Nikola Vaptsarov Naval Academy
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Global perspectives in MET: Towards Sustainable, Green and Integrated Maritime Transport

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The **18th Annual General Assembly** of the International Association of Maritime Universities together with the **Scientific conference** was held in Varna, Bulgaria, 11-14 October 2017 supported by Nippon Foundation. The Conference consist of two main workflows depending on the status of authors: researchers/lectures and students.

On the Conference "**Global perspectives in MET: Towards Sustainable, Green and Integrated Maritime Transport**" were presented researchers/lectures and students from Maritime Universities.

The research papers were arranged in three thematic sections:

- Education and Training in Maritime Professions, and Support for Seafarers
- Sustainable Maritime Transportation Systems
- Environmental Protection, Green Industry and Blue Growth.

Also the research papers are issued in 3 volumes.

- The first volume includes all the papers that pass the refereeing procedure. They are included in the index of scientific citation.
- The second volume includes all the papers that have not been put on a refereeing procedure.
- The third volume includes the papers presented on the student's conference.

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Modern Concepts of 'GREEN SHIPS'

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Keywords: Green ships; SOx and NOx emissions; fuel consumption; renewable energy

Abstract

Recently, pollution has become one of our major concerns; the whole world is suffering from the consequences of the irresponsible polluting actions. Therefore, all institutes and individuals should take steps in the journey of a less-polluted planet.

All industries, countries and individuals are responsible for the current high rates of pollution, according to S. Seddieka and M. Elgoharya (2014), maritime industry is responsible for 2.7% of the global CO2, 15% of all global NOx emissions and 4-9% of global SO2 emissions.

Therefore, IMO and other stakeholders are doing researches to contribute in decreasing the harmful impact marine vessels have on the environment.

This is done by working on enhancing the machine used in this industry. There are several technologies that can be applied on ships to make them more eco-friendly. Those technologies are divided into three categories: using renewable energy sources, reducing fuel consumption and reducing emissions. This paper discusses the procedures that recently been taken in terms of fuel efficiency and gas emission reduction to minimize the impact of marine pollution from ships through modern concept of "Green Ship".

1. Introduction

Shipping is one of the fast growing sources of air pollution causing health problem, acid rain and eutrophication. In 2000, rate of Sulphur dioxide (SO2) emissions from international shipping in the seas surrounding Europe were estimated at 2.3 million tons a year, Nitrogen dioxide (NOx) ones at 3.3 million tones. These emissions are expected to grow by 40 to 50% by 2020.

It is important to pay more attention to ship emissions to control this continuous growing. If things are left as they are, by 2020 shipping will be the biggest single emitter of air pollution. (**Transport & Environment, 2017)**

This paper discusses the environmental impacts of pollution from maritime industry. It also highlights the measures that can be taken to reduce SOx and NOx emissions from ships.

2. Eco-Friendly Technologies

Recently, many institutes have been concerned with the high pollution rates, including our university, which made us think more about this issue. We discovered that maritime industry is responsible for 2.7% of the global CO2, 15% of all global NOx emissions and 4-9% of global SO2 emissions. These percentages were surprising but optimistic. It was surprising to discover that one industry can make that great contribution in global pollution and optimistic because that is our field of study, so doing some researches and exerting some effort can decrease them which means decreasing the global pollution rates, also maritime industry is one of the industries that are under good control, therefore; it will not be so difficult to apply some technologies to marine vessels that can help in reducing emissions and pollution and increase fuel efficiency, here we present some of these technologies.

2.1. Exhaust Gas Recirculation

One of the most recent important technologies is the Exhaust gas recirculation (EGR); it is a nitrogen oxide (NOx) emissions reduction technique used in petrol/gasoline and diesel engines. EGR works by this technology mainly depends on reusing part of the exhaust gas by recirculating it back to the inlet manifold where it is blinded with fresh air. That means that there would be less amount of oxygen which is replaced by carbon dioxide, carbon dioxide has higher heat capacity than oxygen which will reduce the peak temperature inside the combustion chamber. Another advantage is that as the amount of oxygen is reduced that means reducing the speed of the combustion, that also will reduce the peak temperature. Reducing the peak temperature reduces the formation of NOx .A valve is usually used to control the flow of gas, and the valve may be closed completely if required. (**Figure No. 1**).

The substitution of burnt gas (which takes no further part in combustion) for oxygen rich air reduces the proportion of the cylinder contents available for combustion. This causes a correspondingly lower heat release and peak cylinder temperature, and reduces the formation of NO_x. The presence of an inert gas in the cylinder further limits the peak temperature (more than throttling alone in a spark ignition engine)

The gas to be recirculated may also be passed through an EGR cooler, which is usually of the air/water type. This reduces the temperature of the gas, which reduces the cylinder charge temperature when EGR is employed. This has two benefits- the reduction of charge temperature results in lower peak temperature, and the greater density of cooled EGR gas allows a higher proportion of EGR to be used. On a diesel engine the recirculated fraction may be as high as 50% under some operating conditions. (**Cambustion, 2017**)

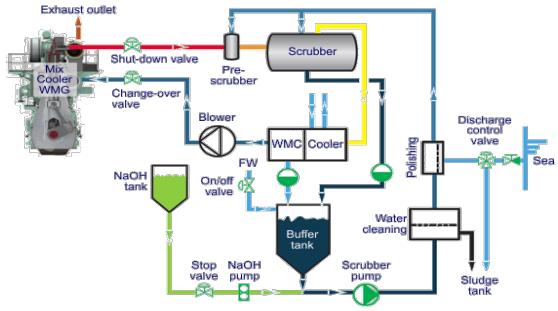

Figure No 1

EGR system for a low-speed two-stroke marine application

Source: MAN Diesel & Turbo (Jääskeläinen, 2012)

2.2.Hull Paint

Hull condition for merchant ship is a key factor in deciding the fuel efficiency of the ship. The application of protective coating of anti-fouling paints results in a smooth hull devoid of any marine fouling, which decreases the frictional resistance caused by the water flow. The anti-fouling paints (Anti fouling is the process of removing or preventing the accumulation of marine organisms from the surface of hull and the paint used for this application is called anti fouling paint) decrease the load on the engine and increase fuel efficiency.

With time, marine fouling and sea condition roughens the hull surface of the ship. As the frictional resistance caused by the water flow over the hull increases, the engine has to consume more fuel to overcome this resistance which adds on to the normal fuel consumption of the ship so applying correct paint at correct hull area can reduce the frictional resistance of the ship resulting in 3-8% of fuel savings. **(Chopra, 2017)**

2.3.Improved Pump and Cooling System

An optimized cooling water system of pipes, coolers and pumps can result in decreased resistance to the flow. This will lead to savings of up to 20% of electric power of the ship and fuel consumption up to 1.5 %.

2.4. Sandwich Plate System

Sandwich plate system is a process of composting two metals plates by bonding it with polyurethane elastomeric core. This avoids usage of steel which requires additional stiffening hence makes the structure light weight and less prone to corrosion. This technology can definitely play a good role in green ship recycling process as SPS feature includes superior in service performance and reduced through life maintenance.

2.5.Sulphur Scrubber System

A scrubber system is one such technology which is used on ships to reduce the pollutants from the ship's emissions. The system operates in an open loop utilizing seawater to remove SOx from the exhaust. Exhaust gas enters the scrubber and is sprayed with seawater in three different stages. The sulphur oxide in the exhaust reacts with water and forms sulphuric acid. Chemicals are not required since the natural alkalinity of seawater neutralizes the acid. Wash water from the scrubber is treated and monitored at the inlet and outlet to ensure that it conforms with the MEPC 184(59) discharge criteria. It can then be discharged into the sea with no risk of harm to the environment. Figure No 2 **(Kaushik, 2017)**

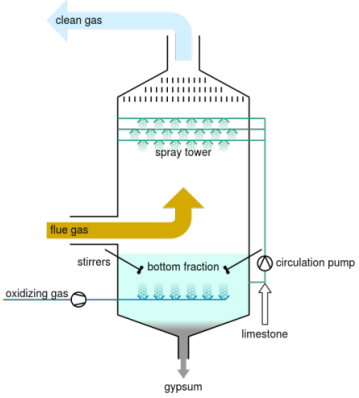

Figure No. 2
Sulphur Scrubber System
Source: Wikiwand "Flue-gas desulfurization"

2.6. Liquefied Natural Gas

The use of Liquefied natural gas as Fuel: More attention has been paid to the use of liquefied natural gas as fuel for ships in Europe, Asia and the United States. There are three factors that can make the use of LNG as fuel one of the most effective technologies to reduce pollution.

- Sulphur oxide emissions (SOx) can be reduced by 90 - 95% by using liquefied natural gas as fuel.
- Another point is the cost of LNG; LNG is much less expensive than marine gas oil. Even while being not widely common, the LNG prices compared to heavy fuel oil concerning the energy content is reasonable.

- A 20-25% reduction in carbon dioxide emissions (CO_2) due to the low carbon content of the liquefied natural gas; however; any slip in the methane while using it may waste that advantage. (**Man Group)**

2.7.DynaRigs

Recently, due to the stringent regulations and the increasing costs of fuel, companies and organizations are exerting more efforts to find alternatives for traditional fuel. In this system of propulsion, sails are used to provide the cargo ship with a considerable amount of energy needed for propulsion. This system is still under research for quite some time now but some researchers have shown that it can provide cargo ships with 60% of the amount of power needed. That means that there would be about 60% reduction in the amount of fuel used. **(RINA, 2017)**

2.8. Sail-Kite System

This system consists of a kite, a towing rope and a control system to steer the kite, a telescopic mast is used to launch and recover the kite. It depends on using the wind energy to provide the ship with the needed amount of power. The kite flies at an altitude of 100-500 meters, itflies in a shape of number 8 producing a towing force of 325 kilo Newton, which reduces the amount of fuel used and the CO2 emissions by 10-35%. 90% of the world trade takes place by sea, so shipping contributes with 3% of the world CO_2 emissions, therefore; applying the sail kite technology can have a great effect on cutting down the CO_2emissions.FigureNo 3**(Watt Now, 2012)**

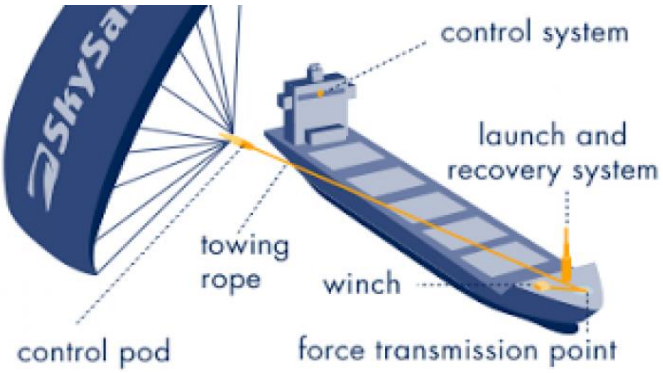

Figure No 3

Sail-Kite System

Source: Next big future

2.9. Solar Cell Propulsion

Solar panels are used as sails along with their primary use, so it uses both solar and wind energy. Solar panels alone are unable to provide the ship with the required amount of power; therefore, it is used as an alternative for onboard electrical systems. It can be also used with other renewable energy sources, such as wind energy where solar panels can be used as sails that use the wind energy to provide the ship with adequate propulsion.

2.10. Water in Fuel

Making low-emission diesel engine has been recently more required due to the strict regulations and the increasing use of diesel engines. The NOx and particular matters are the diesel engines only problems that have not been solved yet. The formation of NOx and PM highly depends on temperature inside the combustion chamber and trying to reduce one of them will increase the other one.

NOx and PM can be reduced by injecting water into combustion chamber. NOx emissions can be reduced by decreasing the combustion products temperature that can take place due to liquid water vaporization. However, the PM emissions can be reduced by adding water while formation of soot or amorphous carbon since the high concentration of oxidation components as OH helps the carbon unburnt remains to burn completely.

Theoretical and experimental studies have been done by Nicolas et al; their theoretical studies have mainly depended on the chemical equilibrium calculations. The water has been injected in suction, compression and power processes, theoretical results have matched the experimental ones which indicated a 90% reduction in NOx.

Injecting water in fuel has several ways; emulsion, fumigation and direct water injection.

The fumigation way depends on injecting the water in a liquid state to the inlet manifold during suction stroke. The emulsion style depends on mixing water with the fuel on surfactants to form emulsion, this emulsion is a fuel alternative. Finally, the system of direct injection of water a dual injection nozzle with an identical water supply system. All these styles of water in fuel technology have a noticeable effect on reduction of NOx and PM. **(Kantharia, 2017)**

3. Conclusion

There are 10 technologies; all of them aim at reducing pollution caused by marine vessel. Those technologies works on slowing down the increasing pollution rates and this happens by reducing emissions from marine vessels such as; CO2 emissions, NOx emissions and SOx emissions, particular matters and by reducing fuel consumption. DynaRigs technology can save up to 60% of fuel used but it is still under research. Also Sail Kite technology reduces CO_2 emissions by 10-35%. Another technology that has a great impact on the environment through reducing emissions is Water in Fuel, since it reduces the NOx emissions by 90%. Another technology that would help our environment is using the proper hull paint since it reduces the fuel consumption by 3-8%. Therefore, using some of those technologies on marine vessels can greatly help us cut down the pollution rates and save the environment for the coming generations.

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Energy Efficiency in Maritime Transport

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Abstract. The maritime industry has developed immensely in the 21st century. One term that has a great importance and basis in the various aspects of shipping and maritime operations is fuel propulsion. Fuel propulsion is the fundamental rock that any machinery and shipping procedure is set upon nowadays. Despite the improvement in the maritime industry, there is still a major issue to tackle, which is the effect of using non-efficient energy sources (propulsion methods) (non-friendly). Per example, fuel oil is the main energy source for propulsion onboard most of the ships producing harmful emissions such as CO_2, SO_x and NO_x, GHG. This has a direct negative impact on the marine and air environment in different ways.

As a result, the IMO exerted great efforts in enhancing the energy efficiency aspect in order to save as much energy as possible from the shipping industry. These efforts appear vividly in the conventions and regulations adopted by the IMO and its amendments in different shapes, such as:

- The Energy Efficiency Design Index (EEDI).
- The Ship Energy Efficiency Management Plan (SEEMP).

All the ships must have an "energy efficiency management plan" that includes steps to insure the optimum energy saving during their voyage, these steps include; regular maintenance and checkups as well as energy efficient habits to be strictly followed by the crewmembers onboard.

This paper will formulate the energy efficiency policies and will discuss how to implement these policies and the measures that can be taken to comply with it. Also, the paper will focus more on the technical solutions such as using alternative energy source and introducing new energy efficiency modifications for the ships with the main aim to save energy, reduce the harmful air emission and their effect on the environment.

Key words: Energy efficiency - non-efficient energy sources - Sox, NOx –
Energy Efficiency Design Index - Ship Energy Efficiency Management Plan.

Energy Efficiency in Maritime Transport

1. Introduction

In shipping operations, there are many terms of great importance, but the one with significant importance is "Energy Efficiency". It has become the root of setting up or planning any machinery or procedure, from the main engine to cargo operations. The effects of not being efficient on ships have been affecting the environment. However, these effects can be avoided by using renewable energy sources. An alternative to the bunker fuel has been introduced to the maritime industry, to be more environmentally friendly. Furthermore, regular maintenance is required to keep the ships up to date and in their best conditions. Moreover, few rules have been introduced to the maritime sector by the International Maritime organization (IMO) on how to improve energy efficiency on ships. Further modifications have been made in ships to cause a reduction in the resistance of the ship, thus less fuel is burned.

No thoughts or actions have been taken in cutting out the emissions of CO2, which the global marine shipping contributes in. However, worrying levels of harmful air pollutants have been discovered by the international maritime organization's assessment on the effects of shipping. According to a 2009 United Nations' and IMO expert group report, international shipping in 2007 was responsible for 870 million tonnes of CO2, which is around 2.7% of total global CO2 emissions. Emissions from shipping have been growing rapidly, and are predicted to rise to 1,475 million tonnes (or approx. 6% of the total) by 2020 [1]. Moreover, the bunker fuel that is being used by large ships releases sulphur that in turn helps acid rain and particulate matter to form, that can lead to fatal diseases. In addition to air pollution, noise pollution also happens to contribute in affecting the environment; this is due to the increase in shipping enterprises, causing harm to marine life that relies on sound to survive. Whales, for example, are challenged with this pollution, and start to behave in ways which may cause their death; swimming close to the shore. Moreover, movement patterns, communication and even physical damage are caused to marine life due to the pollution. Furthermore, it is noticeable that the prices of fuel are increasing, and these resources are being wasted as they are not used efficiently. This has a negative impact on the income and the profit of companies as they are funding for the fuel of the ships.

2. Effects of Energy Inefficiency

To save up more money and electricity on ships, LED lighting is being utilized instead of conventional lamps and tube lights. There are numerous advantages of LED lights including that it has better performance than an incandescent globe or fluorescent lamp. An incandescent globe has a much shorter lifespan than LED lights; they're lit up for 7500 hours, whereas LED lighting can function for 50,000 hours and consume 60% less energy. The use of LEDs for lighting enables weight savings of up to 30%, which means the overall weight, can be reduced by up to 8 tonnes. For a cruise ship with 50,000 light sources, the use of LED solutions can allow a reduction of CO_2 emissions of up to 3,000 tonnes per year and an annual cost saving of up to EUR 200,000 [2]. In addition, slow steaming is now used to cut down carbon emissions and fuel consumption by purposely slowing down the speed of cargo ships. The usual speed of a container ship is 20-24 knots which are reduced to 12-19 knots in slow steaming; this reduces fuel consumption and engine power. There are a lot of cases in which there is the optimal utilization of fuel used for the main engine on board ships; this includes the increasing interest in emission reduction, ship operating costs reduction, and the newly adapted IMO Energy Efficiency Design Index (EEDI) rules. Because of the heat flow and temperature of the main engine exhaust gas energy, it is the main waste heat resource of a ship. By utilizing this exhaust gas energy, it is possible to generate an electrical output of up to 11% of the main engine power in a waste heat recovery system comprising both steam and power turbines.

3. Regular maintenance

Mechanical equipment on a ship requires regular maintenance to keep the machinery up to date and in a great condition. Under water hull cleaning helps ships to restore their efficiency without the requirement of dry docking, this process helps vessels to reestablish an act as close as possible to its optimum condition and offers ship owners extensive investment funds in fuel. The objective behind underwater hull cleaning is to expel organic unpleasantness or fouling. Moreover, the accumulation of marine fouling can increase drag, altering the hydrodynamic performance of the vessel. The underwater propeller polishing is vital to save energy and optimize the performance of the ship. Propeller cleaning gets rid of marine growth from the blades' surfaces, which may fundamentally lessen fuel utilization, improve reliability and enhance the maintenance cycles of the vessels. Research has shown that the adoption of a propeller polishing routine generates significant savings. For example, it is typically believed that proper propeller maintenance should result in fuel savings per annum of at least 10% depending on vessel activity and extent of layups [3]. Anti -fouling coating is a waterproof hull paint that is applied as the outer layer to the hull of a ship, to slow the growth of sub aquatic organisms that can affect the performance and sturdiness of a vessel. Furthermore, this type of coating acts as a barrier against corrosion of metal hulls and improves the flow of water past the hull and this increases the efficiency of the fuel.

4. IMO Requirements

Due to the greenhouse gas emissions from the international shipping, the IMO has implemented some rules to reduce these emissions. The Ship Energy Efficiency Management Plan (SEEMP) is a management tool that helps the owners maintains the efficiency of their ships. Furthermore, the IMO adopted the single most important technical measure aimed at promoting the use of more energy efficient equipment and engines which is known as the EEDI. It is used to calculate the energy efficiency of a vessel, by a complicated formula which takes the ship's emissions, capacity and speed into consideration. However, the lower a ships EEDI, the more energy efficient it is and the lower its negative effect on the environment. IMO regulations stipulate that ships must meet a minimum energy efficiency requirement, so their EEDI must not exceed a given threshold [4].

5. Wind Energy

The Wind is a major energy carrier, and there are a lot of ways for harvesting its kinetic energy. For instance, there has been a new system in the maritime transport field called skysails system. The system consists of a towing kite, a launch, a recovery system and a control system. The towing kite is placed on a telescoping mast to be lifted to a sufficient height so that it unfolds and launched. After launching, the winch releases the ropes until the kite reaches its ultimate altitude between 100 and 300 meters high. When the system is no longer in need, the process is carried in reverse to retrieve the kite back from the sky [5]. Another way to benefit from wind's energy is by using the rotor sails technique. The system is mainly about spinning cylinders, using electric energy the cylinders are rotated so that they can harness the wind's energy with the help of the Magnus effect. When the wind passes through the cylinders, it creates a thrust force in a direction perpendicular to the wind's direction to be used for assisting the propulsion [6]. Wind assisting the ship's propulsion reduces the load on the main engine. Therefore, less fuel is consumed, money is saved, and fewer emissions are produced.

Another major fuel saving strategies on board ships are ship resistance reduction, which could be implemented in multiple ways. For example, the friction between the ship's hull and sea water can be reduced by generating a layer of air bubbles underneath the ship's hull. The system uses oil free compressors to compress the air, which is then released under the hull as micro bubbles resulting in less resistance. It can be observed that the ship's shaft power is reduced and the speed is increased, once the system is turned on.

6. Alternative Energy Sources

Hydrogen is the most abundant element in the universe and can be used as a clean and efficient source of energy. It can be obtained by one of two means: firstly, hydrogen can be used in an internal combustion engine to be burnt with the sufficient amount of oxygen to produce vast amount of heat energy per unit mass when compared to hydrocarbon fuels. The end product of this reaction is merely water, creating no harm to Mother Nature. Secondly, hydrogen can be entered in a fuel cell generating electricity which can also be used in the ship's propulsion using a DC motor. Unfortunately, using hydrogen as a fuel isn't as easy as it sounds as there are major difficulties to conquer such as storing it onboard [7]. The process of storing hydrogen is extremely dangerous and way too expensive therefore it's challenging to replace hydrocarbons with hydrogen nowadays.

Fortunately, there is a clean way to produce hydrogen onboard the ship using electrolysis. This method is carried inside a brown gas generator where sea water is entered and then separated to hydrogen and oxygen molecules. The process of water electrolysis requires an input of electricity, so the presence of an electric source is required as well as the presence of electrodes where Oxygen and hydrogen are formed [8].

$$2H_2O + \text{Electric Energy} \rightarrow 2H_2 + O_2.$$

Electricity required to carry out this procedure can be obtained from a battery specified and charged only to carry out this reaction. The process mainly converts water to a renewable fuel reducing the amount of fuel consumed along with the ship's emissions. Speaking of energy sources produced from sea water, researchers at the U.S naval research laboratory (NRL) have accomplished forming hydrocarbon fuels by obtaining carbon dioxide and forming hydrogen from sea water using an Electrolytic Cation exchange module [9]. Moreover, fuel can be made from waste food oils known as biofuels or biodiesel which is a source of renewable fuel. The process of manufacturing biodiesel is carried out by alkali trans-esterification of waste oils along with the addition of sodium hydroxide and methane [10]. Biodiesel is a non-toxic, renewable and a biodegradable fuel that produces fewer greenhouse emissions.

There are ways for reducing the fuel consumption from the bridge. For instance, weather routing can be helpful to the ship's fuel efficiency, as deck officers set their optimum voyage route based on the weather forecast [11]. Moreover, a device could be installed on the bridge called the Advanced Ship Autopilot System (ASAS). This device is like a computer that requires the insertion of the following to work: way points, wind speed, and direction, ship's position and speed through the GPS, speed through water from the speed log, the heading through the gyro and depth. Further measurements are introduced to the device including the rudder angle and the propeller's rpm. After

all these measurements, the device then calculates the ultimate path through which the autopilot sails [12].

7. Conclusion

All in all, there are numerous ways to increase energy efficiency in the maritime transport field. Reduction in fuel consumption can be achieved by modifying the ship's construction phase by adding the bulbous bow and the air lubrication system to the ship's hull. Also, switching from the existing lighting system to the more efficient LED lighting, slow steaming, and regular maintenance. Also, harnessing wind energy via skysails or Flettner rotor technique and manufacturing a synthetic fuel from water or waste cooking oil. Finally, replacing hydrocarbons with hydrogen or by introducing the ASAS device onboard the ship. These techniques are both economical and environmentally friendly since they save money spent on fuel and limit the ship's emissions.

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EMISSION CONTROL IN RESPONSE TO MARPOL ANNEX VI REGULATION 13

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Abstract The International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI regulation 13 comes into effect on September 1, 2017. "The fuel emissions generated by a single container ship are equal to 50 million cars". (Vidal, 2009) Ergo, the impact of shipping on the global environment is highly significant. Currently, MARPOL Annex VI Regulation 13 suggests that environmental protection is as important as monetary considerations.

This report identifies multiple emission control methods used to adhere to the new legislature in accordance with MARPOL, regarding emission reduction requirements. The methods are presented with numerical data and evaluated. Based on the analysis of the technologies; a selection of the most suitable process for industry is presented as a suggestion for retrofit and ship design.

Keywords: MARPOL Annex VI, emission reduction, green shipping

1. Introduction

The factors considered when choosing a mode of shipping are time and money. Time impacts how much time the goods need to reach their destination? Is there a time constraint? Money determines how much it costs to transport. When focusing on the cost and dealing in bulk, shipping by sea is the first choice for most international trade. Increasing the size and speed of vessels is beneficial to further increase profit margins based on the higher delivery rate and quantity. Fuel efficiency provides further opportunities to increase revenues. As the shipping industry developed with mankind and society, the expansion of environmentalism and protection has become increasingly evident. In November, 1973 the International Maritime Organization (IMO) adopted the

International Convention for the Prevention of Pollution from ships or MARPOL in order protect the environment.

In the last 40 years, environmental considerations have assumed an increasingly influential role in shipping and ship architecture. This paper focuses on ANNEX VI of MARPOL, which contains the regulations for the Prevention of Air Pollution from Ships. The regulations are divided into three tiers: Tier I - ships constructed between January 1, 2000 and 2011; Tier II - constructed after January 1, 2011; and Tier III - constructed on or after January 1, 2016.[1] This paper reviews different engine modifications and auxiliary attachments in order to effectively compare solutions that best align with the new and future regulation limits for Tier III vessels. According to Solhaug and Eide-Fredriksen, "It should be noted that the Tier III limits cannot be achieved without additional means, such as Selective Catalytic Reduction (SCR) and Water Injection" (2008, p.1). The emission limits are so low that marine engines are guaranteed to exceed if modifications are not made. Therefore, this investigation is essential for current and future shipping success.

For the purpose of this paper, the processes being analyzed are separated into two methods based on their form of emission reduction: primary and secondary. The primary methods are technologies that alter the combustion process in order to reduce the emissions that are produced. Secondary methods reduce emissions without affecting engine performance with emission reduction following combustion but prior to expulsion into the environment.[2]

2. Primary Methodology

Primary methods that manipulate the combustion process in such a manner provide the ability to reduce the production of a given chemical. However, the elemental makeup in fuel is relatively fixed, which means that manipulation focuses on additives that influence combustion.

NO_X generation is affected by two factors; high temperature in the combustion chamber and what is known as the excess-air factor. Excess-air factor is a term that describes when the volume of air that is forced into the combustion chamber exceeds the air requirement for combustion of the amount of fuel injected.[3] This is desired for increased performance due to the increase in O_2, and is obtained by either supercharging or turbocharging. The excess air, subsequently equates to excess Nitrogen as well and when exposed to the high temperatures during combustion the Nitrogen and

[1] 6. International Maritime Organization, 2009 p.24-25

[2] 8. Mitu & Memet, 2010 p.1-5

[3] 4. Clean Air Technology Center, 1999 p. 3

Oxygen react to form NOx.

