of sales. It should be noted that this company annually sets aside a large part of a liquid current assets.

Since JSC "Limarko maritime agency" provides ship agency and freight forwarding services, it is characterized by a large amount of buyers' debts. All of this has both a positive and a negative value: sales of services are increasing, however, the likelihood that liabilities will be covered are decreasing. In order to prevent doubtful debts, it is necessary to control the buyers' debts. This control is carried out according to the following steps:

- prior to entering into a transaction, it is necessary to search for information about the buyer of services;
- based on the data that a buyer may be insolvent – it is worth not to provide services on credit;
- if the customer constantly delays the payments – the likelihood appears that the debts may not be paid up.

The higher number of reliable buyers indicates higher income. After receiving the income, it is important to select the minimum amount of cash that will not be invested, but which would maintain adequate liquidity of current assets. Based on the JSC "Limarko maritime agency" financial data, the company keeps a sufficient amount of money that would solve most of the problems associated with transactions and administrative expenses.

In consequence, the company does not have any specific current assets management policy. In order to remain solvent, the company annually devotes a sufficient amount of liquid current assets. In order to find out whether the company's executives use the correct current assets management methods and how it affects the financial result, the basic solvency and liquidity indicators were calculated.

Evaluation of JSC "Limarko maritime agency" assets management

Current assets are characterized by their liquidity – they can be very quickly converted into cash. It is customary to assume that these assets are intended to cover the current liabilities. To determine whether the JSC "Limarko maritime agency" is able to cover its current liabilities in case of need, the current liquidity rate has been estimated (Figure 11).
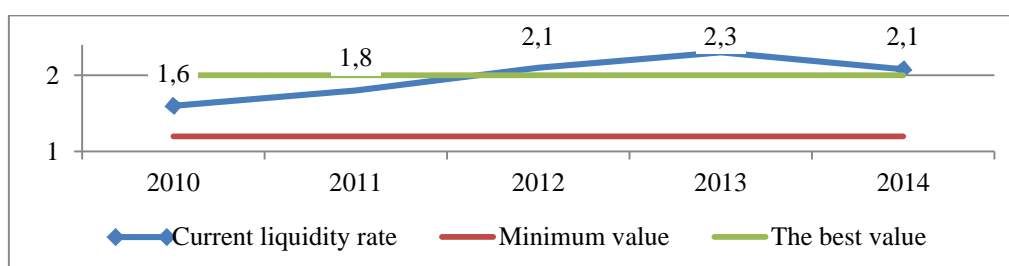
Figure 11. JSC "Limarko maritime agency" current liquidity ratio in 2010-2014.

The average value of this indicator reaches 2 times – that's how many times the company's current assets exceed current liabilities. The maximum was reached in 2013 when the value of this ratio increased by 44% and reached the mark of 2.3 times. Although the value decreased by 8.7% in 2013-2014, the company's executives should not worry, because this result falls within the range of a nominal value (1.2-2). Based on the fact that during the period of 2012-2014 this value exceeded the 2 times margin, it was found that the company is fully prepared to cover the current liabilities using its current assets in case of need.

It takes time to convert current assets into cash. In order to assess whether the company could cover all current debts with the cash in bank accounts and on hand, the calculation of an absolute short-term solvency rate was conducted, the result is expressed in Figure 12.
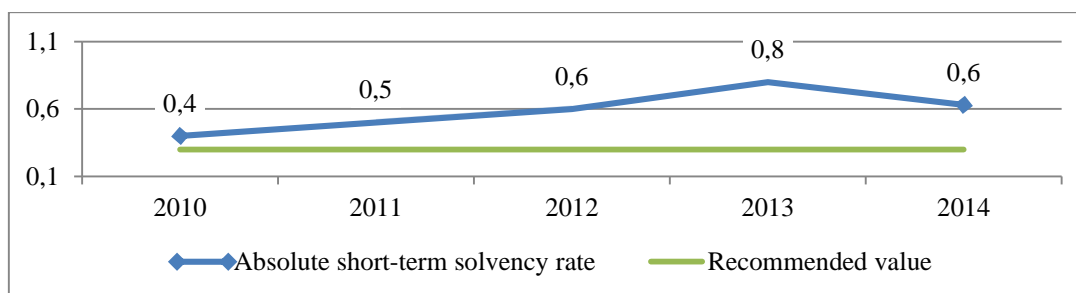

Figure 12. JSC "Limarko maritime agency" absolute short-term solvency ratio in 2010-2014.