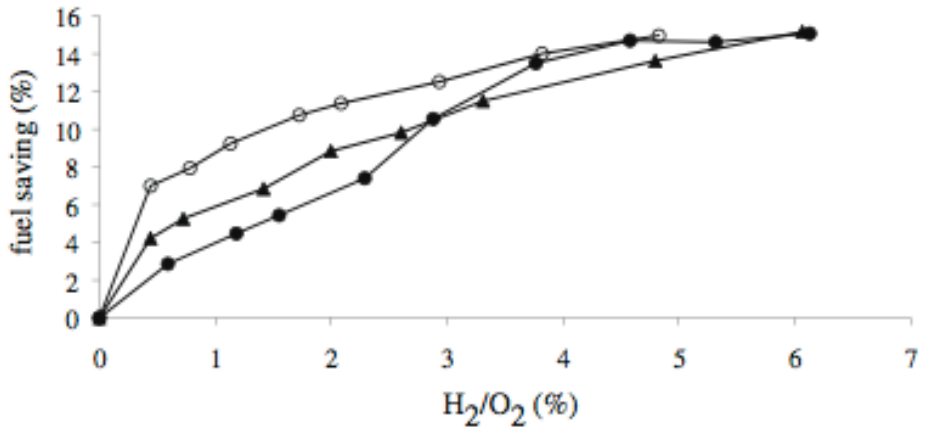
Direct Water Injection (DWI) is the first primary method to be analyzed. The concept of DWI technology is relatively simple: inject water to lower the internal temperature. The reduction in temperature results in the reduction of NOx generated, due to its relationship with high temperatures. The water that is injected does not interfere with combustion because, immediately following injection, the water is subjected to intense temperatures and evaporates. The heat absorbed by the water during evaporation, results in a reduced chamber temperature. This technology has the capability to reduce NOx formation levels by 70%, with an increased water injection volume. The elemental structure of the fuel is fixed so when one emission is reduced, others will increase. With water injection, CO_2 emissions increase as NOx levels decrease. The fuel efficiency of the engine is also negatively impacted by DWI technology. In order to decrease NOx formation levels, water injection volume must increase, but with the increase in water, there is also an increase in fuel consumption. A 30% emission reduction can be achieved without compromising fuel efficiency; however, if a greater reduction percentage is obtained, then fuel consumption increases significantly.[4]

DynaCERT is a private and relatively new company. CERT is an acronym for Carbon Emission Reduction Technology. The technology injects a mixture of pure hydrogen and oxygen gas into the combustion chamber in order to achieve a more complete burn during combustion. Pure hydrogen and oxygen is extracted on location from distilled water using DynaCERT's patented electrolysis technology before injection. Hydrogen, a carbonless fuel, when substituted with diesel, forms a mixture that produces fewer carbon emissions. The hydrogen used in conjunction with fuel increases energy output with each combustion cycle. Each piston/engine has operating limits such as peak pressure and maximum temperature and with the supplementation of hydrogen as fuel, diesel injection will require reduction in order to retain operating levels. Graph 1 provides data demonstrating that the supplementation of 6% hydrogen-oxygen mixture will increase fuel savings approximately 15%.[5]

[4] 3. Chybowski, Laskowski, & Gawdzińska, 2015 p.397

[5] 2. Bari & Esmaeil, 2010 p.378

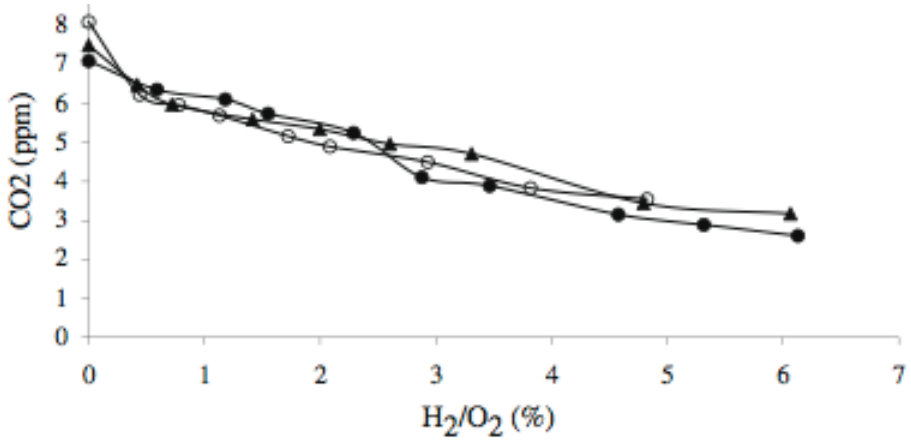
Graph 1



Note: From *Effect of H_2/O_2 addition in increasing the thermal efficiency of a diesel engine* (p. 381), by University of South Australia, 2009, Mawson Lakes, AU: Bari, S. & Esmaeil, M.

The fact that hydrogen is a carbonless fuel results in a faster flame speed meaning that there are fewer carbon molecules in each combustion cycle and that the duration of combustion is significantly shorter. Subsequently, peak temperature duration is much shorter. "The quantity of emitted CO_2 is proportional to fuel consumption – therefore, any reduction in CO_2 is only obtainable by lowering fuel consumption" (Stein, 2014, p. 182).

Graph 2



Note: From *Effect of H_2/O_2 addition in increasing the thermal efficiency of a diesel engine* (p. 381), by University of South Australia, 2009, Mawson Lakes, AU: Bari, S. & Esmaeil, M.

Combustion, along with added hydrogen, results in a more complete burn. With the addition of hydrogen to the combustion chamber, the engine becomes much more fuel-efficient. The presence of hydrogen lowers the CO_2 production, as seen in Graph 2.

3. Secondary Methodology

Supplementing engine exhaust systems with auxiliary attachments are the secondary methods for emission reduction; these attachments remove the emissions that are produced. These methods are far less cost effective because energy is wasted two fold, producing the undesired emissions then requiring energy to remove the emissions. The reduction percentages for the secondary methods compared to primary are significantly higher because primary technologies are required to take the engine performance into account vs secondary, which are not so restricted.

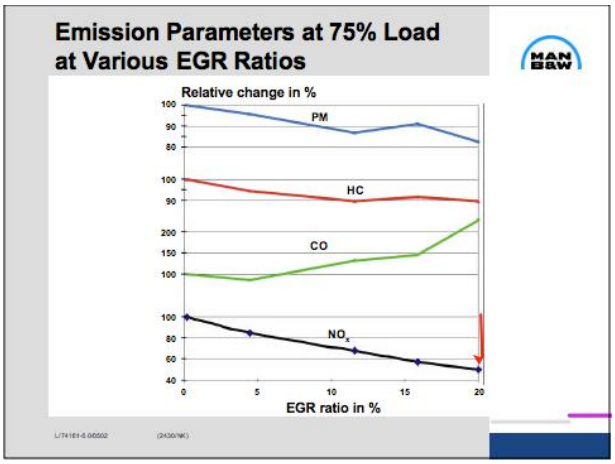
Selective Catalytic Reduction (SCR) technology uses the application of ammonia into the exhaust gas in a specific temperature range of 290-350^{o}C. A catalyst is positioned inside the exhaust stack in order to activate the reaction, ammonia then reacts with the NOx and chemically binds forming nitrogen and water.[6] This method operates with an attachment located after the exhaust manifold, allowing the engine construction to be unaltered. The system is extremely effective in removing the NOx emissions; reduction is between 90-99%. This technology can function on all ships; it can be implemented as a retrofit on old ships or installed in new builds.[7] This is proven technology with the highest percentage reduction in NOx of all the methods investigated; however, it has no impact on carbon emission reduction in the exhaust.

Exhaust Gas Recirculation (EGR) technology follows the discharge of the combustion chamber. The exhaust gases flow through a filter and a cooler prior to being re-circulated back into the combustion chamber. The reduced temperature and the chemical makeup of the exhaust gases work simultaneously to lower NOx formation levels during combustion. Far less oxygen is present in the re-circulated air than in natural air. The lack of oxygen in the combustion chamber lowers NOx formation.[8] There is a development of these methods as in all technologies. Older data collected stated that the top reduction percentage for an existing ship is 20%, whereas 40% NOx reduction for a new build could be achieved. However, clearly shown on Graph 3 MAN Diesel conducted experiments that prove EGR can reach up 80% reduction.

[6] 5. Diming, Bin, Piqiang, & Zhengxing, 2010 p.72

[7] 1. Azzara, Rutherford, & Wang, 2014 p.3

[8] 9. Stein, 2014 p.197



Note: From *Emission Reduction Methods* (p.12), by MAN B&W Diesel A/S, 2002, NA: Kjemtrup, N. Retrieved from http://www.arb.ca.gov/ports/marinevess/presentations/072602/manbw072602.pdf

With the increase in EGR ratio percentage, the NOx reduces consistently, which proves that technology is effective but the graph also states the increase in GH gases simultaneously.

The disadvantage to this method is that the exhaust gases being re-circulated back into the combustion chamber contain particulates and HHG gases. The air filter cannot fully clean the gases, and because of this there is increased build-up in the combustion chamber. Carbon build up increases wear, load, and reduces fuel efficiency. The reduction in fuel efficiency increases the carbon emission production, percentages will continue to increase with carbon build-up and in turn, causes decreased effectiveness and profitability.

4. Conclusion

Chybowski, Laskoski and, Gawdzińska described the opportunity of minimizing total operating costs as well as fulfilling Tier III regulations by utilizing multiple technologies at the same time.[9] A combination of these analyzed technologies is the most logical action in moving forward. When investigating the data collected, Selective Catalytic Reduction, despite the costs, is necessary to achieve the reduction levels established by MARPOL. Combining the SCR with the DynaCERT technology will effectively reduce the net cost impact of the SCR installation and operation by considering the fuel savings. The data collected are general statistics, and are not ship, engine, or fuel specific. The MARPOL ANNEX VI regulatory limits are subject to change and are dependent based on the body of water and distance from shore.

[9] 3. Chybowski, Laskowski, & Gawdzińska, 2015

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EQUIPMENT IN THE RENOVATION PROCESS OF A BOW THRUSTER

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Abstract. *The need to increase maneuverability of floating units forced the rise of demand for production of bow thrusters. Installed in tunnels located at the bow or stern of the vessel below the water line, they significantly improve the possibilities of maneuvering. Difficult operating conditions cause damage to subassemblies, they are also the cause of changes of geometry, and strength parameters of screw blades, which undergo various types of damage. This necessitates in regeneration, which in turn forces the repair centers to be equipped with suitable devices for repair work. Authors describe the way and the working environment of bow thrusters, and also typical damage with regard to their importance for renovation process. Further part of the study is focused on selected technological issues which occur in the renovation process of bow thrusters and proposals for their solution with the help of specialized tools facilitating this complicated and complex process. The article presents instruments used for transport of adjustable screw's blades between the repair stations and tools used to it's mounting on the repair station- lathe.*

Keywords: *bow thrusters, blades, renovation process, maritime engineering*

1. Introduction

Continuing growth of possibilities of cargo and tourist marine transport result in ever increasing demand to construct larger and broader vessels. Harbours and narrows through which vessels must sail are characterized by limited space, which makes manoeuvres difficult and increases the danger of collision. Bow thrusters were introduced as an answer to these issues. Using

the force produced by the water flowing in canals, they immensely improved the manoeuvre abilities of marine vessels. Thanks to the force mentioned, vessels are now able to turn around even at stoppage.

Bow thruster, similarly to many other parts of the vessel is vulnerable for various kinds of damage in course of exploitation. Because of its location, the main threats for it are cavitation and mechanical damage. In order to repair these, it is subjected to processes such as turning, machining or welding.

The paper aim is to describe typical kinds of thrusters' damage, their regeneration methods and usage of instruments designed to improve the repair process.

2. Characteristic of Bow Thrusters

The main purposes of bow thrusters are to vest the vessel in desired direction, to maintain the chosen course and to enable its rapid change through manoeuvring or quick turn. [5] The advancement of scientific knowledge thanks to which new, highly salt water corrosion-resistant materials were discovered, opened the possibility to introduce solutions which improve the vessel manoeuvre abilities. This followed in introduction of bow thrusters located fore and aft, which contributed to advancement in manoeuvre abilities of the marine vessels. Bow thrusters are viewed as an addition to the main thruster. They consist of propulsion unit, propeller and flow duct. [3]

Bow thrusters can be divided into following:

- TUNNEL THRUSTERS (standard, with fixed pitch propeller „magnetic", with controllable pitch propeller);
- AZIMUTHAL THRUSTER (with fixed pitch propeller, with controllable pitch propeller)

3. Materials used for bow thrusters production

According to PRS regulations, materials which can be used in construction of bow thrusters are casting copper alloys. They are characterized by high corrosion and abrasion immunity. Properties of a given material depend on their chemical composition, which is precisely regulated by rules of Polish Ship Registry.

4. Main types of damage and their detection

Damages of bow thruster can be divided into following main categories: mechanical damages, electrical damages, hydraulic damages and control damages. Mechanical damages can be further subdivided into external and internal. The former, because of difficult access to the tunnel, can be detected only with use of camera, through which entire system is inspected and verified. Typical damages in this area are damages of angle drives and seals, sleeves and bearings. Damages of the second group are characterized by easier detection, without the need to dock the vessel. Engagement of frogman or trimming the vessel to aft or fore are typical examples of measures of their detection. Despite easier diagnostic procedures, detection of faults of the group mentioned also results in the necessity to dismantle the damaged part and send it overhaul. This group of damages consists of curved or broken foils, dents, cavitation and corrosion. The usual cause of breaks and dents are pieces of garbage located in water, ex. stones, beams etc. Damages caused by corrosion and cavitation mostly appear because of lack of anodal coatings.

Image ***4.1 Mechanical damage of the blade. Author's photograph.***

5. Regeneration of bow thrusters blade.

In the course of bow thruster overhaul, after its dismantling, firstly its parts have to be cleaned and verified (for instance, through accurate examination or penetrating diagnosis), which in turn makes the decision about regeneration or replacement of that part. If individual parts of the thruster, along with economical premises advocate for the repair, the next step is the transport of

specific elements of the thruster to adequate working stations. Afterwards, foils are installed at stations devised for boring, pad welding, straightening or grinding. [2]

5.1. Devices simplifying transport of the bow thrusters' blade.

Important part of the bow thrusters' renewal process is the transport of its particular parts between the work stations. The elements are particularly heavy, and due to this factor, special equipment for their transportation is needed. Following sketches depict outlines of devices designed especially for the bow thrusters' blades transport.

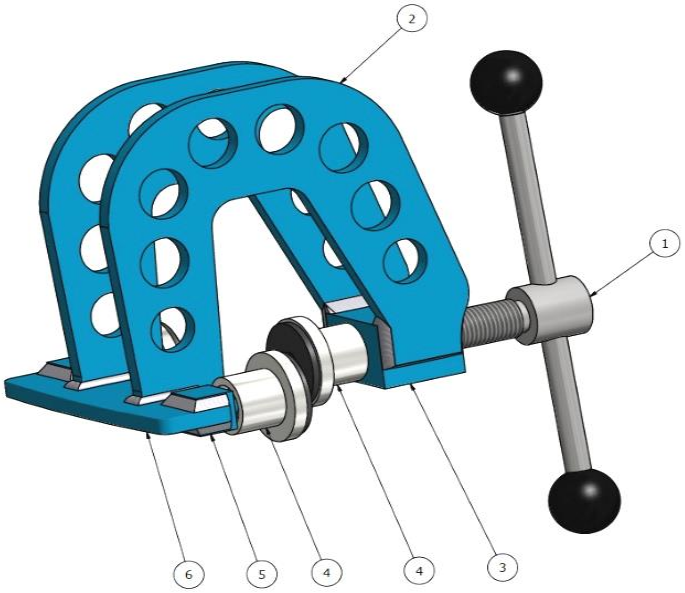

Image ***5.1.1 Draft of blade transport welded handle. [6]***

1-screw with lever, 2-construction metal component, 3-construction threaded element. 4-shoes, 5-shoe embedding element, 6-construction metal component.

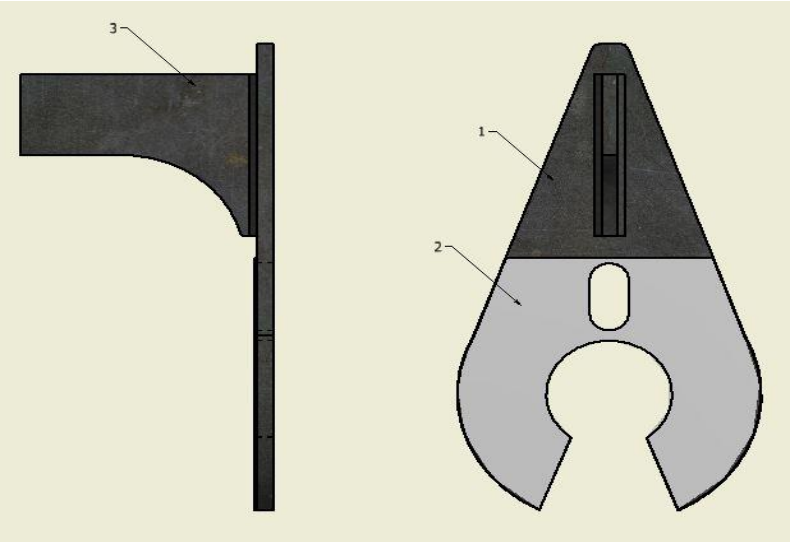

Image ***5.1.2 Draft of blade transport welded handle. [4]***

1-grip footing, 2-teflon pad, 3-grip arm.

5.2. A device facilitating tooling of a blade.

Image no 5.2.1 shows visual sketch of a special handle made for bow thrusters blade mounting while machining horizontally in a lathe.

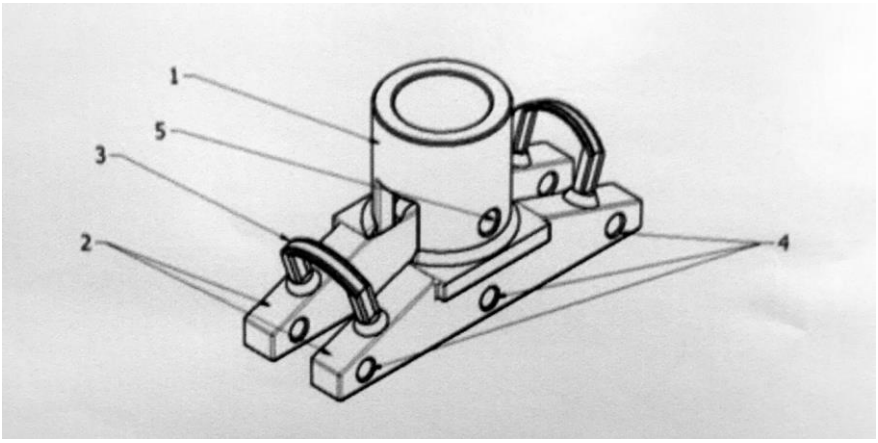

Image 5.2.1 Visual sketch of a mounting handle.[1]

1- collar, 2 – body, 3 - support elements, 4,5 - threaded gaps.

On a next drawing (5.2.2) we can see a photography of the same handle after realization on the basis of above mentioned project.

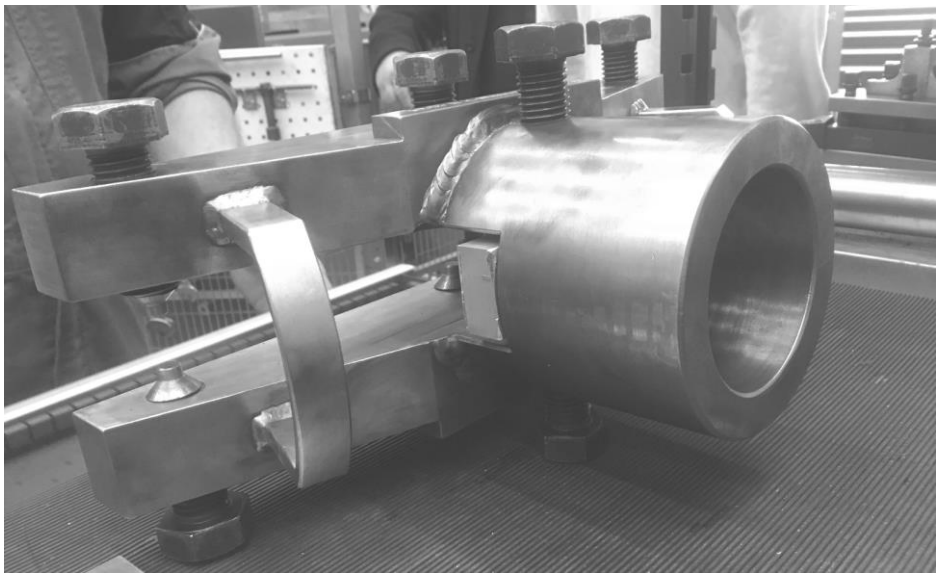

Image ***5.2.2 Photography of a realized project of a special handle for lathe machining. Author's photograph.***

6. Conclusions

Wide spread of the bow thrusters usage, constant need for carrying out their overhauls and the search for means speeding up the repair process inspired us to carry out the analysis of the equipment used for their blades overhaul.

Bow thrusters became an indispensable element of each newbuilt vessel because of their assets. However, their localization results in necessity to carry out frequent inspections or repair operations. Solution presented above is devised to accelerate this type of work. Presented devices improve transport and treatment of the foils in need of a repair.

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Battery operation

Implementation on Sea Challenger

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This project examines the suitability of covering the energy consumption of the A2SEA vessel Sea Challenger with a battery pack, when it is jacked-up and is installing offshore wind turbines.

The purpose of installing a battery pack is to optimize the load on the diesel generators, thus increasing efficiency during periods of sailing, and supplying solely from the battery during installations.

The project concludes that it is not suitable to cover the energy consumption of the vessel during wind turbine installations exclusively by a battery pack, due to the relatively high consumption. A battery pack that is able to supply the needed energy would be too large and too expensive, compared to the space available and the payback period.

Keywords: Energy, consumption, battery pack, optimisation, efficiency

1 Introduction

During our education and practice on board merchant vessels, we have seen plenty of work and studies aimed to optimize and make processes more efficient. On a global scale MARPOL's SEEMP and the upcoming MRV regulation aims to affect the shipping companies and the mariner's behaviour to reduce exhaust fumes and waste impacting the climate[1]. On a national scale, companies, universities and the Danish government established Blue INNOship. It is a partnership

[1] 5 (IMO) 4(DNV GL)

working towards a greater and more flourish marine sector through innovations and energy-efficient solutions[2].

Inspired by various newbuilding's and projects implementing battery packs in ferries we chose to investigate the possibility of retrofitting MV Sea Challenger with a battery pack. MV Sea Challenger is a purpose-built jack-up vessel designed to install offshore wind turbines. Data from Blue INNOship revealed that the generators of MV Sea Challenger in the jack-up periods where runningat one third of the designed capacity.

1.1 Problem statement

Is it suitable to retrofit MV Sea Challenger with batteriesto cover the energy consumption, when it is jacked-up installing offshore wind turbines?

Due to the project's timeframe delimitations were necessary. The project aims to cover the aspects of the financial incitements of which it consider the economical difference between a normal jack-up operation versus a possible battery operation. The project focus on the jack-up period and thereby the battery packs impact on the complete operation and voyage will not be considered. The technical solution, integration and costs of implementing the battery pack will not be considered. Calculations are based on a six hours' jack-up operation determined by preliminary interviews[3].

1.2 Data processing

Knowledge of the ship and its performance including battery technology was required to approach the problem statement. We were given access to live performance data from MV Sea Challenger in the time frame 8/3- 19/5 2016. MV Sea Challenger was installing 6 MW turbines atGode Wind 1 & 2, Germany. These performance metrics were chosen:

- 6x Diesel Generators (2880 kWe)
- 6x Hydraulic Power Units
- 3x Voith Schneider propeller
- Speed (STW)

Furthermore, we gained access to the Integrated Control System of the ship from where we collected the diesel generators efficiency performance. In the given timeframe MV Sea Challenger installed 35 offshore wind turbines.

2 Battery applications

Implementation of a battery pack can be done differently depending on its purpose. *Enhanced Dynamic Performance* is a concept where a sudden increase of load will be absorbed by the battery

[2]2 (Blue INNO+) 3(Blue INNOship+)
[3]6 (Koenemann)

pack. Gradually the load will be distributed to the generator. This application of batteries is suitable for engines with slow regulation like LNG and dual fuel engines[4].

The concept of *Peak Shaving*is that the engine is running at the best efficiency during high loads while the battery pack is designed to absorb peak loads. This is illustrated on figure 1.

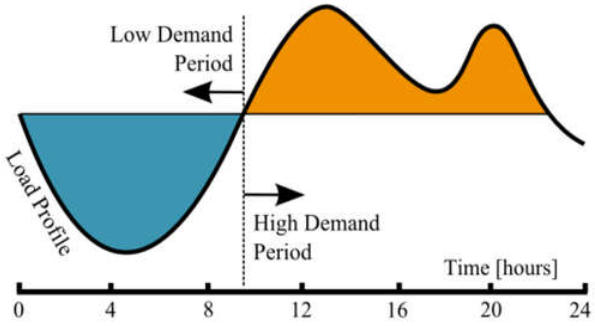

Figure 1 - Peak Shaving

In low demand periods the engine continues to run most efficiently as it charges the battery pack. Peak Shaving aims to produce the most kWh per fuel unit.

Spinning Reserve is a concept of which the battery pack is operated as a standby energy supplier meant to substitute the generators for a specific period. Furthermore, it can be used as a back-up supply in the case of loss of power. This project covers the aspect of a spinning reserve solution.

3 Operational pattern

MV Sea Challenger has several operation conditions. The analysis of the operational pattern is centredat the specific Jacked-up Installation Work period. The analysis is conducted to clarify the duration, the consumption and the peak loads to determine the particulars of the battery pack.

Figure 2 visualizes the data of one trip. Between port and platform, the vessel operates in *Transit* where the load is high and all generators are running. The vessel is operated in *Site Manoeuvring DP* mode when approaching the platform. This is followed by the *Jacking Operation*. These modes are illustrated with the upper part of the figure. The single blue line on the right represents one generator supplying the ship in the installation period.

[4]1 (ABB)

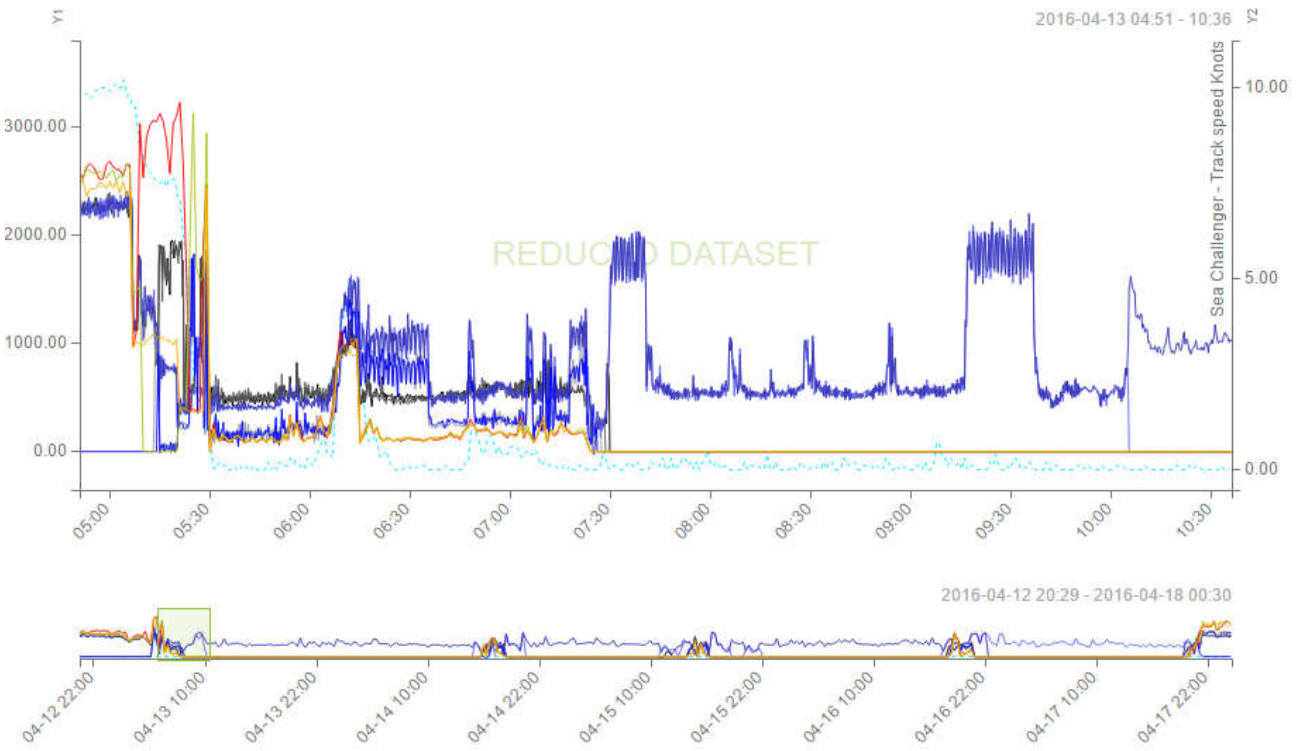

Figure 2 - ALDAQ, Manoeuvring

A greater view of the trip from port to port is shown at the bottom. During the trip, four wind turbines are installed which shows as similar periods on the graph. Throughout the jacked-up installations one generator is running with a steady load. The energy consumption was calculated for every 35 installations in the specific period. By average the ship then consumed 1015 kWh. Given the preliminary conditions of a six-hour long installation the battery pack should delivery 6090 kWh. The time spent on wind turbine installations represents 49.8 % of a typical trip whereof the following calculations are based on.

4 Processing data: Efficiency

The purpose of installing a battery pack is based on the fuel savings achieved by running the diesel generators at a more optimal load. The fuel savings are calculated from data on g/kWh. By comparing the efficiency (g/kWh) at low load with the efficiency at a higher load due to charging of the batteries, the fuel savings are observed.

4.1 Data – g/kWh

By comparing efficiency with the energy consumption, a trendline can describe the connection between efficiency and consumption and different loads.

Data on efficiency from the period: 16.05.2016 00:01 to 19.05.2016 23:59 (DD.MM.YEAR HR:MIN) exported from the vessels ICS was paired with data on energy consumption. In this period the diesel generators were sharing the load equally.

5 Trendline

To be able to determine the efficiency at any given load, the correlation between efficiency and load is described with a trendline. The following section describes and evaluates the selectedtrendline.

By plotting the matching data in a coordinate system with the load as the ordinate and the efficiency as the abscissa the trendline, Figure 3, shows that the correlation matches the data from the manufacturer, although measured values in all are higher than stated on the engines data sheets.

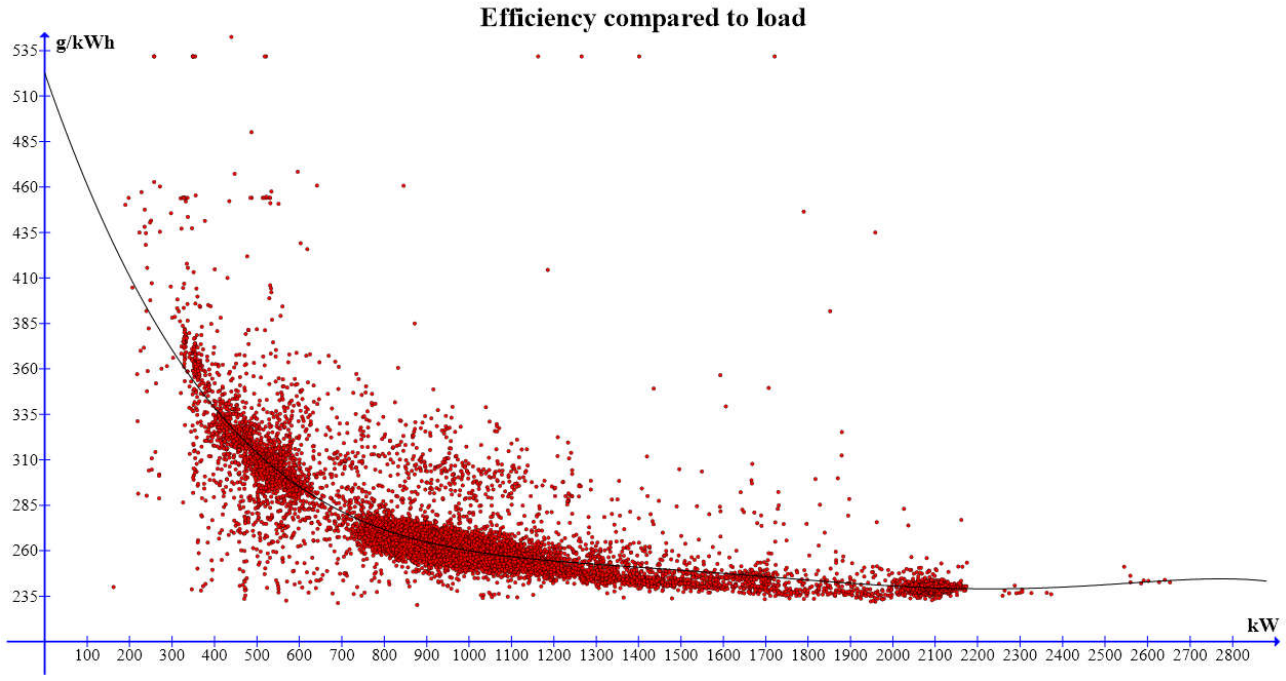

Figure 3

The trendline shows that the engines are working at the highest efficiency at loads between 2000 and 2500 kW, and that loads below 1000 kW cause a significantly worse efficiency.

The chosen trendline is decreasing at loads higher than 2772 kW. This is inaccurate, as efficiency is expected to drop at maximum loads. It is caused by the fact that no data is collected at loads higher than 2650 kW, and thereby no data is present to affect the trendline in the highest loads.

6 Economic perspective

To be able to evaluate the fuel savings from implementing a battery pack, the fuel cost of charging the batteries must be calculated. The intension is to charge the battery pack as the vessel moves between two installations. To estimate added fuel consumption from charging the batteries, a representative period of sailing from one installation to the next is evaluated.

6.1 Cost of charging

The calculations show that the charging time is 3.04 hours. The total consumption without charging is 2457.8 kg fuel. With charging the consumption is 3783.5 kg fuel.Charging leads to an added fuel consumption in comparison to normal operations of:

$$3783.5\ ton \quad 2457.8\ ton = 1326\ ton$$

The vessel is running on MGO 0.1 % only. Per Dan Bunkering A/S the price for this fuel type is 3202 DKK per ton.Charging of the battery package will have a fuel cost of:

$$1326\ ton \quad 3202\ \text{DKK} = 4245\ DKK$$

6.2 Savings during battery supply

In the periods where the ship is supplied from battery, no diesel generator will be running. The fuel that would have been used is the equivalent of 5059 DKK.By comparing the price of charging the battery to the cost of fuel saved, the gain of every battery cycle is:

$$5049\ DKK \quad 4245\ DKK = 804\ DKK \approx 130\ \text{USD}$$

This saving comes from running the diesel generators at a more efficient load at manoeuvring while charging, compared to the load at installations.

At 97 installations per year, given that the battery covers 6 hours of energy consumption the fuel cost savings per year are: $804 DKK \quad 97 = 77988\ DKK \approx 12{,}500\ USD$

Interviews with represents of 3 different manufacturers give an indication of the price of a battery package needed: $56{,}345{,}853\ DKK \approx 9\ million\ USD$

Compared to the yearly economic savings, the payback period is:

$$\frac{56{,}345{,}853\ DKK}{77988\ \frac{DKK}{year}} = 723\ \text{years}$$

The payback period is dependent on the price of the battery and the savings by running on battery. The price on batteries is decreasing. The savings by running on battery is a combination of fuel price and amount of fuel saved. Fuel prices are constantly changing. The amount of fuel saved can be further increased by continuously matching the number of running diesel generators to the load, taken charging load into consideration.

7 Conclusion

The purpose of the project is to examine whether it is suitable for MV Sea Challenger to use a battery pack as a spinning reserve during the installation period.

The operational pattern and energy demand has been analysed through quantitative data. The single cost and size of the battery has been estimated through interviews with leading authorities in the field including knowledge of preceding projects and battery technology.

Based on collected and analysed data we conclude it is not suitable for MV Sea Challenger to implement a battery pack as a spinning reserve.

The analysis revealed that the vessel is in jack-operation longer than initially considered. This will require a larger battery pack. The consumption on 1 MWh will require a larger battery pack which will increase the physical size as well as the price.This will increase the payback period, which already surpasses the lifetime of the battery pack and ship. It is estimated that errors and uncertainties of the data is negligible considering the physicalsize and payback period.

8 Perspectives

Besides the economic benefits of installing a battery pack, running on batteries can improve work environment due to less noise and vibrations including zero emissions. Especially zero emission operations with a spinning reserve installation could be relevant when berthed in future ports.

The duration of the installation period combined with the consumption of 1 MWh does not fit a spinning reserve solution.On the other hand, the generators will run ineffectively with 1/3 of their capacity. To solve the problem a new study should be made to examine implementation of a smaller generator combined with a battery pack operating as Peak Shaving.

The development of big scale battery technology is currently driven by companies developingGridStorage units toaccumulate energy from wind turbine, solar farms etc. As this sector develops, the maritime sector will gain from the increased research and development in large battery packs.

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Performance Analysis of High-Efficiency and Compact Heat Exchanger Using Environment-Friendly Refrigerant

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Abstract. *Over the years, high-performance and energy-efficient onboard equipment has been developed; however, most of the waste heat at low temperatures level is lost from marine vessels, discharging carbon dioxide. In marine engineering, with a small heat exchanger, high-efficiency and environment-friendly refrigerants are needed to prevent global warming and to use energy effectively. This study experimentally investigated the two-phase flow characteristics and void fraction of an environment-friendly refrigerant in a narrow rectangular channel imitating a plate heat exchanger and the influence of the flow characteristics on the performance of the heat exchanger.*

Key words: *Heat exchanger, Refrigerant, Narrow channel, Two-phase flow, Void fraction*

1 Introduction

The research theme of the Energy Conversion Laboratory is environmental conservation technology related to energy saving and improvements in the performance of element equipment, mainly heat exchangers in the field of refrigeration air-conditioning engineering for general

households and onboard environments.

Owing to globalization and growth in the marine transport industry, the total amount of carbon dioxide emissions from ships has been increasing. Over the years, various types of high-performance and energy-efficient onboard equipment have been developed; however, most of the waste heat at low temperature is lost from marine vessels, and discharged as carbon dioxide.

A binary power generation system, which uses working fluids with a low boiling point, such as fluorocarbons, as a low-medium temperature heat source, has attracted the attention of researchers. Low-boiling-point fluids are considered next-generation working fluids owing to their effective use of low-temperature waste heat.

In marine engineering, a plate heat exchanger composed of narrow passages has received significant attention because it can be miniaturized and uses waste heat effectively. A plate heat exchanger is a type of heat exchanger that uses metal plates to transfer heat between two fluids. It has four advantages: high efficiency, energy saving, miniaturization, and maintainability. The size of the air-conditioning system used on a ship needs to be minimized owing to the spatial limitations of marine structures. Hence, the development of high-performance and compact heat exchangers, such as a plate heat exchanger composed of narrow passages, is required for improving the performance, reducing the charge amount of the refrigerant, and minimizing the space requirements.

Over the years, fluorocarbons have been used as a refrigerant. Fluorocarbons are nontoxic, incombustible, stable, and easy to liquefy, and can be classified into three types: chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and hydrofluorocarbons (HFCs). CFCs and HCFCs contain chlorine, which acts as an ozone-depleting substance. Through the Montreal Protocol in 1987, it was decided that the production and consumption of ozone-depleting substances should be regulated. In 2010, CFCs were completely abolished all over the world; in addition, HCFCs will be abolished by 2020 in developed countries, and by 2030 in developing nations. Under this protocol, HFCs have been promoted as a substitute for CFCs and HCFCs. On the other hand, because HFCs do not contain chlorine, they are used for domestic air conditioners. Although they do not impact the ozone, the greenhouse effect from HFCs is several hundred to four thousand times greater than that of carbon dioxide. For this reason, in 2016, HFCs became a regulated material. The Kigali amendment requires an 85% reduction of HFCs by 2036 in developed countries, and by 2047 in developing nations. Large-scale refrigerators use the refrigerant R134a, which is a type of HFC. As an alternative, R1234ze(E) has been suggested because it does not destroy the ozone and its greenhouse effect is much lower than that of R134a. Thus, the use of this environmentally friendly refrigerant will continue to spread.

However, studies on plate heat exchangers using a next-generation refrigerant as a test fluid have

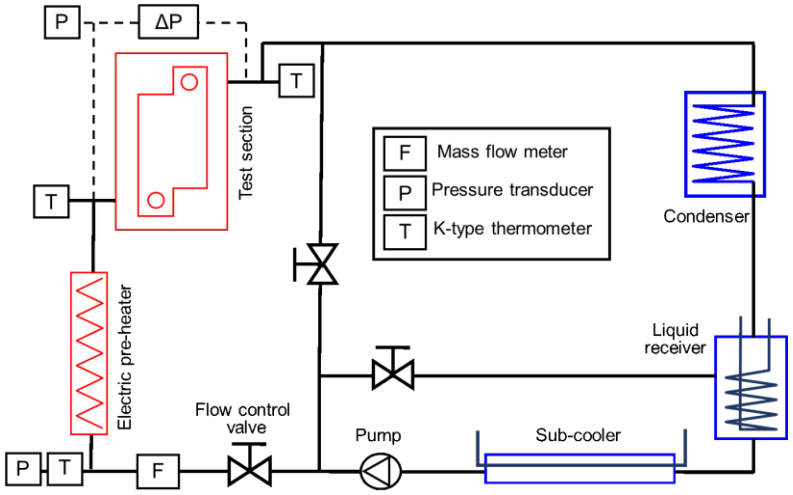


Fig. 1 Schematic of experimental apparatus

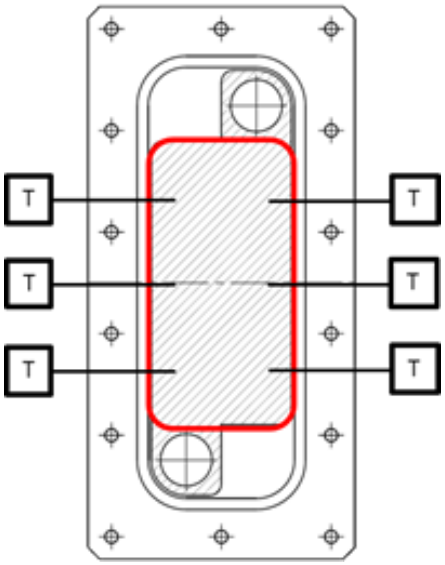


Fig. 2 Schematic of test section

been limited. The present study experimentally investigates the two-phase flow characteristics and void fraction of an environmentally friendly refrigerant, R1234ze(E), in a narrow rectangular channel imitating a plate heat exchanger, and the influence of the flow characteristics on the performance of the heat exchanger.

2 Experiment Apparatus and Procedure

2.1 Experiment Apparatus

The experiment apparatus consists of a main loop and a bypass loop, as shown Fig. 1. The main loop consists of a pump, flow control valve, Coriolis mass flow meter, electric preheater, test section, condenser, receiver, and super-cooler. The test refrigerant pumped by the pump is adjusted to a predetermined quality in the electric preheater and flows into the test section. The refrigerant then returns to the pump through the condenser and receiver.

Fig. 2 shows an outline of the test section, which is made of a stainless sheet with a total length of 234 mm and a width of 114 mm. The test channel is a narrow rectangular channel with a depth of 0.5 mm, a width of 60 mm, and a length of 180 mm. The upper part of the flow channel is covered with glass to observe the flow patterns. The temperature and pressure of the test refrigerant at the inlet and outlet of the test section are measured using K-type sheath thermocouples, as well as an absolute pressure transducer and a differential pressure transducer. The wall temperature in the test channel is measured using K-type sheath thermocouples, as shown Fig. 2.

2.2 Experiment Procedure

Table 1 Experimental conditions

Test refrigerant	R1234ze(E)
Saturation temperature [°C]	15
Mass velocity [$kgm^{-2}s^{-1}$]	100, 200
Vapor quality [-]	0.05 – 0.9

Table 1 shows the experiment conditions. The experiments were carried out using R1234ze(E) as the test refrigerant at mass velocities of 100 and 200 $kgm^{-2}s^{-1}$ and a vapor quality of 0.05 to 0.9 at a saturation temperature of 15 °C. The part surrounded by the red line in Fig. 2 was filmed using a high-speed camera to observe the flow patterns. The void fraction was determined through an image analysis of a randomly chosen image frame taken by the high-speed camera.

3 Data Reduction

The superficial velocities of the gas and liquid J_G and J_L are defined below:

$$J_G = \frac{Gx}{\rho_G}, \tag{1}$$

$$J_L = \frac{G(1-x)}{\rho_L}, \tag{2}$$

where G is the mass velocity, x is the vapor quality, and ρ_G and ρ_L are the densities of the gas and liquid phases. The properties of R1234ze(E) were obtained from REFPROP ver. 9.1 [1].

The void fraction ξ is calculated using the area ratios of the gas and liquid phases in the observation area. The void fraction is defined using the following equation suggested by Wojtan et al. [2]:

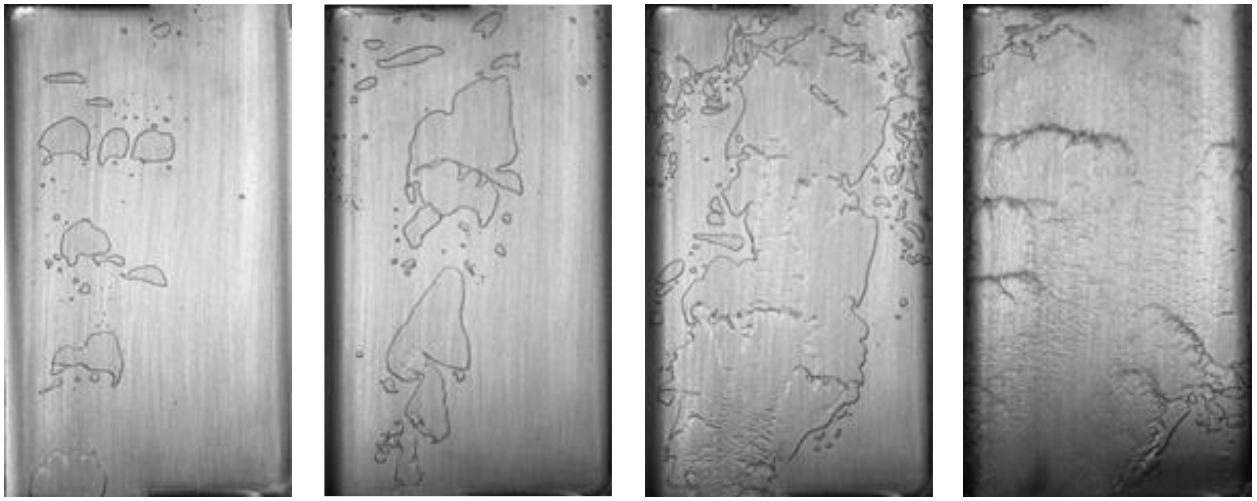
$$\xi = \frac{N_G}{N_G + N_L}, \tag{3}$$

where N_G and N_L are the total number of gas and liquid phase pixels. The gas and liquid phases were discriminated based on the difference in brightness using MATLAB.

4 Results and Discussion

4.1 Flow Patterns

Four flow patterns were observed in this experiment: bubble, slug, churn, and annular flows. Fig. 3 shows these flow patterns. A bubble flow was observed under high-velocity and low-quality conditions. As a whole, there is a tendency to shift from a slug flow to an annular flow as the quality increases.



(a) Bubble flow G=200kgm^{-2}s^{-1}, x=0.05 (b) Slug flow G=100kgm^{-2}s^{-1}, x=0.05 (c) Churn flow G=100kgm^{-2}s^{-1}, x=0.3 (d) Annular flow G=200kgm^{-2}s^{-1}, x=0.5

Fig. 3 Typical observations of the two-phase flow patterns

4.2 Void Fraction

Fig. 4 shows an image of a flow pattern and image analysis using MATLAB. The gas phase is in white and the liquid phase is in black.

Fig. 5 shows the relationship between the vapor quality and void fraction of each mass velocity. It can be seen that the measured void fraction increases with an increase in vapor quality and mass velocity. Compared to the two previous correlations of Smith [3] and Huq-Loth [4], the correlations show a good prediction for the condition of the highest mass velocity and a high vapor quality. However, these correlations overpredict the void fraction, and the deviation becomes significant under the lowest mass velocity.

5 Conclusion

This study investigated the flow pattern and void fraction in a narrow rectangular channel. The following conclusions were obtained.

(1) Bubble, slug, churn, and annular flows were observed.

(2) The void fraction was greatly affected by the mass velocity, and increased with the increase in vapor quality and mass velocity.

(3) The previous correlations overpredicted the measured void fraction, which was expected to be G = 200 kgm^{-2}s^{-1}.

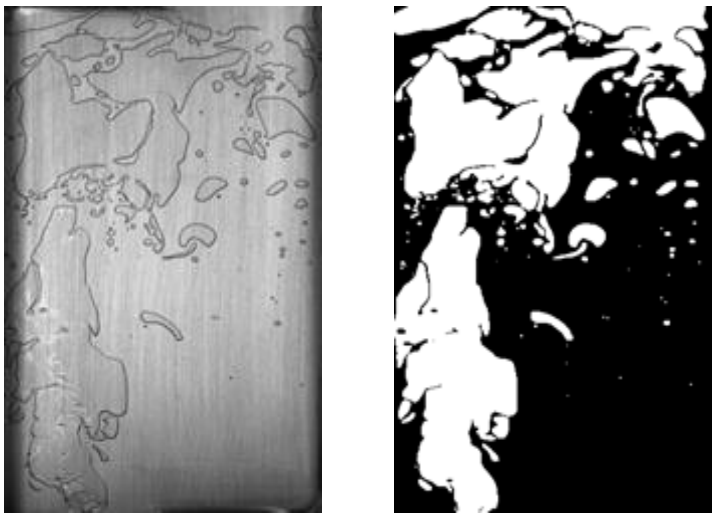


Fig. 4 Photograph and image analysis using MATLAB

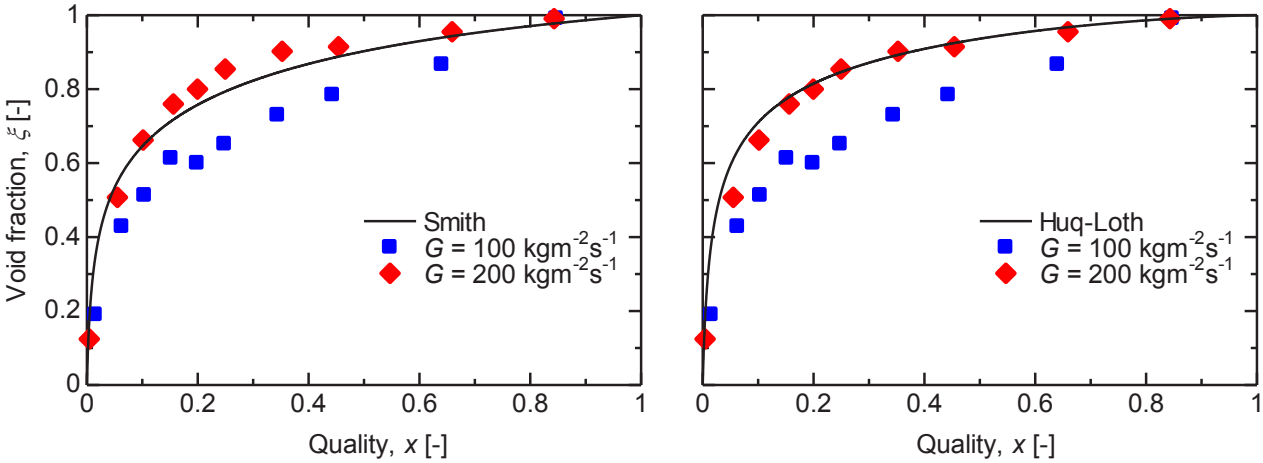


Fig. 5 Comparison between measured void fraction and previous correlations.

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Energy efficiency in maritime transport

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Abstract: This paper covers the possibilities of fully exploiting available resources in order to raise energy efficiency. High energy efficiency can be achieved by adjusting and improving current systems on ships with proper maintenance.

Shaft generator and turbo generator are two separate systems on ships power plant that can be used to increase its efficiency. A shaft generator on a ship is powered by the main engine and it powers the electricity network. Turbo generator consists of a generator powered by turbine that uses superheated steam in order to achieve rotation of its shaft. Maintenance is very important for raising ships efficiency not only in a way of keeping the power plant clean, undamaged and fairly organised but also making sure that all of the plants parameters are in order. Ships efficiency can be greatly increased by making sure that the fuel consumption is in its optimal limits as well as providing the best one, parallel work of more than one pump under condition they all work in the same parameters, better isolation and more ways to use heat exchangers, cooling of the main engine has to be regulated to keep in its limits for the best performance etc… Sankey diagram can be used to visualise the percentages of power distribution for the power plant and also how changing the parameters affects its end result.

Even though ships are by far the most economic means of transporting goods this can be greatly increased by following some guidelines and investing in some specific systems that enable raising it to much higher level with less losses and maximum usage of given resources.

Key words: Turbo generator, shaft generator, parameters, optimal work, Sankey diagram.

1. Introduction

This presentation introduces existing systems and maintenance options in order to fully exploit resources available on a ship. By implementing these methods and systems it is possible to use a higher percentage of generated power.