During the analyzed period, the average value of this coefficient amounted to 0.6 – it is 2 times higher than the recommended value (0.3) and even by 3 times exceeds the lowest recommended value (0.2). In 2013, the rate had reached the maximum (0.8) – it is even 2 times greater value than it was at the beginning of the period. Despite the negative change (25%) in 2013-2014, the results of absolute short-term solvency coefficient nonetheless exceed the recommended value even by several times. Based on this, it was found that the company has a sufficient amount of cash, which could help to cover the most of the short-term liabilities.

Consequently, in order to achieve a better financial result, JSC "Limarko maritime agency" keeps a sufficient amount of liquid current assets, which, if necessary, could be converted into cash. As a result, the company is solvent, so there should not be any financial problems in the near future.

Conclusions

JSC "Limarko maritime agency" provides ship agency and freight forwarding services. The main part (74%) of total assets consists of the current assets, so their change is important to the financial result of the operations. During the research period, the amounts receivable within one year increased even by 80%, cash and cash equivalents – even 2 times. These changes resulted in the growth of the current assets (77.6%).

In 2013 net profit reached the maximum – 0.59 million EUR. This was more than 2 times higher than it was in the previous base year. Proper management of current assets contributed to such result.

JSC "Limarko maritime agency" does not have a prevailing current assets management policy. The company's executives select the best current assets management policy each year according to the company's financial situation and sales volumes. According to the solvency and liquidity indicators, it is a solvent company, there is a strict control of buyers' debts and cash management.

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1. Page Layout (paper size A4 - 21 cm x 29,7 cm) should be as follows: Top – 3 cm, Bottom – 3 cm, Left – 3 cm, Right – 3 cm.
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3. Minimum length for the article is 6 pages, maximum length - 10 pages.
4. No page numbering.
5. Text should be typed using font Times New Roman and be single-spaced. New paragraph should be started with indentation 0,75 cm from the left margin.
6. The article should include these sections:
   – title;
   – author's name(s) and information (organisation, city, country, address, phones, and e-mail addresses);
   – abstract (100–150 words);
   – keywords (max. 5);
   – introduction – explaining the nature of the problem, goal and tasks of the research, research object, previous work, contribution of the research, research methods;
   – description of research;
   – conclusion section (mandatory!) which should clearly indicate advantages, limitations and possible applications;
   – references.
7. The text of the article should be prepared in English (spelling – British English).
8. The title of the article – 14 point, UPPERCASE, style Bold and centered.
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10. Author's information – 10 point, Upper and lower case, style Italic, centered.
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12. The first level Headings – 11 point, Upper and lower case, style Bold, alignment Left. Use one line space before the first level Heading and one line space after the first level Heading.
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15. The set of formulas on application of fonts, signs and a way of design should be uniform throughout the text. The set of formulas is carried out with use of editors of formulas MS Equation 3.0 or MathType.
16. The formula with a number – the formula itself should be located on the left edge of the text, but a number – on the right.
17. Font sizes for equations are: 11pt – full, 7pt – subscripts/superscripts, 5pt – sub-subscripts/superscripts, 16pt – symbols, 11pt – subsymbols.
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Figure 1. This is an example

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21.3. Conference proceedings:

Andrejeva, D. The air pollution prevention from ships. In: Maritime Transport and Infrastructure. Proceedings of the 12th International Conference (Riga, Latvia, April 29-30, 2010, Latvian Maritime Academy), 2010, pp. 84-86.

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