2. Sankey diagram

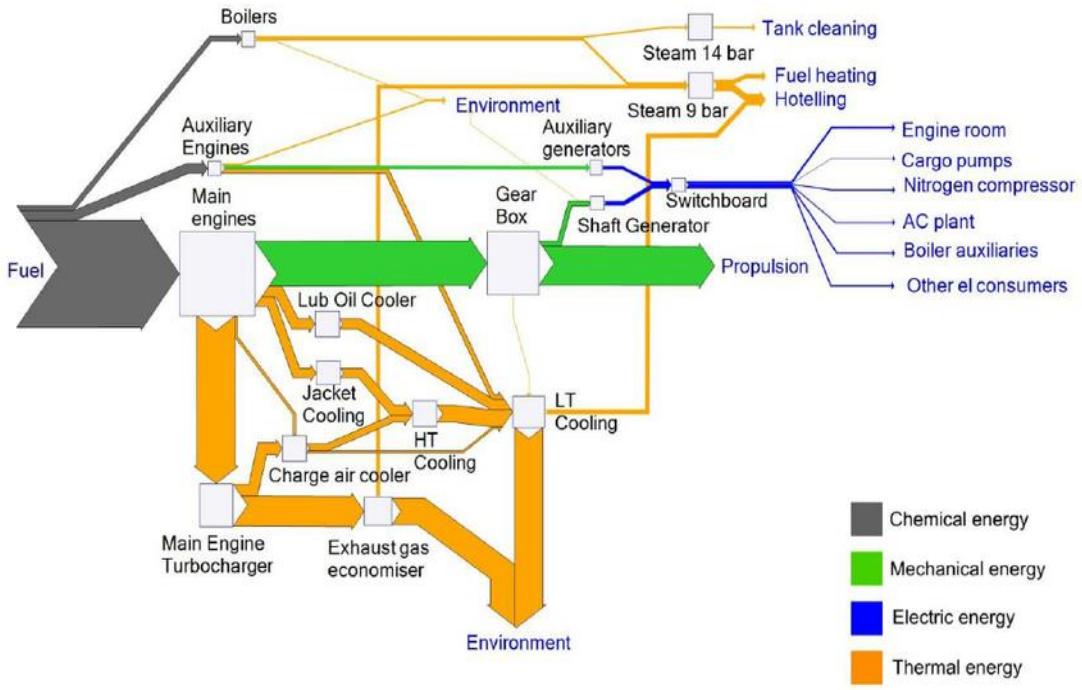

Fig 1: Sankey diagram[1]

This diagram, figure 1, shows energy consumption of all systems on a ship. Main engine uses almost 90% of energy input while 70% is used on propulsion. Most of the systems potential for a better usage of energy lies in exhaust gas (41%) manipulation. Exhaust boiler consists of economizer, evaporator and super heater and with it is possible to use the heat energy of exhaust gas. Economiser is used to preheat the feed water before entering the main boiler, evaporator is placed in recirculation of the steam generation plant and finally super heater is being used to superheat the saturated steam and transmit it to high pressure turbines of the turbo generator. The low-pressure turbine blades use almost all

[1] Francesco Baldi, Hannes Johnson Von Knorring, Cecilia Gabrielii, Karin E Andersson, Energy and exergy analysis of ship energy systems - The case study of a chemical tanker, ResearchGate , June 2014

generated superheat energy. Increased pressure in steam generator ensures higher efficiency. For better efficiency the turbine exhaust steam has to be condensed, by calculations it is shown that systems with condensers have 37% increase of efficiency. [1]

Very low efficiency of all auxiliary heat consumers could be overcome by using a different heat transfer fluid or, in alternative, steam at a lower pressure. Less than 9 bar steam could be used to reach temperature of fuel handling (70-80°C) apart from HFO(90-100°C). It would be possible to generate the same heat requirements while using much lower heat-grade sources.[1]

3. Shaft generator

Implementing this system it is possible to reduce fuel consumption where it is driven by the main engine that uses less expensive heavy fuel oil or LNG. The realisation of this system is now possible with frequency converter to ensure the maintenance of the network frequency. There is no need for additional panels on the main switchboard where it can adapt to shore supply voltages and frequencies.

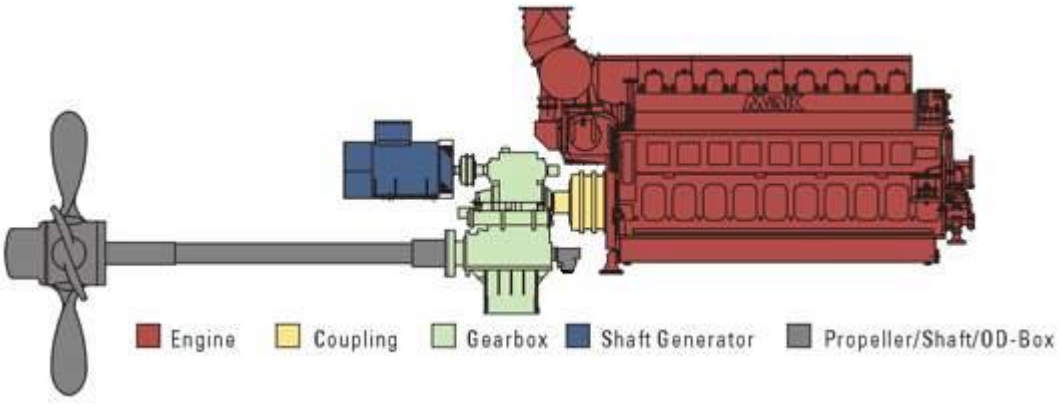

Fig 2: Main engine, shaft generator and propeller [2]

4. Conclusion

Energy efficiency in maritime engineering is a very popular topic nowadays but also a very big subject. This paper has only scratched the surface but it shows some interesting solutions

[1] Francesco Baldi, Hannes Johnson Von Knorring, Cecilia Gabrielii, Karin E Andersson, Energy and exergy analysis of ship energy systems - The case study of a chemical tanker, ResearchGate , June 2014
[2] Martin Leduc, The marine Diesel engine, Part two: The four stroke engine, Martin's Marine Engineering Page, 2001

to these problems. The hope behind this seminar is to rise interest and encourage further research. A lot of energy is being wasted through heat and mechanical energy that is not being fully exploited.

Reference

[1] Francesco Baldi, Hannes Johnson Von Knorring, Cecilia Gabrielii, Karin E Andersson, Energy and exergy analysis of ship energy systems - The case study of a chemical tanker, ResearchGate , June 2014

[2] Martin Leduc, The marine Diesel engine, Part two: The four stroke engine, Martin's Marine Engineering Page, 2001

BALLAST WATER TREATMENT SYSTEM INSTALLATION COST ASSESMENT

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Abstract

The possibility to transfer invasive species from ship ballast water between different world regions today is clearly recognized. Also, it is quite clear that expected increase in world seaborne trade in the future will make the problem even more serious[1]. Consequently, the International Maritime Organization IMO adopted the International Convention for the Control and Management of Ships Ballast Water and Sediments (BWMC) in February 2004. The main goal is to prevent the transfer of invasive species within different world regions by ballast water and sediments. The BWM convention will enter into force on 8 September 2017[2]. According to regulations of the Convention, all new and existing ships in international trade are required to install Ballast Water Treatment System (BWTS). Although there were no such systems just a few years ago, the requirement in very short time created a completely new market. The main stakeholders in the market are ship owners, BWTS producers, and shipyards. Total costs include purchasing costs, installation costs, operating costs and maintenance costs[3].

The paper presented analyses at most the Ballast Water Treatment System installation costs as well as other factors that have a relevant impact on the installation cost. In order to estimate the extent of the costs and efforts expected by different stakeholders, at the beginning of the paper the structure of the global fleet will be shown. In the second part of the paper, the basic parameters determining installation costs will be analyzed. Finally, at the end of the paper the validity of data, collected from different sources, will be examined as well as overall cost assessment. In the conclusion, the future market dynamics is estimated as well as possible impacts on the technology development of the ballast water treatment systems caused by estimated market forces.

Key words: BWM convention, BWTS market, BWTS installation costs, market development

[1] imo.org
[2] Ibidem
[3] D. M. King, P. T. Hagan, M. Riggio & D. A. Wright (2012) Preview of global ballast water treatment markets, Journal of Marine Engineering & Technology, 11:1, 3-15, p. 9

1. Introduction

Almost all human activities related to the progress and development of civilization has more or less destructive impact on the environment. There are different pollutants which cause degradation of the environment. Ballast water is not the usual pollutant, it does not contain harmful substances, but the transfer of invasive species via ballast waters represents a serious problem. Problem of transferring ship ballast water is ecological, economical and health[4]. To prevent transfer of organisms and non-native species, in February 2004, the IMO adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments to regulate discharges and to reduce risk of introducing invasive species in new regions[5]. Once the convention has entered into force, ship owners will be required to install the approved ballast water treatment system. Beside many other costs, installation cost and factors influencing on it will be discussed. There are many factors that have an effect on total costs, such as treatment technology, vessel type and size, ballast capacity, suitability of ship to install the system. Installation can be done at sea or in dry dock, so that also will affect final price. Before installation, ship owners have to think about which technology is best for the specific vessel, which capacity of the system is needed and is it there sufficient space to install such system. All these factors mentioned more or less reflect on final ballast water treatment system installation cost.

2. World fleet structure

In order to estimate the number of ballast water treatment systems to be installed on ships, few statistic information papers will be examined. Also, it is important to know the distribution of ship types, sizes and age. According to the King[6], it is estimated that more than 68 000 vessels will install BWTS on board before 2020. It is possible that older ships will not be part of the BWTS market because they will be retired or rerouted. On the other side, there are larger vessels that will need more than one ballast treatment system unit.[7]

Regardless of the mentioned information, the structure of the world fleet considering vessel type and age is shown in the following table. As it mentioned before, BWTS technology, capacity and method of installation depends on ship type so data given in next table shows the distribution of vessels by their type and age.

[4] Understanding ballast water management, Guidance for shipowners and operators, Lloyd's Register, Third Edition, August 2016., p.3
[5] Ibidem
[6] D. M. King, P. T. Hagan, M. Riggio & D. A. Wright (2012) Preview of global ballast water treatment markets, Journal of Marine Engineering & Technology, 11:1, 3-15, p. 4
[7] Ibidem

Table 1: Distribution of world fleet by type and age

SHIP TYPE	TOTAL NUMBER OF SHIPS	DISTRIBUTION OF SHIPS BY AGE			
		0-4	5-14	15-24	+25
General Cargo ships	11951	976	3402	2378	5195
Specialised Cargo ships	279	44	54	29	152
Container ships	5158	901	2752	1291	214
RO-RO Cargo ships	1459	176	576	348	359
Bulk Carriers	10979	3539	4891	1707	842
Oil and Chemical Tankers	10867	1604	5367	1935	1961
Gas Tankers	1768	361	704	378	325
Other Tankers	545	125	141	64	215
Passenger Ships	3012	238	708	775	1291
Offshore vessels	5620	1342	2290	448	1540
Service Ships	2472	310	490	373	1299
Tugs	987	130	298	92	467
TOTAL	**55097**	**9746**	**21673**	**9818**	**13860**

Source: Equasis statistics 2015

3. Determining BWTS installation costs

Ballast water treatment system installation cost can be estimated by analysis of different factors that affect on the complexity of installation. There are many factors that influence on complexity of BWTS installation and by that on installation cost, here are some of them[8]:

- type of BWTS
- ship type and operating profile
- ballast capacity
- space required and ship construction limitations
- integration with existing systems
- power availability
- availability of support

[8] Understanding ballast water management, Guidance for shipowners and operators, Lloyd's Register, Third Edition, August 2016., p.15

Also, there are different ballast water treatment systems available on market. They come in different configurations, such as separate BWTS, interconnected in different locations within a vessel or containerized.

Before installation any of mentioned options, shipyards offer installation survey to define which type of system and technology is best for the specific vessel.

Also, there are different technologies on which ballast water treatment systems work. These technologies are derived from other industrial applications, but they are adjusted for use on board. There are two sequences of the process used in ballast water treatment. The first is called solid-liquid separation, where solid materials and larger microorganisms were separated. The second process is disinfection, and it is used to remove and inactive microorganisms. These two processes can be done by using different technologies shown in the following figure.

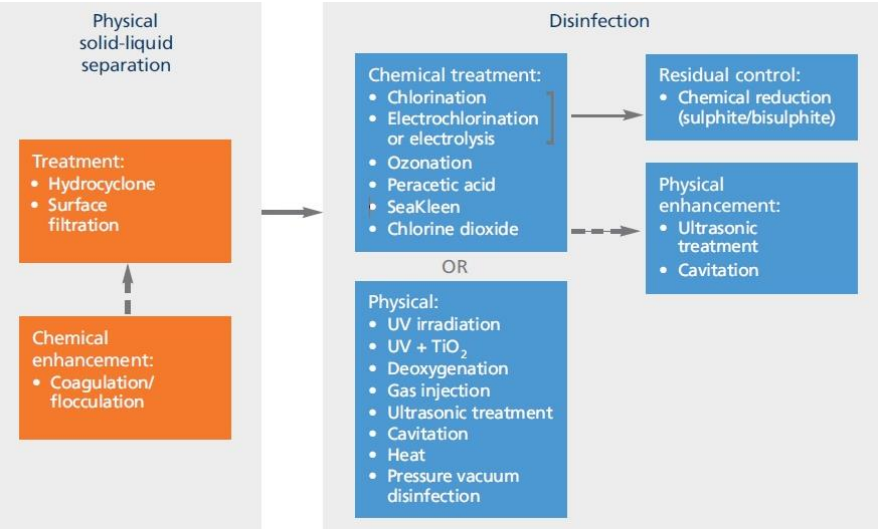

Figure 1: Typical ballast water treatment process

Source: Understanding ballast water management, Guidance for shipowners and operators, Lloyd's Register, Third Edition, August 2016

Also, another factor that impacts on installation cost of BWTS is the method of installation. It depends if the installation is done at sea or in dry dock. Certainly, installation at sea is more expensive, but if the vessel is in dry dock for long period, lost profit can exceed installation cost at sea.

According to King[9], the most critical factor affecting BWTS installation costs is the space requirements of the BWTS and whether various components of a particular BWTS can be located in a single location on the ship or need to be placed in separate locations and linked together.

[9] D. M. King, P. T. Hagan, M. Riggio & Da Wright (2012) Preview of global ballast water treatment markets, Journal of Marine Engineering & Technology, 11:1, 3-15, p. 12

4. Installation cost assessment

As mentioned before, total costs are formed from few separated segments. There are purchasing costs, installation cost, operating cost and maintenance cost. Installation cost is also composed of many elements. There are some usual components of installation cost[10]:

- design engineering
- design review
- purchasing support
- piping installation
- electrical installation
- steel fabrication
- QA/QC costs
- supervisor costs
- painting costs
- regulatory fees
- dry dock costs
- divers costs
- vessel downtime

Table 2 shows BWTS installation cost and it can be assumed how different factors influence on it, specifically type and size of the vessel and whether it is installed in dry dock or in service.

Table 2: Installation cost for different ship types/sizes and installation at shipyard or in service (US $)

SHIP TYPE/SIZE	SHIPYARD/DRYDOCK (US $)	IN SERVICE (US $)
VLCC	67000 – 147000	96000 – 210000
Tanker TAPS Trade	63000 – 131000	92000 – 170000
General Cargo RO-RO	33000 – 132000	24000 – 185000
General Cargo Break Bulk	33000 – 114000	24000 – 140000
Container Vessel 8000 TEU	57000 – 143000	91000 – 197000
Container Vessel 2500 TEU	47000 – 115000	67000 – 140000
Bulk Carrier Panamax	54000 – 125000	85000 – 155000
Bulk Carrier Cape Size	73000 – 173000	74000 – 190000

Source: D. M. King, P. T. Hagan, M. Riggio & Da Wright (2012) Preview of global ballast water treatment markets, Journal of Marine Engineering & Technology, 11:1, 3-15, p. 11

Also, it can be discussed how different treatment technologies affect on costs. Next table is showing costs of systems considering different technologies.

[10] D. M. King, M. Riggio, P.T. Hagan, Preliminary Cost Analysis of Ballast Water Treatment Systems 2009, MERC Ballast Water Economics Discussion Paper No 1., p. 5.

Table 3: BWTS installation cost for different treatment technologies (US $)

	BALLAST WATER TREATMENT TECHNOLOGY			
SHIP TYPE/SIZE	**Filtration and UV Light**	**Filtration and Chemical**	**Deoxygenation and Cavitation**	**Electrolysis and Electroclorination**
VLCC	67000 – 111000	136000 – 210000	113000 – 178500	99000 – 167500
Tanker TAPS Trade	63500 – 106000	119900 – 170500	97000 – 146000	96500 – 156000
General Cargo RO-RO	24500 – 48500	120900 – 164500	108500 – 185500	82500 – 136000
General Cargo Break Bulk	24500 – 48500	97000 – 140000	85000 – 136000	71400 – 124000
Container Vessel 8000 TEU	57500 – 103000	128500 – 197000	108500 – 167500	75500 – 121500
Container Vessel 2500 TEU	47000 – 74000	106000 – 139000	94000 – 140500	80500 – 116500
Bulk Carrier Panamax	54500 – 93500	115500 – 151000	96000 – 155000	87000 – 139500
Bulk Carrier Cape Size	62000 – 85000	132000 – 190300	139000 – 173000	79000 – 131500

Source: D. M. King, M. Riggio, P.T. Hagan, Preliminary Cost Analysis of Ballast Water Treatment Systems 2009, MERC Ballast Water Economics Discussion Paper No 1.

According to Full – Scale Design Study for BWTS, prepared by Northeast – Midwest Institute, Washington DC and the Lake Carriers' Association, following information is gathered[11]:

- shipyard labor rate: 50$/hr
- shipyard engineering cost: 15% of the installation cost
- material markup: 15%
- contingency: 12% on material and labor

5. Conclusion

Data for this paper is gathered from different sources, and because of that it is not strictly precise but gives the range of the values that are more or less correct. Also, used literature has different age, so it is possible that some information is outdated. However, a good framework for understanding BWTS installation cost is given.

Already there are many shipyards that specialized the whole service for fitting BWTS on board. They provide planning, designing, installing and testing of BWTS, and also help ship owner with choosing the type of BWTS for a specific ship.

Global awareness for environmental protection is increasing more and more. Consequently, Ballast Water Management Convention (BWMC) is introduced in the maritime industry, and now with International Convention for the Prevention of Pollution from Ships (MARPOL) is consisting strong frame for environmental protection.

[11] Design Study Report, Full – Scale Design Studies of Ballast Water Treatment Systems, Northeast – Midwest Institute Washington, DC and Lake Carriers' Association, April 2002. p. 33

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Are Moratoriums Necessary: Investigating Methods to Mitigate Risk Associated with the Marine Transportation of Oil

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Abstract. *The issue of marine transportation of oil and the risks it poses is an important and ongoing topic in today's societal discussions as there will always be valid concerns with regard to the environmental damage which could occur in the event of a spill. Environmental concerns have driven Canada to formalize a moratorium banning oil tanker traffic off the northern coast of British Columbia [1] even though statistics indicate that despite an enormous increase in global tanker traffic, there has been a massive decline in the frequency and severity of oil spills [2]. This paper reviews the factors that have contributed to this escalation in safety, and considers some innovative systems that could be implemented in sensitive areas to further enhance oil tanker safety. In addition, human error was found to be a major contributing factor in most maritime accidents; therefore, to have a noticeable impact, rigorous procedures during the marine transport of oil must be in place. The regulations and restrictions reviewed in this paper would unite to mitigate the risk of an accident. Several countries have recognized this need for improved safety and they are emerging as leaders in the marine transportation of oil. As a result, this paper suggests various actions to help mitigate risk in the marine transportation of oil so that moratoriums on tanker traffic may not be necessary measures as we move forward in the 21st century.*

Keywords: *Moratoriums; Tanker Safety; Oil Spills; Modern Technology; Human Error.*

1. Introduction

The issue of marine transportation of oil and the risks it poses has become one of the most important topics in today's environmental and transportation discussions. This issue does require scrutiny, as there is an increase in tanker traffic due to the global need for crude oil and petroleum products [3].

Although transporting oil by tankers is considered a safe method of transportation compared to other modes, accidents can still happen. Marine transportation is considered to be the most cost-effective way to move goods and raw materials globally, and with 90% of the world's trade being carried by sea, marine transport is vital to global economies [4]. According to the United Nations Conference on Trade and Development (UNCTAD), the world's fleet of tankers transporting crude oil and petroleum has increased by 73% since 2000 and accounts for a third of global maritime trade [5].

Environmental concerns have motivated the Canadian Government to impose an oil tanker moratorium on British Columbia's (B.C.) north coast, from the Alaska/B.C. border to the northern tip of Vancouver Island [6]. While many of British Columbia's Coastal First Nations have been advocating for the formalisation of this moratorium since 2011 [7], there are others who plan to challenge the moratorium. The Eagle Spirit chief's council are backing a $14 billion pipeline between Fort McMurray, Alberta and Prince Rupert, B.C., as they feel the pipeline will benefit the Canadian economy [8].

Therefore, as the world becomes increasingly more reliant on the marine transportation of oil, we need to ensure that our marine ecosystems remain pristine. The objective of this paper is to acknowledge that oil tankers are currently operating in a very safe manner while also recognizing that there is room for improvement. By reviewing existing safety regulations and investigating additional methods to mitigate the risks associated with the marine transportation of oil, the findings of this paper aim to provide some additional options.

2. Tanker safety

Global statistics indicate that oil spills are declining while tanker traffic is increasing [2]. This significant decline in oil spills (refer to Figure) can be attributed to more stringent regulations such as double hulls, new construction materials and enhanced operational practices. [9]. In 1993, the International Maritime Organization (IMO), in a commitment to prevent marine pollution implemented a phase-out policy for single hull tankers and imposed a policy stating that all tankers operating worldwide would have double hulls by 2015 [10]. In 2013, Transport Canada amended the Canada Shipping Act to create a "World-Class Tanker Safety System". Amendments included proposals to increase tanker inspections, upgrade navigation systems onboard tankers, develop an efficient response to oil spills, and add hazard warnings to navigation routes [11].

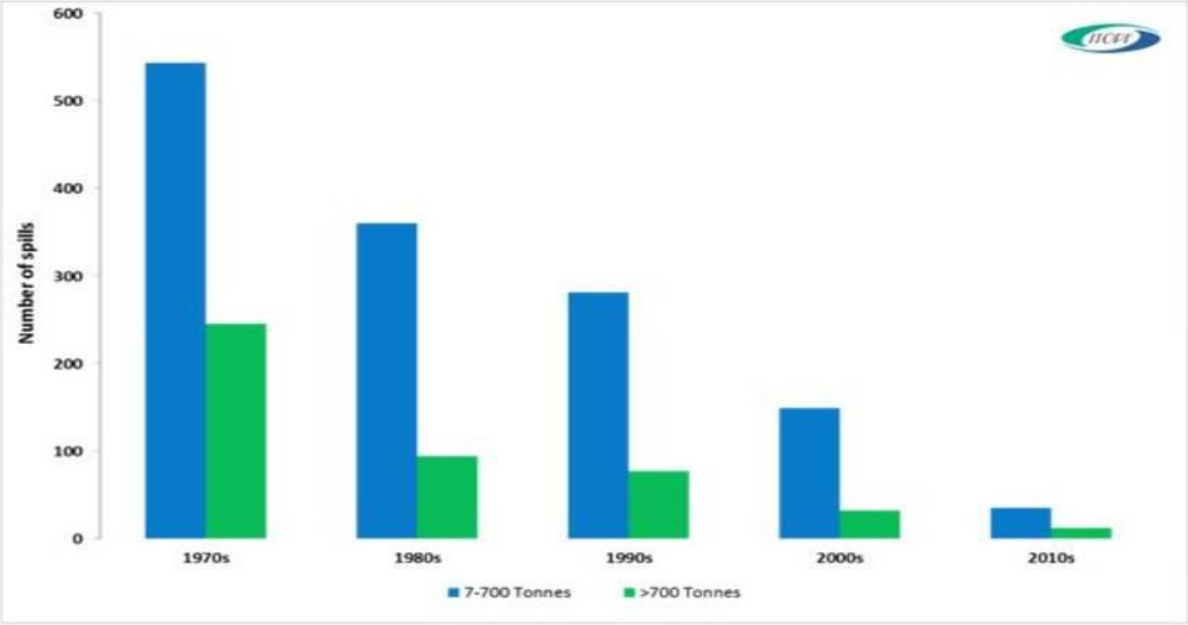

Figure: Number of large (>700 tonnes) and medium (7-700 tonnes) spills per decade from 1970 to 2016. Retrieved from ITOPF website: http://www.itopf.com/knowledge-resources/data-statistics/statistics/

Many other countries are also taking positive measures to improve oil tanker safety in accordance with IMO regulations, and the International Safety Management (ISM) code [12], In addition, best-practices to further enhance safety during the arrival and departure of oil tankers are imposed at the discretion of each terminal as per the Oil Companies International Marine Forum's (OCIMF) Tanker Management and Self Assessment (TMSA) programme. Procedures include the exchange of information between the terminal and vessel, environmental limits for

safe transit, speed and angle of approach, as well as the use of tugs and pilots [13]. The OCIMF's Ship Inspection Report Programme (SIRE) is another example of a very positive initiative, where up-to-date information on tankers and barges is shared through a very large database [14]. Actions currently in place within areas of Canada, the United States, the Gulf of Finland and northern Norway include imposed speed restrictions, designated shipping lanes, compulsory pilotage, operation during daylight hours only, areas to be avoided, and mandatory tug escorts. Up-to-date navigation equipment and shore-based Vessel Traffic Services (VTS) are additional safety measures to consider implementing [15]. Industry standards must continue to evolve with more ports and terminals going beyond the basic safety measures as demostrated in Placentia Bay, Newfoundland as well as in Washington State. Placentia Bay has a voluntary Line of Control for tankers entering the bay to ensure that incoming tankers remain in uncongested waters that are free of navigational hazards until a pilot is available to board the vessel [16]. Washinton State's remarkably low spill rate compared to the rest of the United States is attributed to the owners and operators of vessels working under mandated and voluntary best-practice procedures for vessel inspections, vessel response and spill preparedness plans, as well as to having pre booming regulations for the transfer of oil [17].

3. Innovative technology

Technology is progressing rapidly in the 21st century. Consequently, there are many technological innovations in navigational safety. These developments include two revolutionary systems that appear to have the potential to mitigate the risk of an accident for an oil tanker: Enhanced Navigation Support Information (ENSI) and ShipArrestor.

ENSI is a two-way navigation service created in 2013 to reduce the chance of an oil spill in the Gulf of Finland. ENSI works in real time in conjunction with VTS services relaying data on route traffic, route danger areas, weather conditions, etc. A VTS control centre receives the ECDIS route information sent from a computer on the bridge of the ship, and the system interprets that information both visually and automatically, providing an extra cross check of the route plan as well as advanced onshore monitoring. All information is reviewed and then route-specific information and feedback is sent to the ship [18].

Another revolutionary new technology is ShipArrestor, developed to help protect the Norwegian coastline by slowing a ship's rate of drift after it has experienced a blackout, giving more time for a rescue tug to reach the ship. It can be used to turn a ship into the wind when Not Under Command and is in danger of grounding or breaking up due to the stresses of lying side-on to the waves. ShipArrestor is a sea anchor system deployed from a helicopter which lowers the chain loop of ShipArrestor around the winches and bollards on the foredeck of a drifting ship. The helicopter subsequently drops a parachute shaped ShipArrestor and its attached towline into the sea, upwind of the ship, which provides the resistance needed to turn the ship's bow into the wind. A 100,000 ton tanker can quickly be turned into the wind, reducing its drift speed by 50%, allowing time for a tug to reach the drifting ship [19].

4. Human error

As per a 2004 report titled *Maritime Accidents and Human Performance: The Statistical Trail*, most maritime accidents can be attributed to human error. This report examined accidents occurring in Canada, the United States, Australia and the United Kingdom between 1991 and 2001. Human error was found to be a factor in 80 – 85% of the accidents and concluded that continued attention to the human element as a means to improve maritime safety is appropriate and that initiatives to enhance situation assessment, reduce risk tolerance and risk taking behaviour, improve awareness, and perform consistent incident investigations would be highly beneficial to the industry. During their research for this report, Baker and Seah discovered that 50% of all maritime accidents originated as a direct result of human error while a further 30% of accidents happened because the humans failed to take action to avoid the accident.

There must be attention focusing on reducing human error within the marine industry. Therefore, a requirement for stringent and enhanced training for all navigation officers working on oil tankers would help reduce accidents in addition to intensified mandatory voyage and contingency planning on every trip [20]. Although maritime safety is rapidly increasing due to the innovations in technology, experts predict that commercial pressures combined with increases in vessel size mean that human error will continue to be a factor in marine accidents.

Therefore, it is vital that the standards for hiring crew are rigorous and that training procedures are constantly updated [21].

Navigation officers must create and implement voyage and contingency plans when operating in or near sensitive ecological areas. If these schemes were in place and continuously monitored, research has found that accidents could be significantly reduced [22]. Risk management mitigates risk, thus preventing accidents. Therefore, it is essential that the navigation team work together to predict all possible risk to ensure a safe passage [23].

5. Conclusion

Neither mariners nor environmentalists want an accident in any marine ecosystem. As per the ITOPF data, oil spill size and frequency have been declining since the 1970s due to improved government, port, and terminal regulations. This paper has revealed that safety measures set out by Transport Canada and the IMO such as double hull requirements and tanker inspections, are vital to reducing the risk of an oil spill if a collision or grounding were to occur. Therefore, the findings of this paper indicate that revisions and updates to government regulations are essential to continue to improve tanker safety. However, adoption of other industry initiatives, such as the OCIMF's TMSA as demonstrated in Placentia Bay and Washington State, should be encouraged by the broader shipping community. Furthermore, several innovative technologies could be implemented to increase marine safety, such as ENSI and ShipArrestor. The rigorous safety measures that have been implemented in the ports and terminals of Canada, the United States, Norway, and Finland to protect the sensitive coastal areas; such as imposed speed limits, weather and visibility restrictions, the employment of tugs and the requirement of pilots onboard each vessel are very positive actions. The findings of this paper suggest that moratoriums are not necessary measures in the 21st century as long as the issue of maritime safety remains a priority for government agencies, ports and marine terminals. Industry standards must continue to evolve and continuously strive to go above and beyond the minimum safety requirements. Rigorous training procedures must be required for navigation officers, up-to-date navigation equipment must be employed and innovative technologies need to continue to be implemented as they become available.

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ONBOARD LIVED EXPERIENCES OF DECK CADETS: MOMENTS OF WORK AND SURVIVAL

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Abstract. Seafaring is a profession that is very risky but worth emulating. For an aspiring seafarer, this study could give lessons for them to learn and ideally unlock what is to be a seafarer. Thus, this qualitative study specifically narratology, aimed to determine the onboard lived experiences of 12 deck cadets by elaborating their happy, sad, angry, embarrassing, fearful, stressful, disgusting, and other moments onboard the ship. Results revealed that the deck cadets experiences were so rich depicting their real life at sea.

Key words: onboard lived experiences; deck cadets; moments; work; survival

1. Introduction

Deck cadets are responsible for navigating the ship safely, maintaining the equipment and condition of the ship through cleaning and painting, cargo loading and unloading, holding duty on the bridge, joining in surveys and inspection (4, 9), participate in emergency training and drills (7) and many others as requested by their officers onboard. Deck cadets' life is a time for learning and at the same time gaining practical experience. However, danger lurks anytime so deck cadets must be vigilant and knowledgeable of the task at hand all the time (5).

Aside from the common duties experienced by deck cadets onboard, they also experienced something personal like homesickness. Based from their study, the other experiences of deck cadets include experiencing bad weather conditions, working for long hours, communicating with their families through text, calls, chat and emails, and developing camaraderie with their colleagues (6).

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In this research, aspiring seafarers will have the idea of what will be their life situations onboard the ship. Thus, this study aimed to determine the lived experiences onboard of deck cadets who had their apprenticeship during the school-year 2013-2014. Specifically, it aimed to determine various moments of their lives most especially in their work and survival at same time.

2. Method

2.1. Research Design

This study utilized the narrative type of qualitative research design. Narrative research or narratology is retelling of the experiences as expressed in lived and told stories of individuals (2).

2.2. Respondents

Twelve (12) deck cadets were chosen in this study through purposive sampling following Creswell (2007) who had their apprenticeship onboard for SY: 2013-2014.

2.3. Instrument

The interview schedule contained eight open-ended questions pertaining to their moments they spent onboard such as happy, sad, angry, embarrassing, fearful, stressful, disgusting, and other moments.

2.4. Data Collection and Analysis

Themes were generated for each moment or situation. The findings were referred to the respondents for validity.

3. Results and Discussion

3.1. Happy Moments Onboard

Several people know the story of Poseidon as the God of the Sea of the Greek Mythology. But behind this story are the more interesting ones rooted on the real life.

Ships are more than just steel-hulled vessels. Anchored on its edges are plenty of encounters of seafarers during the voyage especially the deck cadets during their first sea experience. When asked, we have a lot of first times to tell.

Knowing their assigned vessels is a preliminary step to the fulfillment of their dreams. Deck cadets of the 2-1-1 scheme began narrating their happy moments after setting their feet on their

[2] Creswell, J. W. (2007). *Qualitative inquiry and research design choosing among five approaches.* 2nd ed. USA: Sage Publications, Inc.

respective vessels.

Joining their assigned vessels brought happiness to many deck cadets. Cadet 1 said, *I felt a mixture of happiness and excitement when I was boarding the vessel. I was thinking that it was the start of my dreams and was looking forward for the next days. It was like saying "This is it!" for me*. Cadet 3, said *when I joined my assigned vessel, I was so happy because it is the start of my career as a seafarer*. Cadet 6 said, *when I first saw Buenos Aires Express, the assigned vessel to me, I felt very happy but anxious at the same time as I was about to embark the said vessel. I was very happy because this will be the start of my dreams, to become a competent officer or even a captain someday*. *I have really no idea, or just a small idea on the work onboard. I only knew the basic things, the basic works or just the basics. That's why I really worked hard onboard. Everytime I got a job from anyone, especially from my senior officers, I really did my best. And everytime I got a compliment or appreciation from us about the quality of my work and my attitude with them, I really felt happiness and contentment. I get inspired to work even better*. Cadet 11 said, *I was so happy that I was given the chance to see these for free. When I first stepped on the vessel, I greeted every crew member gladly. I know that I will get along with us for a long time.* Next source of their happiness is going ashore to interact with other people and visit some places. Cadet 1 said, *it feels like heaven for me being on another country, eating, shopping, and just enjoying even for a short period of time. It was like really priceless being on another country and seeing the beautiful places*. Cadet 2 said, *I had a lot of happy and joyful memories during my cadetship. I was very delighted every time I set my foot on different countries and buy some souvenir items for my family and friends. I always take pictures of beautiful sceneries, historical places, world-known landmarks and skyscrapers if I had a chance. We also had the opportunity to visit the Seaman's Club and mingle with fellow Filipinos.* According to him*, it's not every day that I will wake-up with new environment that's why I value every country to where I set my footprints*. Cadet 3 said, *when I joined my assigned vessel, I was so happy because it is the start of my career as a seafarer. At the age of 20, I've been to several countries. Meeting other people and being friends with us made me happy*. Cadet 6 said, *my happiest moment happened when I was given my first shore leave onboard. Since we have a long voyage, it takes a long time for us to get into land. It was in Mexico together with my Second Officer and an Able Bodied Seaman. That day, I felt so special because in the first place, I still can't believe that I could get into this place and to meet its people, to know their culture, way of living, their attitude, cuisines and everything. It was only my dream on my childhood days. I feel blessed because at this age, I have travelled some places that others are dreaming of*. Cadet 7 said *their time onboard a vessel is not just spent on working. We also got some chances to go ashore during our vacant hours and visit places that we've just seen in movies, magazines, and televisions. We've been in Buenos Aires cathedral where Pope Francis was*

assigned before he became a Pope. We also had a very rare chance to visit the statue of Christ the Redeemer in Corcovado, Rio de Janeiro, Brazil. These places are really amazing for me. I was very glad that I've been there. Cadet 9 said, *my happy moment was everytime I got to different places that I have not gone through, meet new people and friends, and learn things that I will be doing in the near future*. Cadet 10 said, *going ashore also, as what I said, is the time of happy moments. You will be able to roam in different countries, see beautiful places and enjoy shopping on malls. This will be your rest time to relieve your stress*. Cadet 11 said, *upon the arrival of the ship to port, I was excited to go for a shore leave after the gangway duty. The reason for a shore leave is likely to buy new things like gadgets, dress, foods, and many others. But in my case, I went out to find for a free wifi or internet mostly in coffee shops, malls and restaurants. If possible, I also bought a calling card to keep in touch with my family and loved ones. There is no other means of making me happy other than knowing that they are happy and in good hands*.

They also felt happy when they disembarked their vessel finishing their contract and knowing that they will be home again. Cadet 1 said, *I was happy when I reached 12 months of being onboard. I was really happy since one of my fears/problems was done because if I can't finish my 12 months, I won't be able to take the board exam so staying onboard for 12 months really made me happy*. *I was really happy when I received my flight details. The joy or happiness I felt was priceless. It's like everything was over. No more worries of work, etc. After more than 12 months of being away from my country and family, I was going home finally. I think it was the best part, the happiest moment of all*. Cadet 2 said, *that I felt grateful when I finished my contract. After all the hardships, perspiration and dedication, finally, I'll be home for my family*. Cadet 3 said, *another thing that made me happy is having a shore leave at different places*. Cadet 7 said, *what really gave the higher degree of happiness is when I was about to leave the vessel and go home, there's no place like home for me, with my loved ones*.

Another source of their happiness is from their fellow crew onboard. Cadet 2 said, *I was also gratified when my master and officers taught me a lot of knowledgeable things. I saw their willingness to help me become an officer. It's a music to my ear everytime I hear their compliments because of my dedication and perseverance towards my chosen path. I was also satisfied when I accomplish my tasks properly. It feels like heaven for me when you've done something right for the good of the vessel and the crew*. Cadet 4 said, *just having a talk with my third officer can be considered my happy moments. I was very close to him and he always gives me food and drinks*. Cadet 5 said, *my happy moments are usually generated by crewmates that became close to me during my year-long apprenticeship. Despite the tiresome work, we were still able to have some time playing table tennis at the ship's gym. Because of this, we were able to bond and share stories about our lives back when we were younger, especially for those who were older and had so much*

to tell. We also enjoyed and shared laughter during parties and late night movies after work. Cadet 8 said *all the crew onboard are good to me and treat me like their son or younger brother. And I was lucky and happy for that because we are just like a big happy family onboard. We care for each other, we help each other if one has a problem, we do that because no one can help us but also one of us. I was really happy because I found new friends, brothers and fathers onboard*.

Work onboard causes stress and fatigue but to prevent this, some vessels conduct leisure activities and had some celebrations onboard. Cadet 2 said, *to avoid stress and minimize work pressure, we had a Barbeque Party at least once a month and a karaoke or movie time during Saturday nights. We also celebrated Christmas Eve and New Year with a bang. I can still remember the time when the officers and the crew celebrated my 19th birthday. I was the happiest person for me during that night*. Cadet 3 said, that *celebrating Christmas and my birthday during New Year are another joyful moments onboard. It was my first time to celebrate those events away from my family. My captain gave me a gift during that time*. Cadet 4 said, *watching animation and movies together with my fellow cadet, having a Saturday night (with a lot of foods and drinks), playing computer games and every finish of cleaning can be considered as my happy moments onboard*. Cadet 8 said, *one of my happiest moments is when I celebrated my 21st birthday onboard. It was my first time to be far away from my family and celebrated my birthday without them. But my birthday onboard was unexpected and I was really surprised. We have no work that time, there were so many foods and drinks. We celebrated it until midnight. And I will never forget it*. Cadet 9 said, that *all are happy every barbeque party because it is the time for enjoyment. There are a lot of foods, drinks, games and sing along over the video. This is the way of enjoying onboard after the stressful day and being away from your family*. Cadet 10 said, *for me, happy moment is when we're going to celebrate the Saturday nights or barbeque party. There are so many foods prepared and drinks. There's no duty during this day because Saturday night is the night of happiness and enjoyment for all the crew members*. Cadet 11 said, *another happy moment of me was when I celebrated my birthday onboard a vessel while we were underway. It was December 25, 2013. I thought that everybody missed my birthday since it was joined with Christmas day. But I was shocked when our captain brought and surprised me with a big cake with candles and my name on the top. Then everybody sang the birthday song. This was one of the happiest moments that happened in my entire life*. Cadet 12 said that, *my happy moments are those times that we always have a Saturday night barbeque party especially during the time when we are at anchorage in Brazil. We enjoyed fishing while grilling fish and meat and drinking beers. Due to the fact that we have endured hard work for the week but still this is the time to refresh and relax*.

Earning their first wage also made them happy. Cadet 3 said that, *after a month of hardwork, I received my first wage. Earning money on my own was really satisfying*. Cadet 7 said,

there is also one thing that made me happy and also the rest of the crew—money. Everytime the captain announces for cash advance after we've signed our wage account or papers, you can really see the smile in everyone's faces.

Being away from their family causes homesickness. Therefore, having a simple communication with their love ones creates happiness for them. Cadet 5 said *I can be happy all-day long but I was happier with my girlfriend despite the distance we had. I was able to communicate with her through Globe Rydex and Amos Connect (communication devices onboard ship). A day without a message from her would make me worry and each message from her gives me a rush. My saturated mind and body would be awakened by simple "I love you" or "I miss you"; things and words that we take for granted when we live normal lives onboard. Her love for me always makes me happy but what makes me happy the most is the yearning for the day I will go home and feel the warmth of her love*. Cadet 7 said that *another thing that made us happy was internet. Everytime we had a chance to buy an internet card or catch a free wifi, we really feel close to our family through calling and exchanging messages with them*. *Other happy moments of mine, when we gone shore leaves, are those during the time we shop, tour, mingle with people on the country where we are, and sometimes go to bars.*

3.2. Sad Moments Onboard

When asked, deck cadets can't be stopped telling their happy moments onboard. They have plenty of it on their memories. But waves on seas aren't calm all the time. Seafarers often, if not all the time, experience the roughness of the seas. Deck cadets learn the job of the sailor before they learn the job of the deck officer (8).

Aside from the physically challenging jobs onboard, deck cadets experience different emotional tests during their cadetship training. Adapting to the new environment onboard isn't that easy, after all.

One of the major problems encountered onboard a ship by the deck cadets is the sadness brought about by homesickness. Cadet 1 said that, *there were a lot of things that linger in my mind. I remembered the happy memories with my family, bonding moments with my friends and my life in the future. I cried when I encounter serious problems that need advice from my loved ones. Homesickness is somehow one of the worst problems of the seafarers. That's why I didn't miss any chance to talk to them through messages and social media every time we are in port*. Cadet 4 said, *in my two months of experience onboard, I have a certain experience that put tears in my eyes. It's been 3 months when I left my family, we arrived in Mina, UAE for discharging coal. Every arrival in ports, we are so busy that everyone was so tired after finishing all the necessary works to start*

[8] Smith, G. (2012). *The merchant navy careers handbook*. Beaufort Offshore Projects. UK: Beaufort Projects.

the discharging. Discharging takes some days to finish. So, mostly of the crew are buying calling cards and internet cards to contact their family. As a cadet, I have less money so I can only buy limited cards. While I was in a duty in the gangway, a businessman board our vessel selling some calling cards and I bought one to make a call to my family after my duty. When I made a call to my mother, at start we had a great conversation then she opened a topic about my grandmother who passed away last two weeks. Suddenly, tears fell into my eyes. I cried a lot until my call has ended. I have no more calling cards to make a call but my mother texted me to lessen the pain that I felt. Cadet 6 said, *there are some times that I missed my family and other special persons in my life. That time I preferred to be alone and to start thinking about the memories we had when I was still here in the Philippines. That serves as my strength and courage in my day to day life onboard knowing how happy and proud they are about me*. Cadet 8 said *I can still remember the night that I cried because I remembered my family. Maybe I was just homesick that time and not really got into it that I was far away from my family. Especially to my grandfather whom I promised that I will really make my dream come true and give my family a better life during his dying moment*. *This is the only sad moment onboard that I can still remember because I had a happy cadetship and all my crew members are good to me*. Cadet 9 said, *my sad moment onboard is when I miss my family, loved ones and my friends. I also felt sadness every time when there is shuffling of crew because my friends onboard who had helped me a lot will be leaving and going home*. Cadet 10 said, *I felt sadness every time I am alone on the cabin and I suddenly remember the things I always do at land and the celebrations on land like Christmas and New Year. Everybody in the land is celebrating while in my situation, I have to work because my captain told to do so*.

Failures to do some tasks and to reach the expectations of some seniors also cause sadness to some deck cadets. Cadet 1 said, *I was saddened when I failed to impress my chief officer. He assigned me to be the team leader of a squad during the Fire Drill but I didn't meet his expectations. He challenged me to become the next leader once again on the next Fire Drill. I felt so discouraged after hearing his comments but I accepted the challenge. I consulted the training manual and sought guidance from my third and second officer on what to do during emergency. After the next drill, my Chief Officer praised me for a job well done and told me to take my job more seriously*. Cadet 7 said, *I also got sad whenever my senior officers scolded or got mad at me and also whenever they were not pleased or satisfied with my work.*

Some moments of sadness were also caused by some expectations of deck cadets themselves. Cadet 2 narrated, *I was told that before our departure, we were told that there will be a big chance that we would transfer to another vessel after six months. But days before six months onboard, we were informed that there will be no transferring of cadets to another vessel. Upon hearing this, I really felt sad since I was expecting that I could be seeing my family before*

transferring to another vessel. But things don't always go your way. We just need to adjust to different kinds of situations. Another was when we had our first crew change. The persons who were signing off were my close friends or colleagues. They treated me as a family member or like a brother. They were also backing me up or helping me up if I have difficulties. They were even doing the job orders requested to me because they don't want me to get tired that much. So when they disembarked, I felt sad and I almost cried. Cadet 7 said that *the next crew change after I embarked was also one of the sad moments I experienced. I felt sad because the people I have worked with whom I was able to get along with were about to sign off and new people will join which means I need to adjust again to the new crew. But despite all of these sadness that I experienced, I didn't let my emotions to distract me, these are just part of our lives, we just need to deal with them and be motivated and learned from them also for us to be better*.

For some, their embarkation on their vessel caused sadness to them. Cadet 3 said that *my sad moment was when the day has come for me to go onboard and my parents are with me at the airport saying goodbye. It was my first time to be away from them for so long. During my first month onboard, I also felt so sad. Staying onboard for one year for the first time was very difficult. It took almost a month for me to adjust. During the time, I always felt homesickness which is one of my major enemies during my training*. Cadet 7 said, *I felt sadness when I was about to embark the vessel, I didn't just felt happiness but also sadness. It was sad because for the first time I will be away from my home, from my family and loved ones for more or less 12 months*.

Negative news from their families and personal problems on land also caused sadness for some deck cadets. Cadet 3 said, *I experience sadness when it was already at the middle of my contract onboard when I received information from my mother that my grandfather already died which made me eager to go home. Lastly, when my contract was about to end, I received another information that my aunt where I was staying in Iloilo City had a cancer*. Cadet 6 said that, *receiving a message that one of our company mate, batchmate and a friend have died onboard marks as one of my saddest moment.* Cadet 11 said that, *distance, no communication for days and months made my life boring and sad. It was really true, a battle between homesickness versus dollar. When I was onboard a ship, the saddest moment in my life is quite personal but I can assure to tell it. Two months and 28 days after I embarked, I got news or a message. My heart went deeply in pain when my girlfriend finally chose to break-up with me because of my work and thousand distances that kept me far away. I was wounded that I even tried to commit suicide. I was depressed and emotionally unstable. I did cry, shout to at least to ease the pain. But every time I was alone in my cabin, the memories come back. I was sad that even my crewmates noticed, even my work was affected. What they did was to cheer me up, guide me and teach me to recover. Well, life was very unpredictable but I was somewhat happy that I did not choose to end my life since I have still my*

family left who love and support me. Cadet 12 said, *my sad moments are those times when I remember my family at home, my friends, and my loved ones. I was sad for the reason that I really miss the things or events we've always done. Those moments sometimes mesmerized me and made me cry. This is due to the reason that I think I was alone and have no hands to hold on or walls to lean on. But in behalf of that situation, I still push myself to think positively that all these sacrifices are for them and because this is my chosen profession that I must continue to live on*.

They may have experienced being on the trough of the waves where distance slowly kills them. They have stated different reasons why they have managed to oppose the wrath of the sea. But they have survived after all.

3.3. Angry Moments Onboard

A ship is a compilation of various races. Different characteristics of different people arise onboard. In order for one to survive, he must adapt on the environment where he is.

But life onboard is not as effortless as many think. A little drop of patience may not be enough to avoid conflicts. One must have sufficient knowledge and experience in handling these different types of persons.

Working on ship is not only tough physically but mentally as well. Dealing continuously with conflicting opinions, racing nerves, and altering egos, a mariner fortunately or unfortunately falls prey to a system, wherein molding according to a situation becomes imperative (3).

One of the reasons that deck cadets onboard get angry is because of the blame from the fault of others that are thrown to them. Cadet 1 said that, *my angry moment was when I took the blame of someone's fault. They thought I lost one of the "walkie-talkies" because I was responsible for recharging it when in fact, I saw the "walkie-talkie" fell down to the ocean when the OS checked the port side of the ship if there was still water that flows overboar*d. Cadet 2 told that, *there was an instance when the keyboard on the ship's office wasn't functioning because water was spilled on it and I was the first one to see it. I reported it to the duty officer because I was making fire and safety rounds. I got angry because he said that maybe I was the one who spilled the water on the keyboard. He said that I was the suspect since no one was there that made me angry. I was just doing my duty yet I was the one suspected for the things I haven't done. It really pissed me off*.

Another inevitable thing that can be observed onboard is seniority. Some even came to a point that they already abuse seniority. Cadet 1 narrated that, *some of the ratings kept on asking favors from me for their personal needs. They want me to bring their slop chests to their cabin, cook their barbeques during parties, wash their dirty cover-all and bring their baggage if they had a chance to shop in the malls. I just don't report it to my senior officers to avoid conflicts and*

[3] Dileepan, V. (2011). The Ugly Side of Life on Ship – True Story.

misunderstanding. I know that I am the youngest. Cadet 3 said that, *I was angry to one of my officers because he was abusive when it comes to work. I knew that I was just a cadet so all the things that they order me is part of my training. But in my case, he is always giving his entire job to me. There was a case that during their watch (0000H-0400H), he told me to keep the watch by myself because he will sleep due to a tiring maneuvering. It made my blood boil because all of us were also tired and besides, it is not right to leave the watch to ratings. Other thing is that my Chief Officer told me that I should rest even Second Officer or third Officer called me to do a cargo watch, he told me to say to them that he ordered me not to go to watch because it is my rest period. But my officer insisted that I should go to watch because I am a part of the cargo operation. Instead of arguing to him, I just go and think that it was part of my training. The following day, I told the Chief Officer and the Captain about what happened. They were called and scolded*. Cadet 6 said that, *it was in Feelung, Taiwan when I served as a Messman (temporary). It was also a salary day when their Chief Cook and Chief Engineer had their shore leave. Since I was a Messman, I was assigned to prepare the table of the officers and to serve them. I thought that Chief Engineer and Chief Cook will have their dinner outside so I don't served foods for Chief Engineer. It was around 1200H when I am preparing to sleep when Chief Cook knocked on my cabin. I was surprised that he was very angry. He scolded me, giving some trash talks on me reminding what I have done. I knew that it was my own fault but the stories he was talking were getting exaggerated. He wanted me to follow all his orders. I know that he has right but it was too much. He was drunk. He was unconscious. I want to talk to him but he's trying to make unnecessary actions. Our conversation reached until 2300H. I was very angry to him but I couldn't let it out. My tears fell because of that anger. And that made my angriest moment onboard*. Cadet 7 said that, *I really got angry onboard against my Chief Officer but I just kept it in me and then later shared it to the crew members whom I was closed with. We went ashore in Vera Cruz, Mexico and that was the first time I went ashore one month after I joined the vessel. We went ashore together with my Third Officer who was the one who invite me to go with him, the Captain, Engine Cadet, Second Engineer and Chief Engineer. We drank in a bar and came back to the vessel drank and very late for our duty (around four hours late). Chief Officer got very angry at me and insisted that I should still have my duty and asked the reason why I came back late. I explained to him that I don't have choice because the rest of the officers are still drinking and I don't know how to come back to the port since we went to a bar far away from the port. But still he insisted that I should have gone back. On the next day, he gave me plenty of job orders that are pretty hard and stressful. Despite of this, I just thought positively and learned with this experience.*

The next thing that most get angry with is the attitude of their fellow crew onboard. Cadet 2 said, my *angry moment happened when my officer scolded me like hell. He said things that were*

*painful and personal because I made a simple mistake in following his orders. At that moment, I was really angry. I felt like I wanted to answer back and punch him because of the things he said that were unnecessary. But I just controlled my emotions and apologiz*ed. Cadet 4 said that, *I felt angry when our Boatswain forced me to drink. I seldom drink, when I am not yet onboard, I don't drink so I'm not used to it. I drank one glass and proceeded to my cabin to have some rest. It's not been an hour when someone knocked my door, when I opened it, it's my Boatswain forcing me again to drink but I still don't listened to him because he was drunk already. I closed the door and went to sleep.* Cadet 5 said that, *in my first and second six-month contracts, it was inevitable that I would not have utmost 1 crew member that I would have a problem dealing with. You got angry on the way they treat and think of you as an animal onboard a vessel. You just have to ignore them to be able to survive. One infamous Chief Officer was physically abusive during my first contract. "Karma" was fast and there is nothing sweeter than seeing them suffer*. Cadet 8 said that, *my angry moment was maybe when I was just a week onboard. Because of the Able Bodied Seaman who always tells me that I am always wrong and he said that, "You're just new here and then you act you already knew everything" which was I never did. Because I was just new, I always ask before doing that job. He (AB) also spoke bad things about me to the Chief Officer. But the Chief Officer didn't trust him. He talked to me that I'll just do my duties and not to mind the AB. After it, the AB apologized and I accepted it. Then we became friends and I treated him already just like an eldest brother*.

Another cause of anger onboard is the unfair division of work. Cadet 9 said, *my angry moment is with some stevedores or some checkers every time we are on port. We are onboard to help with the cargo operation but some of them are hard-headed. If you want something to be fixed since what they're doing was wrong, they will not follow you and will even get angry. I requested them in a diplomatic way but if they don't follow, I threatened them that I will tell it to the Chief Mate or the Captain so that they will not be paid*. Cadet 12 said, *my angry moments are those times when my reliever on port-watch duty did not come back on time when he applied for shore leave that made me stand as gangway watch for eight hours straight or even more because I was not a type of person who always go on night trips. For me, once or twice is okay but when it was done to me repeatedly, I felt very angry that's why sometimes, if I didn't intentionally want to go out, I did to avoid that situation*.

Time management and lots of work are also the root cause of anger onboard. Cadet 10 said that *my angry moment was when I have to do so many orders in a hurry. For example, your officer ordered you to do a certain job then suddenly he will going to order you again another job even the first order was not yet finished. Then the Boatswain accidentally saw you and asked you to do something for a limited time. He will be going to scold you even you did everything just to finish*

what he asked you. Cadet 11 said that, *it is normal onboard a ship to get angry, mostly because of so many tasks to do. As a deck cadet, I was obliged to follow whatever task that my senior officer ordered me to do so even if I have to extend extra time in working. Actually, the rest hour period that was given to us, seafarers, was not been followed onboard. This made me sick so I complained why we, as cadets, will have to retain one to two hours in daily routine job without having a duty on the bridge. It was stated on our company policy that we, cadets, are onboard for learning to become a future officer and not a future rating. It has come to a point when I fought back with our Captain complaining about the rest hour period. During our voyage to Geelong, Australia, after discharging cement, we have hold cleaning operation. We worked 24 hours for three days straight. We had our meals inside cargo hold. We took a nap for one to two hours then go back for work. It was really hard that I wanted to cry but have no intention to complain not until when our Captain shouted, scolded and threatened me that my salary will be deducted since I fell asleep for six hours while everyone was still working. That time, I answered that it is better that my salary will be deducted than to put my life at risk.*

These are some of the negative encounters deck cadets have experienced onboard. They may be called as "newbies" during their cadetship training, but the way they dealt with these are worth emulating.

3.4. Embarrassing Moments Onboard

Our curiosity has led us to the peak of our actions. Since deck cadets are considered novice of the works and things onboard, try tried several means to learn at the most possible early time. But sometimes, their curiosity results to an embarrassment.

The attitude of some crew onboard results to embarrassment of deck cadets. Cadet 1 said, *my embarrassing moment was when everybody was enjoying the barbeque party, our Chief Engineer joined us and drank a lot of beers. We sang merrily and laughed so hard but the atmosphere suddenly changed. He requested me to stay beside him, which I followed. I was shocked when he hit my head so badly with his knuckles. He did it again but this time, he requested the Wiper to provide me a helmet on my head. He kept knocking my head in front of the officers and crew without a valid reason. What I did is to ask permission that I had to go to sleep which they permitted. As I walk through the stairs going to my cabin, I cried hard and loud because I couldn't accept what the Chief Engineer did to me. I couldn't stop myself from voicing out my hurt feelings which made the crew rush to where I was. I told them that I didn't deserve what he did to me and it's better for me to go home. Our Captain reported the incident to our company and our crewing manager told me to stay calm and report to the Master if the situation happened again. I was traumatized and my officers were monitoring my actions. It took time for me to recover from that*

embarrassment. Our Chief Engineer apologized to me and he was given a warning. Cadet 6 said that *my embarrassing moment was when my crewmates kept on underestimating me*.

One's mistakes also cause embarrassment. Cadet 2 said, *I felt embarrassed when my officer asked me questions that I really don't know the answers because I have not been taught of that before. I was really embarrassed since I can't answer his questions. He even shared what happened to the other officers and even to the captain. And it made me more embarrassed. So, I started studying harder by reading books and publications, so that the next time I can answer the questions he will give to me*. Cadet 3 said, *my embarrassing moment* was *when one of my officers asked me about something and I can't answer his questions because I forgot the answer. What made it more embarrassing is that he already asked me about that question few days ago and yet I already forgot the answer*. Cadet 4 said, *my embarrassment happened after our dinner*, *able bodied seaman and ordinary seaman went to my cabin to check me or do whatever comes to their mind. One night, they went to my cabin, as they enter they said my cabin was so messed and smells bad. I was so ashamed of it*. Cadet 8 said, *my embarrassing moment was when my boatswain told me to wash the lifeboat. After washing the lifeboat, the Boatswain laughed at me because he meant to wash the inside part of the lifeboat and not the outside part. I also laughed at myself and I don't know what to do*. Cadet 9 said, *my embarrassing moment was when I cut my hair by myself. Since I have no crewmate who knows how to cut my hair, I did it myself. Since it was my first time, it resulted to a funny hairstyle. My crewmates always laugh at me when they see it*. Cadet 11 said, that *my awkward moment was when it was summer in Southern Hemisphere when our vessel made a way towards Portland, Australia. Onboard a ship, we have this weekly inspection of cabin. Captain and Chief Engineer make sure that the crews clean their cabins as a part of the QHSE policy. It was done every Saturday with no given time. They surprised everyone on their cabin. But in my case, I was totally embarrassed since they caught me inside my cabin wearing underwear. Who's not going to be shocked and embarrassed when the two big bosses found you wearing underwear only. Well, the story is that, it was really hot inside my cabin since the air conditioning system was not working properly. I already told it to the electrician but unluckily, he doesn't have time to fix it. So that time I decided to wear only an underwear while working for something when suddenly my cabin's door opened and both of them were shocked too. Captain and other senior officers had a master key to open all cabins and rooms inside accommodation*. Cadet 12 said, *my embarrassing moment was when I reported late in my work because of tiredness in last day's work. I got slept instead of reporting 12 noon, I reported at 1:30 PM. But good thing, our Boatswain is understandable therefore nothing to worry*.

They may have experienced a lot of embarrassment onboard and will still experience a lot of it, but the most important thing is, we have learned because of their curiosity, after all.

3.5. Fearful Moments Onboard

Being a beginner and having expectations for a certain field often results to fear. Cadet 1 said, that *my fearful moment was the time that I embarked the vessel. A lot of things emblazoned in my mind. I didn't know where to start. The first time I went to the bridge was a challenge. They asked me to plot a ship's position in the chart but I failed to perform it properly. I was afraid that I couldn't meet their expectations. Next is being the officer of the watch was one of my most challenging task. I was responsible to monitor the ship's movement and other navigational equipment under the watchful eye of the Captain. I was afraid that I cannot impress him but according to him, I did a great job. In addition, my experience as helmsman in the river of Rotterdam was also one of my fearful moments. I must maneuver our vessel to the port safely passing through the narrow channel with heavy traffic density.* Cadet 6 said, *my fearful moment was when I was signing-on, I have no idea of what is life onboard, on how to survive on my 12 months contract. And I don't have an idea of what kind of person I will be with. In addition, when it is my first time to steer a ship with a pilot berthing on China was also my fearful moment. China has so many fishing vessels especially on coastal areas. First, I don't know what to do, it seems that all I have learned in steering have gone. I felt so nervous, that I could turn back and give it to the Able Bodied Seaman. After all it was also a success*. Cadet 7 said, *my first fearful moment was when I was about to embark the vessel. I was very anxious that I don't have any idea on what to do onboard. Also, one fearful moment that I had encountered was when we were conducting a life boat drill and we will embark the lifeboat that was already lowered on the water and will go there through Jacob's ladder that was lowered from the deck with the height of around more or less 20m. My legs were shaking when I was about to go down on the ladder.* Cadet 10 said, *my fearful moment was when you committed mistake then the Captain and Chief mate were there observing you. Then you were to be scolded.*

Inevitable dangers onboard cause fear for deck cadets as well. Cadet 1 said, *my other fearful moment was a close quarter situation between our vessel and a tanker which was overtaking us. We had a CPA of 0.02 nmi five minutes in Malacca Strait. Good thing that our Captain maneuvered our vessel away from the other vessel.* Cadet 2 said, *my fearful moment was a time when I first experienced bad weather with big waves and swells, and our ship was rolling up to 15°. At that moment, I was afraid since it was my first time experiencing those things. I was even thinking of what will happen if our ship capsizes etc. I even prepared my lifejacket beside me when I was asleep. But after sometime, I got used to it*. Cadet 3 said, *my fearful experience was during the month of November, when we are bound to Vera Cruz, Mexico. While enroute, we encountered a strong storm. Even our vessel was big, it rolled so much when the waves hit the hull. I was very afraid of it because our vessel is already 10 years old and might sink during that time. Fortunately,*

we survived during the storm and arrived at our destination safe and strong. Cadet 4 said that, *I experienced my fearful moment when our ship was at anchor along the Indian Territory waiting to be alongside. In that day, we are having a break time or coffee time at the crew mess. Then the Boatswain went to the ship's office to check emails for him while drinking his coffee, he checked our works in the window when he saw oil flowing from the ventilator of our oil tank. The Boatswain acted immediately, called the engine room and the bridge. We immediately contained the spill and fortunately no oil flowed into the sea. I was thinking that if the oil will leaked into the sea, I will be detained by the Indian Authorities. That is one of my fearful moments onboard that I will never forget.* Cadet 7 said that, *I experienced fear when we arrived on Buenos Aires Port, during docking (mooring operation), our first spring line snapped because of too much tension, luckily it projected upwards and away from us but if it projected inward, towards us, somebody may be injured or killed with that incident*. Cadet 8 said that, *I felt terror when we were going to collide with a floating pipe line. I was very nervous that night and I was thinking that maybe we will die. But the pilot came by the helicopter and very angry, when the pilot was at the bridge while opening the door he shouted hard port. Then we did not collided in the floating pipeline. The pilot asked the captain why it happened, the captain explained that he didn't know that there was a floating pipeline. The pilot said that in 5 seconds that he was late we already collided at the pipeline and no one can survive. Thank God that it didn't happen.* Cadet 9 said, *my fearful moment was when I was doing a bridge watch keeping duties in the waters of China. It was a very dense traffic lane because there were so many fishing boats and to make the matter worse, it was a reduced visibility because of the fog. I felt my heart beating fast every time that these things happen because of the responsibility to keep clear the vessel from colliding with us and you were in charge of the lives of your fellow crew. Thanks God that I have finished my duties without dangerous things that occurred*. Cadet 10 said, *my fearful moments when the weather wasn't in good condition and the ship was pounding and rolling heavily with listing of about 20 degrees that it seems the ship will going to capsize.* Cadet 11 said, *my fearful moment when I thought at first ships that rapidly roll, sway and pound during bad weather in movies were not real. But in my case, I have witnessed what I called the "greatest nightmare" of my life. We left Portland, Oregon, USA fully loaded with logs on both cargo holds and weather deck with a free board of approximately 4 meters. Vessel is in great circle sailing traversing from North Pacific passing through Unimak Pass when we encountered a terrible situation. Aleutian Island and waters were known as the birthplace of super typhoon. Lucky for us to face two strong low pressure of both side of the vessel. Wind force is 9-10 with waves ranging from 7-8 meters high. Some fixed stanchion broke and some collapsed but thanks we have firm lashings to support. All materials that we have on deck were washed out and most of all, we were all wide awake since the inclination was more than 30 degrees on both sides*

(rolling period). All of us are wearing our lifejackets and kept our documents. In my case, I was stationed on bridge helping the OOW seeking for further advice from WNI (weather forecast). Duty AB was on the help manually steered the vessel. After duty, we stayed on the crew mess and some of us started praying. We couldn't sleep, barely ate, and were afraid of what will happen anytime. Mountainous waves came from all sides of the vessel. Yet, we survived because we believed that God heard our prayers. Cadet 12 said that *my fearful moments are those times when I thought that what if our ship will sink, what if we will be invaded by pirates and what if I cannot return home. When those ideas struck into my minds that make me fear. But thanks to God that through a year that I was onboard nothing of those ideas happened*.

Pirates, as one of the threats on seas, give fear to most seafarers. Cadet 1 said that, *transiting in high risk areas was the worst for me. You have to be vigilant to avoid pirates. Our lives were at utmost danger if these robbers will come aboard our vessel. It was very scary*. Cadet 2 said, *my other fearful moment was when we first transit in the High Risk Area. There was a time when we were steaming at 8-9 knots and we can see small fishing boats, dhows and skiffs on the horizon. I felt nervous thinking that any of those vessels may be pirates and can attack or run after us any time since our vessel's speed was nothing compared to what they have. Luckily, none of those things approached us at less than two nautical miles. I felt better after we had passed that area*.

The sea will continue sending more and more challenges for those who want to explore on it. And folklores on the dangers at sea will continue invading the minds of the people without knowing that what happens on real life was far more treacherous than it is.

3.6. Stressful Moments Onboard

While still in a maritime college, a deck cadet often wonders as to what his shipboard duties exactly are. The common answer to this intriguing question at college is that a cadet must assist the deck officers in the day-to-day operations of the vessel (1).

As what is stated in their company code, deck cadets are onboard for training as future officers. Given this situation, they have expected a lot of tasks onboard. Some of these even test their patience and hard work.

Different works conducted onboard is often the main reason of stress onboard. Cadet 1 said that *"entering" and "leaving" port is one of my stressful moments. I should plot the ships position at least every three minutes because it's important for the officers and the pilot to monitor ships movement for safety reasons. As much as possible, I had to provide everything that was needed for the operation such as completing a lot of checklists, providing pilot cards, complying legal*

[1] Bhattacharjee, S. (2014). 10 Important Jobs Deck Cadets Have To Perform Onboard Ships.

documents before leaving or entering port and giving the best comfort for all the port authorities. Cadet 2 said that, my *stressful moment was when we were on our way from the discharging point to the loading port, the expected date of the arrival was 6 days from the departure and we still need to clean the cargo holds which was loaded with coal before. The time for cleaning the nine cargo holds and deck wasn't enough if we just work 10 hours per day in five days. So, even during the weekend we worked from 1600H-1730H during the weekdays. It was really stressful since we didn't have enough time to rest since cleaning cargo holds was one of the most or should I say, the hardest work for me onboard*. Cadet 3 said, *being awake for almost 24 hours and having not enough rest was a very stressful moment during the cadetship training. Lots of works during that time was present. Like receiving provisions for the ship and after it you should proceed to cargo watch. It was very stressful because you were so tired yet you still needed to work. Danger is always present when you are stress. You cannot think properly and cannot concentrate to your work*. Cadet 4 said, *my experience on my vessel which was a bulk carrier loading mostly iron ore and coal but sometimes fertilizer or limestone. In every discharging, at the end, cleaning will be made. The length and procedure of cleaning depends in the length of the voyage and the cargo to be loaded. I had an experience that we will take a less than one day voyage. At this time, we must finish cleaning the five cargo holds by sweeping and washing. I had experienced also an almost one month cleaning. Our voyage is from China to Canada and we will load a clean cargo. Our last cargo is iron ore that made too hard to clean. We must scrape the cargo in every edge of the load then wash it and paint it. This was very stressful and our Master was already pressuring us to finish the cleaning. We started at 6 AM then a lunch break, resumed on 1300H until 1900H then back again at 8 PM and stopped at almost 2200H*. Cadet 6 said, *when I and my crewmates arrived at port of Manzanillo, Mexico from port of Pusan, South Korea, authorities on Mexico were so strict when it comes to quarantine inspection thus, preparation on different areas on ship must be done with accordance to the company and Master's order. From 0800H in the morning, we started to wash the whole accommodation from the navigational bridge to the upper deck which is composed of eight decks. We cleaned also the ship's starboard and port sides which was about 600 meters all in all. It was the busiest day since I was onboard. After one job, our Boatswain immediately gives another job order the whole day not taking into consideration that we will be arriving at night. We finished all job orders at 1800H. Dinner is only our rest time and we directly go on our duties on maneuvering. I was assigned on bridge. Since it was channeling, it took four hours for us to be berthed. At 2330H, all inspection was done and I still have a duty at 0000H-0400H, a mix of fatigue and sleepiness was my encounter after duty. I was asked by my Captain to clean the bridge and all was done at 1000H the next day. This was the first time I has encountered a 28-hour straight work without sleep and full of stress*. Cadet 7 said, *my stressful moments*

happened when we receive our supplies from Port of New Orleans, nobody is exempted, everybody should help in carrying the supplies to the storage room even though you still have no sleep, it is your rest time or you just finished your duty or work. Also, whenever we play card games during duty hours. Playing cards happen when we came alongside during our rest hour from duty or work earlier and still have no sleep but we are still obliged to wake up and proceed to our designated stations (mooring) to operate and work. Cadet 8 said, *every end of the month is considered my stressful moment because of the monthly end report. Every night of the last week of the month, I sleep late at night just to finish it. But I thank God that I finished it every end of the month or before Captain will e-mail in the office*. Cadet 9 said, *my stressful moment is when we departed Tanjung Pelepas, Malaysia bound for Pasir Panjang Terminal at Singapore. It is a very short distance from each other so we don't have enough rest. To add to the burden, we only stayed on Pasir Panjang for almost six hours and I had a port duty. We departed there and transferred to the other terminal in Tanjung Pagar, Singapore. It was very close as well from the port we have departed. All of the crew are stressed and tired because no one got a rest. We haven't slept for almost 24 hours*. Cadet 10 said, *stressful moment is when you have to work or have a gangway duty for six hours in the morning, from 0600H-1200H, a rest of six hours and another duty again of six hours in the evening and vice versa. You have no straight rest and sleep because you have a six hours of sleep and six hours of duty and vice versa. Also, it is also stressful when you have to finish cleaning the holds even if it is the time to rest. You must continue until it is finished. You are not going to rest until your work is finished*. Cadet 11 said, *my most stressful moment that happened on me was when our vessel is on a dry-dock. The first day we entered the floating dock was the most stressful of all. Everyone on shore will come onboard and start to work while they, the crews, have so many tasks to do. After you have finished with one, there's another one waiting. The pressure of shore personnel as well as the officers was there. It's like you've been stricken by a whirlwind with so many things to do and you don't know which one should go first. But three to four days later, it was all in calm. Another one is the paperwork onboard ship most especially when you're running out of time and need to submit it immediately. It is normal for us cadets to do some paperwork as a part of our training*. Cadet 12 said, *my stressful moments are those times we are cleaning cargo holds, since we have always short voyages from one port to another, therefore we are always making overtimes. We worked late until 11 PM to 12 midnight and woke up at about 5 AM the next morning to continue the work. It's quite hard but thanks to my officer, they gave a rest day after that hard labor*.

Some activities outside the ship also cause stress to deck cadets. Cadet 1 said, *my stressful moment was during the Port State Control Inspection. This happens at least once every six months. Most difficult one took place in Gibraltar, where Port Authorities embarked our ship and inspected*

the ship itself, the crew and the legal documents. I was tasked to stay beside our Third Officer and observed what he's doing during the inspection of lifeboats and other life-saving equipment. I felt the pressure when their officers were rectifying our deficiencies because the ship cannot sail if there were no corrections applied. That was very stressful but I learned a lot.

Some stress was also caused by some problems on land. Cadet 11 said, *additional to my stressful moment is when I heard news that super typhoon Yolanda struck our region. I was extremely worried that time that I could not sleep thinking if my family is okay since I couldn't contact any of them. I was awake all the time. But thanks after several days, they texted me that they were fine (we used Globe wireless sim onboard -25 cents per text)*.

Their profession may have offered a lot of challenging tasks, not mentioning the paper works they have to comply with. But it's all worth it after surviving those stuffs of stressful errands.

3.7. Disgusting Moments Onboard

Ships are not just mainly centered on transporting goods. Several business transactions happen inside it. Deck cadets tend to overlook the message behind the seafaring profession. And they sometimes end up disgusted.

One of the reasons that deck cadets felt disgusted is the environment found on ships. Cadet 1 said, *I felt disgusted in the way the Port Authorities of some countries deal with the important matters of the ship and the port. They tend to be very stringent in checking our documents and informing us about our deficiencies which, technically, were negligible. Each deficiency has a corresponding penalty which requires the company to pay which was a big headache for the ship's master. To avoid high amount of mulct, Port Authorities will simply visit our Bonded Store and get what they wanted in bulk as reams of cigarettes, cartons of wine and spirits, and even our food from the kitchen. Our goods could erase the ship's deficiencies*.

Some felt disgusted on their own actions. Cadet 1 said, *I was disgusted about my own carelessness. Sometimes, I go to work without observing safety. There was a time that I walked on the main deck and slipped badly because I wore rubber slippers instead of safety shoes. And the worse that had happened to me was the time when we were paint washing the aft deck. I was singing while washing the mooring winch when an AB called my attention. When I looked back, my head was hit wretchedly by the winch break. Blood shed from the wound on my head and I was rushed to the ship's hospital. I was not allowed to work for two days.*

Another reason that deck cadets felt disgusted is because of the attitude of their fellow crew onboard. Cadet 2 said, *I was disgusted when one of the officers taught me about solving sunrise and sunset. I noticed that there was something wrong on what he was teaching me, so I asked questions*

regarding those things. I even told him that there was something wrong but he insisted and told me that I was the one who was wrong and maybe the things I have learned in school were wrong. I was really disgusted but I just kept my mouth shut and I asked the other officers. And they said that what the other officers taught me was really wrong. They also said that I shouldn't mind it anymore because it may cause trouble if I would still insist my case. Cadet 5 said, *disgust can be within you, but most of the time, disgust can be because of other people's stupidity and incompetence, stupidity in a sense that you know better than some people but continue to be humble, yet they would always try to insult you. When you know better, you should accept these stupidities and carry on the things you know was right. Remember that people with higher IQ and EQ tend to hide their superiority to others. Incompetence in a sense that because they are unsatisfied with their lives, they tend to resort to foul and sly methods because they only want to put you down. They tend to harbor happiness through the sufferings of others. People like these tend to fight unfairly, thus, they're incompetent. Never contend with idiocy because idiocy will only drag you down to the lowest level of life.* Cadet 6 said, *disgusting moment was similar with my angry moment, it is when my Chief Cook scolded me knowing that he's drunk. I can't let out my emotions because I was afraid of him. I was three months onboard that time that's why I don't have an idea on how to fight for your right as a cadet. All I have done was just listen to his trash talks*. Cadet 12 said, *my disgusting moments are those times when my reliever on port watch did not went back on time when I shore leaved that made me stand as gangway watch for eight hours or even longer because I was not the type who always gone shore leaves. For me, once or twice is okay but when done many times, I felt disgusted so sometimes that I intentionally shore leaved to avoid that situation.*

Too much pressure because of work also causes disgust. Cadet 4 said, *my disgusting moment was when I joined in daywork together with the Able Bodied Seaman and Ordinary Seaman, our head was the Boatswain. We follow what the Boatswain wants us to do. The work was given by the Chief Officer. As a daywork, our working time is 0800H-1200H and 1300H-1700H.There is one day that the Chief Officer gave a hard job order for us. We started immediately doing the job. We worked until 1700H, we can't finish the job but the Boatswain wants to finish it just to impress the Chief Officer. It was very tiring, we worked two hours of overtime without pay. But it was not about money, all we think is that the job order can be finished the next day. I was thinking what my first Boatswain said, "work is not yet finished, we have to finish the contract." In the end of the work, we were all complaining just in our minds.*

Disgusting moments sometimes arise from the facilities of the ship itself. Cadet 8 said, *my disgusting moment was when the storage of our frozen foods was destroyed and we don't have food for more than a month. But we survived it*. Cadet 9 said, *my disgusting moment is when the pipeline for food waste in the galley clogged. It was not a very interesting smell and it lessens your appetite*

every time you eat. Good thing that the engineers have fixed it. Cadet 10 said, *disgusting moment for me is when you have to clean a dirty bilge with so many dirt stuffs like mud and sometimes human feces. And also when you have to compact the garbage and dispose the food wastes*.

After those sickening experiences onboard, deck cadets have never turned their backs on their career as what most of them said. They are seafarers and they accept whatever things come behind it.

3.8. Other Moments Onboard

After narrating their different types of experiences onboard, deck cadets have been given a special part to tell their special moments onboard.

Cadet 1 said, *my unforgettable experience was when our vessel was dry docking at Port of Cadiz, Spain for three weeks. I was so blessed because I was onboard during the major repairs of our vessel considering that not all cadets were given the chance to witness this moment. Together with the Captain, Chief Officer, Surveyor, Ship's Superintendent and port Authorities, we entered all of the void and enclosed spaces such as Ballast Tanks, Fuel Tanks, Freshwater Tanks, Chain Lockers, and others after eight to ten hours of work, we pampered themselves by having a tour in the city, dine in to their restaurants, and chill on the beach with a bottle of drink. These memories are surely worth keeping*. Cadet 4 said *my unforgettable experience in my 11 months onboard is having a good time in Indonesia. I love Indonesia*.

For some deck cadets, they have an unexplainable feeling during their cadetship. Cadet 8 said, *the feeling when you don't know what you feel when you're going home. You can't even sleep thinking about it*.

4. Implications

This study simply implies that a deck cadet must enjoy every moment of work onboard the ship. This is also to ensure his survival while he is with his crew mate for a year. Furthermore, a deck cadet should have to have good values and hard work in order to perform work onboard and survive at the same time.

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IAMUS AGA 17: The Vessel Recycling and the Ship Cemeteries of Southeast Asia

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- **Abstract**

Annually, more than a thousand ships are declared as worthless and recycled to be sold as scrap metal. About the 80% of those ships are sent to highly deficient scrap yards, located mainly on the coast of Bangladesh, India, Pakistan, and Turkey. Around forty years ago, ship dismantling took place in Europe, but the hardening of safety, quality, and environmental standards made the recycling process more expensive. Hence, vessel operators, with the objective of reducing costs, moved the process to underdeveloped areas by taking advantage of the lack of prioritization of human rights.

In those places, facilities are not properly equipped with the safety devices that are needed for the correct developing of the ship's recycling process, which results in scaring death taxes and continual marine and environmental pollution.

Everything previously mentioned raises a lot of legal issues that need immediate solutions. To achieve that, many institutions like the International Maritime Organization implemented several regulations. And although the United Nations designed the Basel Convention, the Hong Kong Convention and other agreements, it hasn't been enough.

Therefore, the project's goals are to evaluate all the legal regulations implemented by Maritime Institutions, study the economical interests of multinational companies, and release a viability study of a new fiscal program that regulates the auction process of the ships, and that incentivizes sustainable scrapping methods.

After all, we summarize the mainly project's goals in explanation of the highly deficient situation in the scrapping yards of Southeast Asia, in the analyzation of the current regulation implemented by maritime organizations, in the definition of a safety and sustainable process to dismantle a ship and finally, to make a proposal of a new fiscal program that regulates the auction process.
To achieve it, the project is divided in four parts:

1. Ship Cemeteries of Southeast Asia.
2. Ship Recycling Regulations.
3. Ship Sustainable Recycling Procedure.
4. Draft Law of Ship's Auction Process

• Ship Cemeteries of Southeast Asia

Nowadays, the current model refers to ship dismantling is unsustainable. According to data from the European Commission, about 1000 ships are destined to recycling every year and more than 70% are sent to countries in South Asia. Overall, a volume that can reach 1.3 million tons of toxic substances dumped in India, Bangladesh or Pakistan, a surprising volume if we consider that it's a completely illegal procedure.
At the beginning of the eighties, coinciding with the hardening of environmental regulations, China becomes one of the best useless ship buyer, to recycle them. Besides, it is known that China accumulates almost half of the world's steel, about 1.140 million tons. This number is much higher than self demand, fact that makes the country the biggest producer and exporter of the world, with more than 400 million tons every year. By applying the ISO 14001 Environmental Management and OHSAS 18001 standards for occupational health and safety management to certify its facilities and procedures, China's market share is reduced by up to 3.7%.
In the middle 1990s, India, Pakistan and Bangladesh jointly controlled 87% of the market, and today almost all of the activity is carried out by these countries. These countries have a cheap labor and a market that reuses almost 100% of the materials recovered in the scrap yards. Due to proximity to China, these countries become essential for a cheap dismantling. There are 3 shipyards with very precarious facilities that have very high accident rates.

GADANI – PAKISTAN: It is the third largest scrapping in the world, with a front beach of 10 km, and about 107 ships recycled per year.

CHITTAGONG – BANGLADESH: With almost 20 km. of front beach, this shipyard has more than 200,000 people working. On average, a worker dies every day.

ALANG – INDIA: Is the largest shipyard in the world, recycling nearly 50% of ships every year. The Knock Nevis (Seawise Giant), the world's biggest vessel ever built, was dismantled there.

- **Ship Recycling Regulations**

First of all, we must know the route made by a ship since it is declared as useless until it is recycled. The owner of the vessel usually contacts a broker who through speculation tries to get the most benefit from the ship. To emphasize that between 80 and 95% of the light weight tonnage of the vessels is steel, the price of this in the Asian market is fundamental for speculation. In many cases the price per ton of non-recycled steel in Asia can double the price it has in Europe.

Derived from the human and environmental problems of the irregular recycling process, several institutions have taken steps to eradicate the problem. After the analysis, it is observed that, to date, these regulations are not enough. We can highlight the following:

Basel Convention by United Nations: Is an international treaty that was designed to reduce the movements of hazardous waste between nations, specifically between developed areas to less developed countries, and also tries to minimize the toxicity of waste generated. It was signed on 22th March of 1992 and it became effective on 5th May 1992.

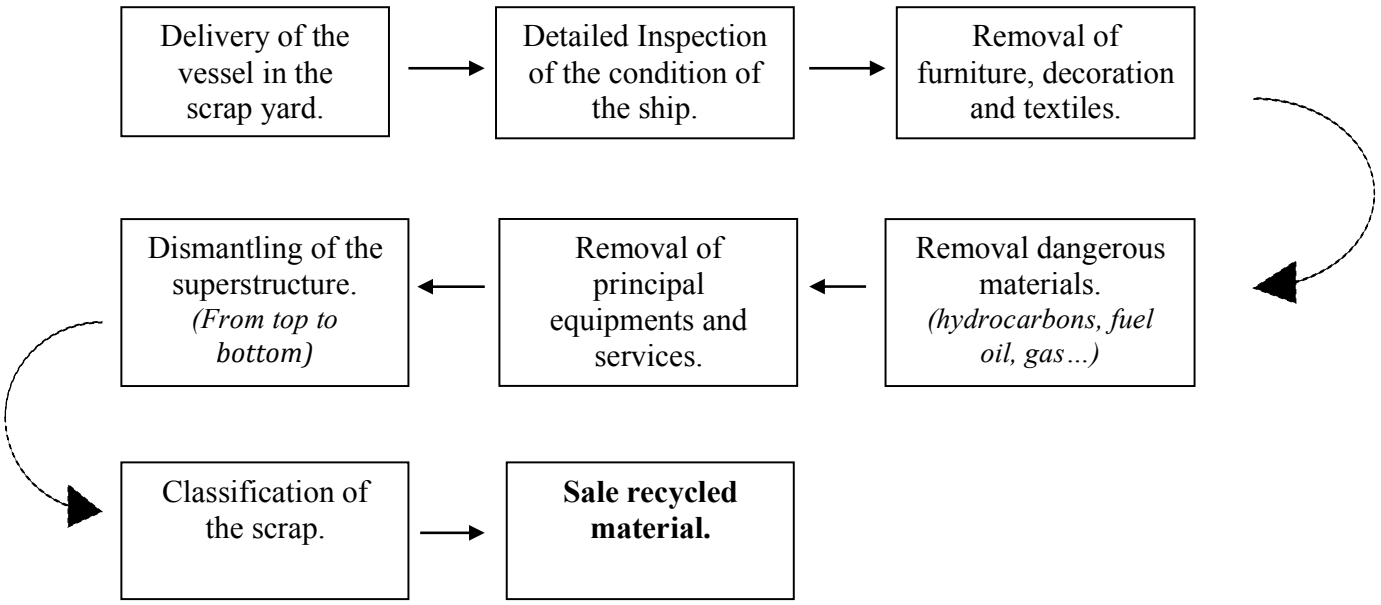
Hong Kong Convention by International Maritime Organization: This international treaty was adopted at diplomatic conference held in Hong Kong (China), on May 2009, which was attended by delegates from 63 countries. The convention intends to address all the issues around ship recycling, including marine pollution and it also concerns raised about the working conditions at many of the world's ship recycling locations.

Proposal for a Regulation by European Commission: The objective of the Regulation is to reduce the negative impacts linked to the recycling of ships. The regulation also includes additional safety and environmental requirements. It also includes "European list of ship recycling facilities" and "Hazardous Materials List".

Ship Recycling Regulations: Safety and health guidelines for ship recycling in Turkey and South Asia by International Labor Organization: It is a compilation of guidelines o prevent several accidents and death in the scrap yards of Turkey and South Asia. In a conference celebrated in Bangkok (Thailand), on October 2013, assist many specialist of naval science to discuss all the issues around ship recycling workers. In the present guidelines are included articles from (ILO-OSH 2001) with the idea of being a practical guide for those countries.

- **Ship Sustainable Recycling Procedure.**

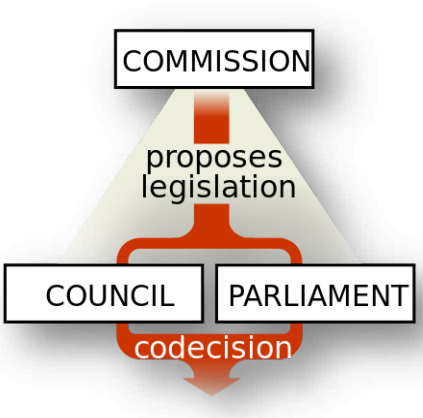
Based on all the regulations mentioned in the previous section, a sustainable recycling process is defined below. The specific order that has been established must be followed for a preservation of safety and reduce the marine pollution.



In addition to following the order of the procedure, workers must be dressed with safety clothes, to achieve maximum prevention of accidents. It must be necessary to wear helmet, glasses (inactive glasses in case of welders), safety gloves, security boots, mask and special suit that protect the worker from toxic and corrosive substances.

- **Draft Law of Ship's Auction Process**

First of all, before the implementation of the proposal law raised on this final project, it is very important to know the European Union legislative procedure. The European Union adopts legislation through many different legislative procedures, this procedure it directly depends on the policy area in question.



For the projects it is chosen the most common process. The ordinary legislative procedure is the main legislative procedure by which directives and regulations are adopted, it is also known “codecision procedure”.

Article 294 TFEU[1] outlines ordinary legislative procedure in the following manner. *(Image left)*

(1) Treaty on the Functioning of the European Union (2007), is one of the two primary treaties of the European Union.

The proposal of the "Regulation of Ship Auction Procedure (2017)" it is inspired on the mainly articles of Economic Regulations from European Commission and some other articles from the Hong Kong Convention (IMO). This Regulation it is based in 3 fundamental applications.

1. **Fiscal Advantages:** It would be encourage safety ship scrapping by means of tax advantages for ship owners and brokers. That measure it would incentivize the constant improving of the facilities of the scrap yards.
2. **State Control for Speculators:** Just as through the MoU[(2)], it has been agreed to use the Port State Control for the regulation of substandard ships, this law will implement a control system to avoid fraudulent transactions and speculation.
3. **Economic Aid:** This bill, wants to encourage economic aid to those shipyards that commit to work with guarantees, for workers and the environment. That measure it would incentivize the constant improving of the facilities of the scrap yards, too.

These are the three most important parts of the bill, but it also has other parts as mechanisms to regulate the market price of steel and thus avoid the speculation of China, among others.
Once the bill is drafted, it can be submitted to the EU through a state agency, and then the Commission submits a legislative proposal to the Parliament and Council. At the first reading Parliament adopts its own positions and If Council approves the Parliament position then the act is adopted. For make it simple, and not being involved in a huge legislative procedure it is supposed that Parliament and Council approves the "Regulation of Ship Auction Procedure (2017)" at the first reading.

(2) Memorandum of Understanding (MoU) is an agreement between two (bilateral) or more (multilateral) parties. It expresses a convergence of will between the parties, indicating an intended common line of action.

- **Conclusions**

Due to all studied in this final project, it's seems obvious that the situation is quite dramatic, and completely unsustainable. Nowadays the developed areas tend to act without caring anything but economic benefit. It is important to solve the human and environmental issues linked to irregular vessel recycling.

Despite current regulations the situations is not improving. On the contrary, a number of years ago there has been a growth in the number of recycled ships in Southeast Asia. The conditions of the workers are getting worse, and every day dozens of people die because they are not well prepared. One of the reasons why the current regulations do not work is because Europe do not have the jurisdiction to trade issues in Asia. With my proposal, what I try to do is to regulate the bad practices taken by companies in developed areas that have a direct impact in those countries.

In some cases, such regulations can stifle the scrapping of ships in South East Asia, because ship owners would have advantages in recycle ships in safe ship yards, which are mainly located often in Europe and United States.

But in the other hand, it can be the necessary incentive for all the scrap yards that are working under the standard levels, to improve their facilities, becoming competitive and safe places for workers and the environment.

To conclude, I would say that as a personal opinion, I think it is very important that everyone in the maritime world becomes aware of the dramatic situation in South East Asia, in order to make a better place for everyone.

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New Technologies in Navigation
(the use of wind force)

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Summary: The course of the vessel in relation with the wind is an angle between the direction of the wind and the midship line of the vessel. One of the most widespread use of the wing is its application in the wind-driven ship. But these ships are not so fast. But there also is an alternative way to use wind for ship movement despite wind speed and stream force – the application of Magnus Effect, which is the result of mutual impact of the physic phenomenon, such as Bernoulli effect and creation of border layer around streamlined object. Using this effect, the first rotor vessel was created. In 1980s more complicated form of turbo sail was developed by French engineers under supervision of oenologist Jacques Yves Cousteau. In comparison with the best of the usual sails, the turbo sail provided 3,5-4 larger propulsive coefficient. It was supposed to install turbo sails to the tankers, bulkers and the large ships to decrease fuel consumption rate. Nowadays there are attempts to put rotor sails into mass usage. The rotor sails give possibility to save 30-40% of fuel at 16 knots speed. The experience of German shipbuilders will show if it is useful to develop the sails, working in application of Magnus effect. We hope, that in future the world navigation will apply the principle, described by the talented German scientist more than 150 years ago.

Key words. Magnus Effect, Bernoulli effect, rotor vessel, comfortable navigation.

We want to touch on the topic of maritime navigation and express our opinion about its nearest future, whose roots lie in the 20-s of the last century. In general, all types of sailing vessels are quite similar, almost all of them have at least one mast for sail maintenance, rigging and Kiel. In modern ships of this type, the sailing structure is folded by means of electric motors - freeing a person from physical work, and new lighter and more durable synthetic materials make it possible to significantly simplify the design. Based on the previous effect, we created a complete operational prototype. This shows the efficiency and practicality of the application of the Magnus Effect.

The Magnus Effect

An alternative way of using the wind for the movement of a ship, regardless of its speed and flow strength, is realized with the help of the Magnus Effect, a physical phenomenon discovered in 1853 by Henry Magnus. The essence of the Magnus Effect is as follows: Imagine a ball or a cylinder that rotates in a gas or liquid flow around them. In this case, the cylindrical body must rotate along its longitudinal axis. During this process, a force appears, the vector of which is perpendicular to the direction of flow. On the side of the body where the direction of rotation and the flow vector coincide, the velocity of the air or liquid medium rises, and the pressure, according to Bernoulli's law, decreases. On the opposite side of the body, where the rotation and flow vectors are multidirectional, the velocity of the medium's motion decreases, as it were, and the pressure increases. The pressure difference arising on opposite sides of the rotating body generates a transverse force. So, The Magnus effect is the result of the combined effect of such physical phenomena as: 1) the Bernoulli Effect; and 2) the formation of a boundary layer in the medium around the streamlined object. Let us explain the latter: the air that touches the surface of the cylinder forms on it a so-called boundary layer in which the closer to the surface, the less its velocity relative to this surface. On the very surface, the air is relatively immobile; it seems to stick to it. As the cylinder rotates, the "adhered" to it the boundary layer rushes towards the external flow, breaks away from the surface of the cylinder, and pressure appears directed perpendicular to the flow washing the cylinder. The same force arises both on the sail and on the wing of the aircraft. But the cylinder is about 10 times larger. Therefore, rotating cylinders (rotors) were used by the German engineer Fllettner instead of the sails of the vessel "Bukau".

Fluttner's rotating sails

The described physical phenomenon was used by the German engineer Anton Flettner when creating a new type of marine engine. Flettner installed a paper cylinder rotor about a

meter in diameter and 15 cm in diameter on a meter test boat. To adjust it, he adjusted the clockwork and the boat swam. Proving in practice the possibility of using the lateral force resulting from the Magnus effect, Fllettner decided to convert the Bukau three-mast into a rotary ship. In 1922, the inventor received a patent for his device and in 1924 the first ever rotary ship. Its rotor sail looked like a rotating cylindrical wind power tower. On top of the rotor-cylinders, Fllettner placed flat plates for better orientation of the air flows around the cylinder. This allowed to double the driving force. Due to the mentioned "Magnus Effect" the resultant force moved the vessel. This force is approximately 50 times higher than the force of wind pressure on the fixed rotor!

Flettner's turbo-parachute tests proved to be excellent. Unlike a conventional sailboat, a strong lateral wind only improved the running qualities of the experimental vessel. Two cylindrical rotors (with a height of 15.6 m and a diameter of 2.8 m) made it possible to better balance the vessel. At the same time, changing the direction of rotation of the rotors, it was possible to change the movement of the vessel forward or backward. Unlike a conventional sailing ship, a rotary ship was practically not afraid of bad weather and strong side winds, it proved to be more stable than a sailboat that the Bukau was before perestroika. The tests were conducted in a calm, storm, and deliberate overload - and there were no serious shortcomings. Of course, the most profitable direction of the wind for creating thrust was a strictly perpendicular direction to the longitudinal axis of the vessel. Unfortunately, the ships with the rotor Flettner depended on the whims of the wind and were forced out by motor ships.

Turbo-coupler from Cousteau

The idea of a fundamentally new system that uses wind power to create the thrust of the vessel was picked up by the French explorer and inventor Jacques-Yves Cousteau. In the early 1980-s, he began work on the creation of such propulsors for a modern vessel. As a basis, he took the turbo-parachute Flettner, but significantly upgraded the system, making it more complicated, but at the same time increasing its efficiency. Construction Cousteau is a vertically installed hollow metal pipe, which has an aerodynamic profile and acts on the same principle as the wing of the aircraft. In the cross section, the pipe had a drop-shaped or ovoid shape. On each side there are air intake grilles through which air is pumped through the pump system. And then the Magnus effect comes into play. Twists of air create a difference in pressure inside and outside the sail.

For the first time, Cousteau tested the prototype of his turboparas in 1981 on the catamaran "Windmill" (Moulin à Vent) during a voyage across the Atlantic Ocean. During the trip, the

catamaran was accompanied by a larger expedition ship for safety. Experimental turbo-steam produced traction, but less than traditional sails and motors. In addition, by the end of the journey, welding seams due to fatigue of the metal burst under the pressure of the wind, and the design fell into the water. Nevertheless, the idea itself was confirmed, and Cousteau and his colleagues focused on the development of a larger rotary vessel - "Allion". It was launched in 1985 on December 23, 1986, already after the "ALSION" mentioned at the beginning of the article was launched. Cousteau and his colleagues received joint patent No.US4630997. In comparison with the best of conventional sails, turboparas provided a 3.5-4 times higher traction factor. The turbo-steam is capable of saving up to 35% of the fuel. Even 20 years after the death of his creator, "Alcyone" is still on the run and remains the flagship of the flotilla of Cousteau.

Conclusions and prospects

Nowadays there are two types of propellers of the Turboparus system. The usual rotary sail, invented by Flettner at the beginning of the 20-th century, and its modernized version from Jacques-Yves Cousteau. In the first model, the resultant force arises outside the rotating cylinders; in a second, more sophisticated version, electric pumps create a difference in air pressure within the hollow tube. The first turbo-steam is able to give a course to the ship only in the side wind. It is for this reason that Flettner's turbo-parachute has not become widespread in the world shipbuilding industry. The structural feature of the turbo-steam from Cousteau makes it possible to obtain a driving force regardless of the direction of the wind. Equipped with such engines, the vessel can swim even against the wind, which is an indisputable advantage both over conventional sails and over rotary ones.

At present, many attempts are being made to realize the idea of Fllettner. There are a number of amateur projects. There are a number of amateur projects. For example, the famous Hamburg company Blohm + Voss after the 1973 oil crisis began active development of a rotary tanker, but by the 1986, economic factors covered this project. Then there was a whole series of amateur designs. In 2007, students at Flensburg University built a catamaran driven by a rotary sail (Uni-cat Flensburg).

The turboparic can be installed on tankers, bulkers and other heavy vessels to reduce fuel consumption. Turboparus is equipped with automatic sensors and mounted on a turntable, which is controlled by a computer. Computers coordinated the work of turbo-parachutes and diesel engines, launching the latter, when the wind completely subsided and stopping them at a sufficient wind speed. The smart machine has a rotor that takes into account the wind and sets the air pressure in the system. Only 5 people were enough to operate the ship.

It seems that the rising prices for oil and the alarming warming of the climate create favorable conditions for the return of windmills. Today, attempts are being made to revive the idea of Flettner and make rotary sails mass. Many companies began active development of a rotary tanker. In 2010, the third in the history ship with rotary sails appeared - a heavy truck "E-ship 1", which was built by the order of Enercon, one of the largest producers of wind turbines in the world. The vessel is equipped with four Flettner rotors, and of course, a conventional power unit in the case of windlessness and for obtaining additional power.

Located in Singapore, the ship-based company "Wind Again", which deals with the creation of technologies to reduce fuel consumption and emissions, proposes the installation of special Flettner rotors (folding) on tankers and cargo ships. They will reduce fuel consumption by 30-40% and pay off in 3-5 years. The company of marine engineering "Wartsila", operating in Finland, already plans to adapt the turbo-sails and on cruise ferries. This is due to the desire of the Finnish ferry operator "Viking Line" to reduce fuel consumption and environmental pollution. The use of Flettner rotors on pleasure boats is studied by the University of Flensburg (Germany).

In March 2017, Royal Dutch Shell and Maersk announced plans to equip a 245-meter-long oil tanker with deadweight of almost 110,000 tons, sails 30 meters high and 5 meters in diameter, and will be constructed of lightweight composite materials and carbon fiber. It is assumed that the sails will be installed in the first half of 2018 and tested before the end of 2019. According to the Company's representatives, this technology will save on average up to 10% of fuel on standard routes.

Our main purpose was to study this Effect and execute it practically. We created mini sample of the vessel working on the wind force. We used two turbo sails, in the first case it was identical of Cousteau’s model, and in the second case it was the mobile rotor constructed by us.

I suppose that besides getting sufficient knowledge and experience I will make a little contribution in the procedure of using wind energy.

Conclusion

In conclusion, we can confidently assume that the introduction of turbo-parachutes has the following prospects:

- Use free and renewable wind energy on ships;
- Save fuel, i.e. money;

- It is possible on the principle of the Magnus Effect to improve the efficiency of coefficient of performance;
- Turbo sails will provide more effective control of the vessel, excluding the problems associated with the weather, i.e. It's a comfortable navigation!
- New workplaces appear, which requires training of new specialists;
- For the training of specialists - it is necessary to introduce new educational programs in higher educational institutions, which will attract more entrants to the Maritime Training Institutions;
- The need for new teachers!
- As a result, you can solve the problems associated with the ecology of the seas and oceans, which in turn has the global significance for all mankind!

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Cyber Security the Unknown Threat At Sea

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Figure (1) represents cyber security.

ABSTRACT:

Merchant vessels are becoming larger and are using more electronic systems than ever before. Currently, computer systems are being used in ships for many purposes such as navigation, rapid unloading of cargo, and handling and tracking of goods at ports. Unfortunately, these computer systems are highly vulnerable to cyber threats.

The paper presents the need to invest time, effort and capital into security measures to ensure that these cyber risks are appropriately managed in the maritime industry.

When discussing maritime safety, the term human element or human factor plays a crucial role. There is no established international definition of the term, but according to IMO (2004a), it is defined as a "complex issue affecting marine safety and security".

- 100% of IT Departments Provide No On-board Awareness or Training Programmes for Crew.
- 91% of Ship Security Officers Believe Training & Education is Required to Manage Cyber Risk
- 80% of Reported Information Security and Cyber Incidents at Sea Related to Human Error.

New Challenges & Opportunities:

- Distinct Lack of Awareness & Training, Lack of Cyber Crime Reporting, Marine Operations Immersed in the Digital Era, More Automation on the Horizon.
- Human Factor Attributable to Most Safety Incidents On-board.
- Greater awareness is needed in the industry.
- Cyber-crime is constantly developing and there is a need to keep up with it.

Technology is only as good as the end user, we can have all the best equipment but without trained and skilled end user, it is useless.

Recommendations for preventing and mitigating risk of cyber-crimes on the maritime industries are as follows:

- Educate seafarers about IT and information security alternatively, we should have a "STCW COURSE included for cyber-crime security" both on basic and advanced levels.
- A cyber-risk assessment can be conducted at frequent intervals by a qualified expert in order to thoroughly review security protocols

Keywords: Cyber-crime, Cyber risk assessment, S T C W courses, Piracy, Cyber feed, Human error.

1. Introduction

This presentation introduces the need of cyber security, the majority of vessels are extremely high-tech, and as time passes more and more depend on satellite communication and electronic control system, and by integrated bridge system. While these electronic systems have enormous benefits, it means that vessels are open to another form of attack, from persons hacking into the system of the vessel and introducing bugs, viruses and false data.
Cyber-attacks are a more feasible, low cost and risk-free option for terrorist action. While initial consideration of cyber-attack has been directed at port infrastructure, there have been reports of merchant ships having incorrect global system positioning systems (GPS) readings with suggestion that ship's equipment can be tampered remotely.

Figure (2) Represents securing digital information

The challenge for ship owners is even more complex because cyber criminals are targeting diverse facets of the shipping industry. For example, there was a well-documented case of drug smugglers subverting an IT system at a major port in order to facilitate the smuggling of contraband in containers.
The rise of targeted piracy and drug smuggling reflects how criminal organizations have become more sophisticated. They will seek detailed intelligence on potential targets and will use modern technology to source information and data to assist in their planning and execution of criminal ventures. Drug traffickers, drug and people smugglers, pirates and fraudsters of all stripes are taking every opportunity to gain information that they can turn to their advantage.
Cyber security threats today are increasing in variety, frequency and sophistication — be it from a Trojan USB stick that introduces malware aimed at acquiring sensitive commercial information, an email with detailed vessel itineraries sent to a large group of unknown people, the full-scale subverting of a company's IT system or the potential compromising of Automatic Identification System (AIS) and Electronic Chart Display and Information System (ECDIS) systems on board ships. The number of potential risk scenarios is significant and keeps growing.

Types of cyber-attack

In general, there are two categories of cyber-attacks which may affect companies and ships:

- **Untargeted attacks**, where a company or a ship's systems and data are one of many potential targets; or
- **Targeted attacks**, where a company or a ship's systems and data are the intended target. Untargeted attacks are likely to use tools and techniques available on the internet which can be used to locate known vulnerabilities in a company and on-board a ship.
-

Examples of some tools and techniques that may be used in these circumstances include:

- **Social engineering**. A non-technical technique used by potential cyber attackers to manipulate insider individuals into breaking security procedures, normally, but not exclusively, through interaction via social media.
- **Phishing**. Sending emails to a large number of potential targets asking for particular pieces of sensitive or confidential information. Such an email may also request that an individual visits a fake website using a hyperlink included in the email.
- **Water holing**. Establishing a fake website or compromising a genuine website in order to exploit visitors.
- **Ransomware**. Malware which encrypts data on systems until such time as the distributor decrypts the information.
- **Scanning**. Attacking large portions of the internet at random. Targeted attacks may be more sophisticated and use tools and techniques specifically created for targeting a particular company or ship. Examples of tools and techniques which may be used in these circumstances include:
- **Spear-phishing**. Similar to phishing but the individuals are targetted with personal emails, often containing malicious software or links that automatically download malicious software.

Stages of a cyber-attack :

Cyber-attacks are conducted in stages. The length of time taken to prepare a cyber-attack will be determined by the motivations and objectives of the attacker, and the resilience of technical and procedural cyber security controls implemented by the company, including those on-board its ships. The four stages of an attack are:

 Survey/Reconnaissance. Open/public sources used to gain information about a company, ship or seafarer which can be used to prepare for a cyber-attack. Social media, technical forums and hidden properties in websites, documents and publications may be used to identify technical, procedural and physical vulnerabilities. The use of open/public sources may be complemented by monitoring the actual data flowing into and from a company or a ship.

 Delivery. Attackers may attempt to access company and ship systems and data. This may be done from either within the company or ship or remotely through connectivity with the internet. Examples of methods used to obtain access include:

- Company online services, including cargo or consignment tracking systems;
- Sending emails containing malicious files or links to malicious websites to seafarers;
- Providing infected removable media, for example as part of a software update to an on-board system; and
- Creating false or misleading websites which encourage the disclosure of user account information by seafarers.

 Breach. The extent to which an attacker can breach a company or ship system will depend on the significance of the vulnerability found by an attacker and the method chosen to deliver an attack. It should be noted that a breach might not result in any obvious changes to the status of the equipment. Depending on the significance of the breach, an attacker may be able to:

- Make changes that affect the system's operation, for example interrupting the display of chart information on ECDIS;
- Gain access to commercially sensitive data such as cargo manifests and/or crew and passenger lists; and/or
- Achieve full control of a system, for example a machinery management system.

 Affect. The motivation and objectives of the attacker will determine what affect they have on the company or ship system and data. An attacker may explore systems, expand access and/or ensure that they are able to return to the system in order to:

- Access commercially sensitive or confidential data about cargo, crew and passengers to which they would otherwise not have access;
- Manipulate crew or passenger lists, or cargo manifests. This may be used to allow the fraudulent transport of illegal cargo; and
- Disrupt normal operation of the company and ship systems, for example by deleting critical pre-arrival information or overloading company systems. It is crucial that users of IT systems on-board ships are aware of the potential cyber security risks, and are trained to identify and mitigate such risks.

Figure (3) represents pirate attack.

Figure (4) represents Intrusion Alert.

Target systems, equipment and technologies :

This provides a summary of potentially vulnerable systems and data on-board ships to assist companies with assessing their cyber risk exposure. Vulnerable systems, equipment and technologies may include:

- **Communication systems** Satellite communication equipment; Voice Over Internet Protocols (VOIP) equipment; Wireless networks (WLANs); and Public address and general alarm systems.
- **Bridge systems** Positioning systems (GPS, etc.); Electronic Chart Display Information System (ECDIS); Dynamic Positioning (DP) systems; Systems that interface with electronic navigation systems and propulsion/manoeuvring systems; Automatic Identification System (AIS); Global Maritime Distress and Safety System (GMDSS); Radar equipment; Voyage Data Recorders (VDRs); and Other monitoring and data collection systems.
- **Access control systems** Surveillance systems such as CCTV network; Bridge Navigational Watch Alarm System (BNWAS); Shipboard Security Alarm Systems (SSAS); and Electronic "personnel-on-board" systems.
- **Cargo management systems** Cargo Control Room (CCR) and its equipment; Level Indication System; Valve Remote Control System; Water Ingress Alarm System; Ballast Water Systems; and Gas liquefaction.

CONCLUSION

Prevention is better than cure.

- Assess your existing processes and procedures - what information/assets need to be protected, what are the potential risks, how can you improve your cyber security.
- Allocate the risk posed by cyber events in your contracts appropriately.
- Regularly update your anti-virus software, firewalls and other software and ensure your security policies respond to new threats and developments.
- Carry out due diligence of the risks posed by cyber events - review your supply chain to see who is the weakest link. It is a truism that hackers target the weakest link to infiltrate an organisation. That link can exist through the supply chain. How do you know that your supply chain has the same standard of cyber hygiene and resilience as your own entity. It can be embarrassing to ask, however, it can be more embarrassing not to ask.
- Set up a strategy to respond to a cyber-event – who should be involved, what are the priorities following a cyber-event, how regularly is this strategy reviewed.

Whether large or small, specialist or global player, everyone in the shipping industry will benefit from a greater awareness and preparedness to deal with the challenges of modern IT-assisted fraud in the 21 century.

Figure (5) represents discussion on how to control cyber threats.

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VISIBLE LIGHT COMMUNICATION IN MARITIME INDUSTRY

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Abstract. The main goal of this paper is to present Visible Light Communication (VLC) technology and highlight the benefits of its implementation in ships and other maritime structures such as offshore platforms and docks. This could be the solution to the problem of many disadvantages which are present in today's communication technologies. The VLC technology refers to communication technology which utilizes Light Emitting Diodes (LED) as a transmitter of visible light through the air as a transmission media and a photodiode as a signal receiver. Since communications took a huge role in our daily lives, people should give a better understanding of it and should work on its improvement. Transferring data from one point to another became a very common routine. Most of the communications are radio wave based. The number of communications is rapidly increasing, which results in an overcrowded radio spectrum. Therefore, Visible Light Communication technology is becoming an alternative solution for wireless technology. Compared to a standard wireless communication, VLC technology has several advantages. There are many reasons and advantages for its use. The most important one is reducing the electromagnetic interference to other instruments or communication channels in specific environments where the technology is present, e.g. Hospitals, airplanes, ships etc. Also, it reduces the overloaded radio frequency spectrum. Furthermore, the advantage of this technology is the utilization of a lot of sources for broadcasting and transmission data when the certain area is illuminated. Data security is also a feature of this technology since the visible light cannot break through the walls. There is an unlimited range of developing different applications with this technology since the light is the safest source of energy and its frequency spectrum is free of charge.
Key words: Visible Light Communication, communication network, maritime, LED, photodiode

1. Introduction

This paper introduces the Visible Light Communication (VLC) as an alternative to many disadvantages in modern technology and communication industry and maritime industry as an aim

of this study. Nowadays, communications have a very important role. Today's communications are mostly radio wave based which means that a radio wave from the radio frequency (RF) specter is used to transmit a signal from one point to another. VLC presents an optic wireless communication technology that uses visible light frequency band (400nm to 700nm)[1], but physical components such as wires and cables also could be used for data transmission. The light created from the LED diodes is used to transmit the signals and photodiodes to receive them. There are several goals that should have been considered for the purpose of using this technology. The main goal of the use of the VLC is to reduce the overcrowded radio part of an electromagnetic specter as more communications are developing. This results in creating a communication technology with higher data rates compared to RF communication. VLC data rate can reach up to 500 Mbps. The VLC provides a high level of security since the visible light can not penetrate through the walls which make a specific room or building more secure. Compared to radio frequency (RF), Visible light communication (VLC) presents a powerful alternative mostly because of the electromagnetic interferences that RF produces on other devices. Implementation of VLC for indoor communication is more practical as people living in urban areas spend most of their time indoors. This implementation of VLC can add to the existing capacity of data communication with use of the same infrastructure which is already there. It can be used in areas where RF can be harmful; like a hospital, an areoplane and other electromagnetic sensitive areas. It is necessary to consider this technology very well since the LED has become very common in lighting because of its cost efficiency, long life service, safety and high resistance to vibrations. Moreover, the current maritime wireless communications at sea mainly rely on satellite links that are relatively slow than HF, VHF and expensive Inmarsat. Like on land, sea users need a high-speed, low-cost maritime wireless communication and special service. Therefore, new technology is needed to improve existing maritime communications.[2] The use of VLC technology could be a very attractive solution in the maritime industry for shore-to-ship, ship-to-ship communications eg. sea beacons or even in offshore platforms as a solution for indoor communications.

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2. Transmitter

LED (Light Emitting Diode) diode is an electronic component which converts electrical signals into optical and represents a suitable component in optical communication performances. A transmitter can be made in a shape of a lamp which is made of a number of LEDs. To achieve data transmission from the transmitter it is necessary for the control circuit to manage the current flow usually in a form of titration of the LEDs. These titrations are representing the binary states of zeros and ones (0 and 1) which the receiver recognizes and reads as an information. The LEDs, in this case, have a double role, to emit the necessary light which is the primary one and to transmit data to the receiver. It is important that the second role has not a negative influence on the first one. Therefore, the system of VLC depends on the quality of design of the LEDs. The most common color of the light which used to achieve the transmission is white which is achieved by using the RGB (Red- Green-Blue) diodes. Objects illuminated with white light have their most natural look. RGB diodes use a combination of three colors illuminated at the same time, red, green and blue. The product of a combination of these three is the white light. The use of RGB diodes in VLC can give a maximum data rates.

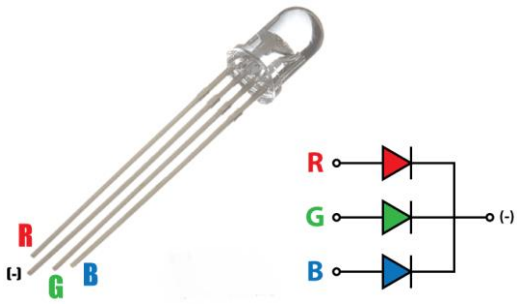

Fig 1. RGB diode

3. Receiver

A photodiode is usually used to receive the transmitted signal. The photodiode has an opposite role from the LED. Its role is to convert the electrical signal into the shape of light from the LED to the electrical signal which represents a useful information for the user. Different modulation techniques are used to single out the useful information from the transmitted electrical signal. The VLC is sensitive to interferences created from other light sources e.g. sunlight, therefore it is necessary for the receiver to implement an optical filter for the purpose of reducing the noise in the received signal. The photodiode is distinguished by low price with high reliability. The principle of

communication between the transmitter and the receiver is based on the titrations of the LED. The LED with it titrations gives the indication to the photodiode that the data transmission has started. The current which flows in the set after the detection of photodiodes as a change of light of the LEDs convert to the useful information.

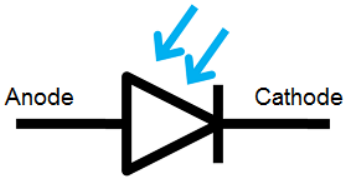

Fig 2. Photodiode

4. Applications of the VLC system

An important characteristic of the VLC is a large broadband which enables communications at high data rates. Also, it has no negative affects on human health such as harmful radiations and it is also characterized by its low power utilization which made this technology as a potential candidate in many applications. The one which it should pay attention to is called the Li-Fi (*Light Fidelity*). Li-Fi is an optical wireless communication system which is characterized by high data rates. It is similar to Wi-Fi (Wireless Fidelity) in which for communication radio waves are used. For this specific reason, Li-Fi presents a better solution in industries where interferences aren't acceptable (hospitals, airplanes, ships etc.). Wi-Fi with its radio frequency produces harmful interferences on other neighboring RF signals. Also, it is possible to reach data rates up to 10Gbps with the Li-Fi which is not possible in the case with the Wi-Fi.[3] With this application is possible to achieve a source of light which illuminates a specific room and at the same time acts as a source of data. This possibility reduces the "extra" power consumption since there is the same source for light and data while also, reduces a lot of cables. VLC can also find its place in hospitals, intelligent transport systems, aircraft, underwater communication etc.

[3] Latif Ullah Khan, "Visible light communication: applications, architecture, standardization and research challenges", pp.80, 2017.

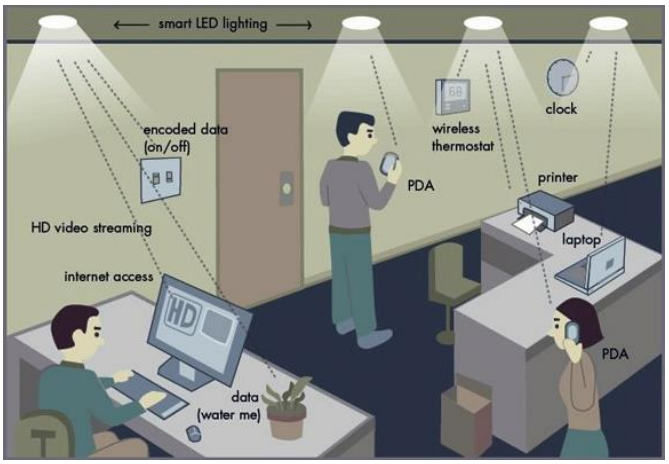

Fig 3. Concept of Li-Fi

5. VLC in maritime industry

Today's maritime communications and its devices are represented by radiotelephony (eg. VHF DSC). The RF is used to establish a communication between two ships or a shore and a ship. Radiotelephony represents voice signal in the electromagnetic specter which is made of different bands such as Medium Frequency (MF), High Frequency (HF), Very High Frequency (VHF) etc. Maritime communication technology represents a powerful industry which improves its characteristics day by day. The side effect of this development is a high price which inspires engineers to create a communication technology that offers a low-cost and high data rates technology. It is possible to enlarge the communication specter for 10 000 times by implementing the VLC technology. In maritime, VLC could be implemented in a shape of sea beacons and lighthouses that are performing a task of transmission data and maritime information to other ships or offshore platforms. Also, could be implemented on ships in a shape of Li-Fi technology to provide internet communication. TRI-media Telematic Oceanographic Network (TRITON) based on IEEE 802.16 and IEEE 802.16e implemented a mesh network in Singapore for maritime communication using a ship, buoys, and lighthouse as communication nodes with the intetion of developing a low-cost and high-speed system for maritime communications close to the shore and in narrow water channels.[4]

[4] Hyeongji Kim, Atul Sewaiwar and Yeon-Ho Chung, "Maritime Visible Light Communication with Sea Spectrum Models", vol.9, pp.67, 2015.

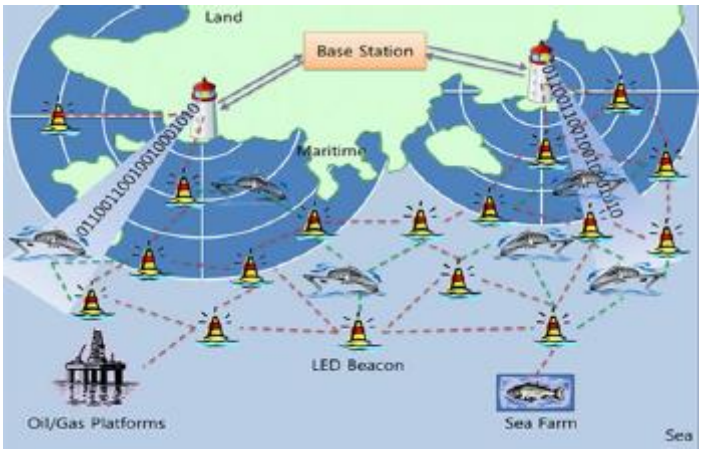

Fig 4. Shore-to-sea communication

Fig 4. shows how a VLC network can be set. The network is formed of ships, sea beacons, and buoys which are all connected via VLC to the terrestrial networks. The base station covers a large area and it consists of power LEDs, while the receivers (sea beacons, platforms, buoys etc.) consists of photodiodes.[5]

6. Conclusion

The aim of the study is to give a clear insight into the Visible light communication wireless technology to make it as a potential candidate for many industries in near future. VLC provides important characteristics and advantages which could be useful in searching an answer to eliminate previous disadvantages. Its high data rate, low-cost and resistance to interferences compared to currently using RF, make this technology of a very high interest. Also, provides a high data security which is of great importance. Light sources surround us everywhere, this is why this technology should have a wide application in order to reduce the high prices of RF and also to reduce a lot of necessary cables. With all the mentioned characteristics, the VLC could be used in numerous applications such as aircraft, medicine, maritime, business building, schools, colleges etc.

[5] Hyeongji Kim, Atul Sewaiwar and Yeon-Ho Chung, "Maritime Visible Light Communication with Sea Spectrum Models", vol.9, pp.68, 2015.

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Planning a route for an unmanned autonomous vessel

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Abstract. The work discusses the problem of optimal route planning for autonomous vessel in order to depth measurements during repositioning. This data can be used to create bathymetric map. The paper describes the application, which allows determining the measurement route in a quick and efficient way. The application was created using web technologies: PHP, JS, Google Maps Api.

Key Words: anchor-trail, autonomous, scheduling, routing, route, trail, coordinates, bathymetric measurements

Introduction

In 2016, along with other students of the Gdynia Maritime University, I have modernized a small remote-controlled vessel into autonomous mode. The purpose of this vehicle was to provide data for the preparation of bathymetric maps, that is the depth as a function of the position. Measurement has been done with a single beam sonar [5].

Although completing this task seemed to bring positive effects, in order to achieve optimal results, the whole project would have to be redone. Because presented issue focuses on many areas, from mechanics through automation, electronics, computer science to geodesy, doing it from scratch with proper diligence is currently out of my reach. That's why I've made a decision to deal only with the fragment that was solved in the least optimal way, i.e. the designation of checkpoints on the route.

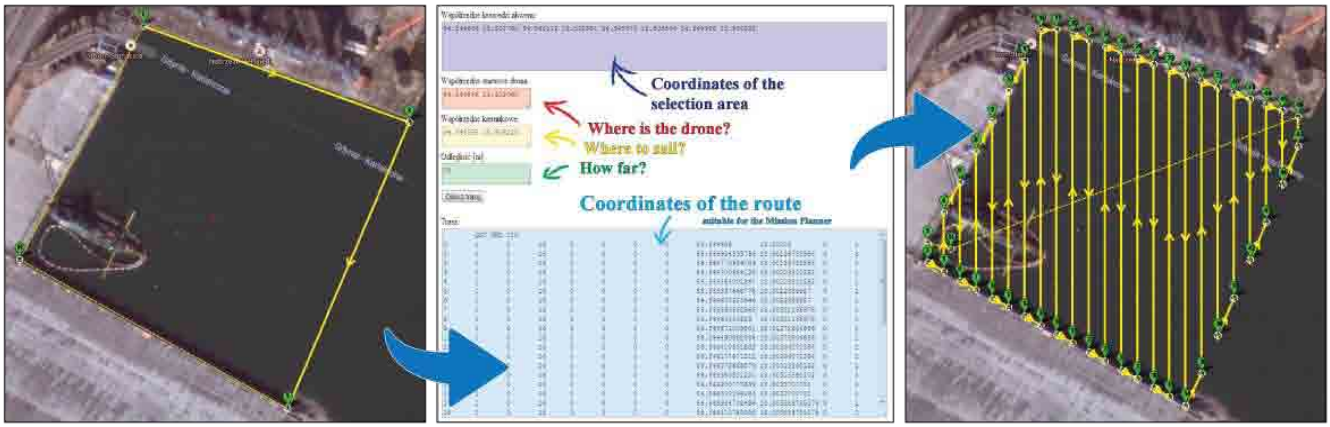

Figure 1. Previous solution (outline, route calculation form, result trail)

Markers were created in the designated area, forming horizontal measurement profiles. Although, skipping the vessel's turning radius when setting the route seemed to be a major omission. The designated route forced the vessel to take very sharp turns that it was unable to perform. As a result, the actual route was not coincident with the planned and vessel's maneuvering could lead to collision.

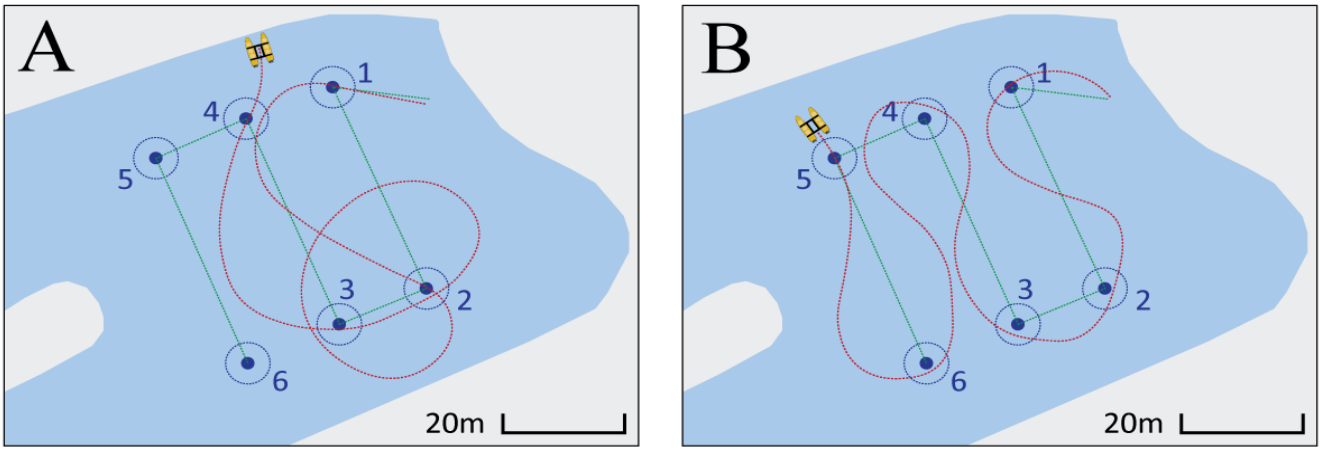

Figure 2. Possible scenarios: A - Greater turn radius (collision), B – Smaller turn radius

During the stand-alone measurements, the use of measurement profiles is not required. However, it is important that the vessel reaches every place from which it is supposed to provide measurement.

This short article will focus on describing the application from the users' point of view, so that those who are potentially interested in the program, after reading the whole would have no doubt whether it meets their requirements and would be able to use it without issues.

Guidelines and Technology Review

Because of the fact that constructing an autonomous water-moving unit is not currently planned by me, the application will be written in such a way it can serve as a ready-made tool for anyone willing to construct such unit.

In that case, the ideal solution from technological point of view will be the use of web technologies such as HTML, CSS, **JS**, **PHP**. So, the presented application is a standard web site that will be available on a given domain: **anchor-trail.eu**.

HTML serves only to create a page structure, and CSS will be used to describe the presentation form of a program. The JavaScript code is executed on user's computer, so that it will be able to handle the functions of the program that need to work instantaneously, i.e. all the planning, data entry and validation activities. Once the user has determined that the route is already planned, all the necessary data can be sent with use of a single button to the server, where the route will be generated by the PHP code. The generation of the route on an external server will provide safety as it will exclude the risk of unauthorized access to a code.

It is worth mentioning that by using JS there is a possibility for a free of charge use of GOOGLE maps. The **GOOGLE MAPS API**, besides the maps, provides users with many useful tools that can be implemented while designing a user interface (GUI). These include markers, polygons, polylines that can be freely placed on the map by referring to the geographical coordinates. All of these elements can be freely grouped and given special features. In a route planning application, each marker group will be creating an area marked with a polygon, and groups will be distinguished from each other by their color. Each of these items can trigger selected events that are to be handled. Events include all the actions performed by the user, such as clicking, hovering over the selected object et cetera. [1][2][3][4]

Graphical User Interface

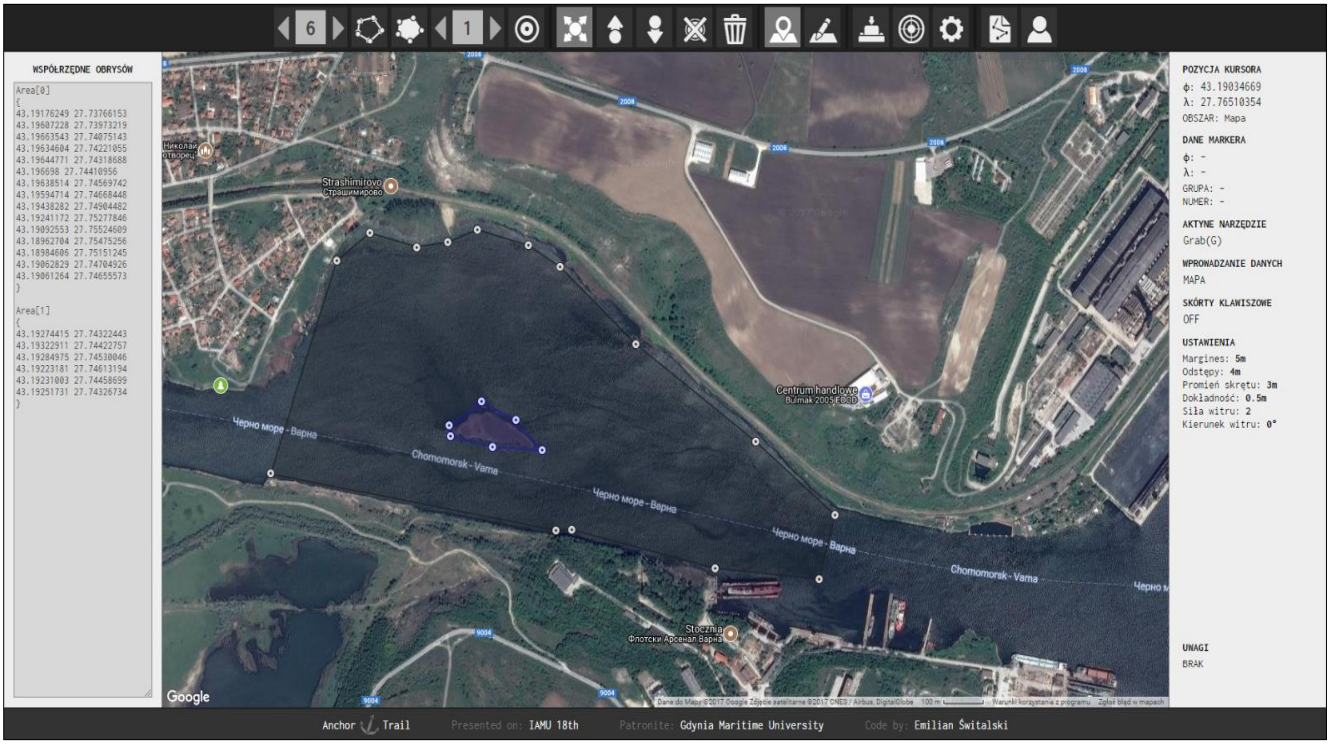

Figure 3. Print screen from the application window

The application is designed to be effective and convenient to use for people who have already used it before, but also approachable for people who are about to use it for the first time.

The application fills up all available browser window space and consists of the following parts:

- toolbar (top);
- coordinate bar (left);
- information bar (right);
- map (center);
- footer (down).

The information bar is to contain all the information that may be useful for the user at given moment. When moving the cursor around the map, its coordinates are being shown, and when pointing the designated area, the bar shows the area's number. In addition, when the cursor is hovering over a marker, the information bar shows all the marker's parameters. The information bar also contains all current program settings. After hovering over any tool, its detailed description will be displayed in the information bar, which can be useful, especially for all the first time users. At the very bottom of the info bar, comments coming from validating data that have not gone through positive, informing about a specific error, will be displayed.

The **Map(M)** and **Text(T)** buttons are important ones on the toolbar. They change the way data is being input into the memory of the program. The Map(M) button, when displayed as being pressed, informs us that the markers on the map can be manipulated and the data in the coordinate bar is being updated on a regular basis. After pressing the Text (T) button, the map will be locked and the possibility to edit the text file, that is the result set of data, will appear. Re-switching to the map will take into account the changes that were previously made in the text file. In some cases, the user will also be informed about using incorrect format during data insertion.

All buttons on the upper toolbar have assigned keyboard shortcuts, that can be activated or deactivated using the **KeyShortcuts(K)** switch. The letter appearing in brackets next to the tool name informs about its assigned shortcut key.

The tool by which the area of the route can be determined is **Area (A)**. When it is active, each click on the map will add another contour marker. Those markers will create the area on which the route will be mapped. In the program, the route stroke markers have a **group of 0**.

In order to bypass any possible obstacles occurring within the planned route, the **ExtraArea(E)** tool should be used. When it is active, each click on the map will add a pair of pointers placed inside the route area to create a terrain that will be bypassed during route generation. The digit placed in the cell to the right of this tool points to a group of added markers of additional areas (obstacles). Additional areas may belong to **groups 1 – 9**.

In order to indicate the starting point from which the vessel will start the route, using the **FirstPoint(F)** tool is needed. The marker added this way will be assigned to **group 10**.

The cell placed to the left of the toolbar contains a number determining the marker number that will be currently added. Markers are numbered with consecutive integers, starting from 0. When the marker number in a cell is smaller than the number of markers in a group, next markers will be shifted.

Markers can be switched with **Up(U)** and **Down(D)** tools. When the Up (U) button is active, clicking on the selected marker (the vertex of the stroke) increases its number at the expense of the next marker, which in practice results in switching places by two chosen markers. Double-clicking will result in setting the marker number to the maximum and adjusting other markers' numbers. The Down (D) tool works similarly, with the exception that it decreases the number of given marker.

The **Grab(G)** tool comes in handy when there is a need to change the position of any of the markers. Once activated, the selected marker needs to be dragged to the appropriate location. Once it is dropped, the outline and position in the text file will be updated.

Deletion of a marker requires clicking on the selected one with the active **Delete (X)** tool. Once the marker has been deleted, the remaining markers will be renumbered.

Removing all the markers from the selected group calls for activating the possibility of adding markers and clicking the **Remove(R)** button. When none of the tools for adding markers is active, all of them will be deleted.

There is a possibility of centering the map by entering geographic coordinates. This can be done via the form hidden under the **Center(C)** button.

It is important to precisely set parameters hidden in the **Settings(S)** tab before generating a route. Those given parameters are as follows:

- margin [m] - safety distance from edges of drawn contours;
- spacing [m] - the distance from which next measurements will be taken;
- yurning radius [m] - smoothing of corners;
- accuracy [m] - the degree of rounding;
- wind power [%] - increases or decreases the turn radius depending on the direction of the rotor (value to be selected intuitively);
- wind direction [°] – inserted in degrees, angle 0 degrees corresponds to the wind blowing from the south to the north.

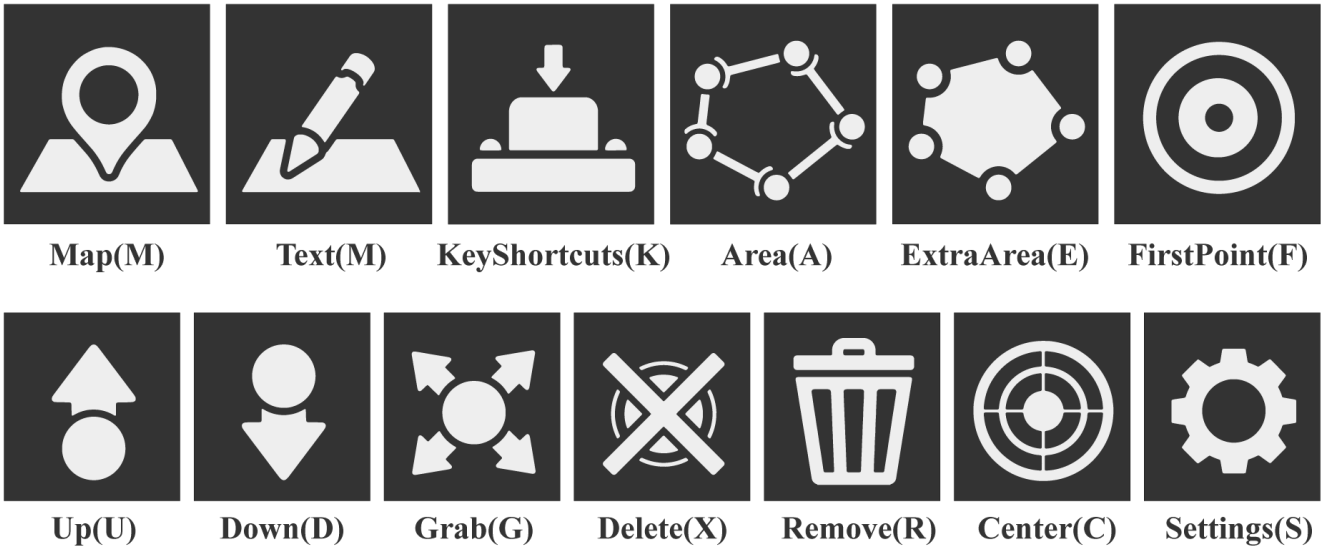

Figure 4. Tool icons along with their names

Generating a trail

When the user assumes that the strokes are set correctly and that all parameters have corresponding values, then the route can be generated using the **GenerateTrail(W)** button. This way all data will be sent to the server. The algorithm placed on the server, using different coordinate systems and basic mathematical operations, transforms the input into a route that is a sequence of consecutive coordinates in the geographic system. Such generated route will be sent back to the user. A new window, designed similar to the route planner, will pop up in the browser. The user then will be able to view the route and make corrections. Once the work is considered to be complete, the possibility to save it in a text file or a special format adapted to the **Mission Planner** autopilot will appear.

The route consists of consecutive points, so all the roundings will be approximated to polygons. Along with decreasing the "accuracy" parameter in meters, the rounding will be mapped with greater precision, but the number of resulting route's points will increase. The density of the measurements, and therefore the accuracy of the future map, is affected by the "spacing" parameter. The smaller it is, the more measurements should be obtained.

GenerateTrail(W)

Figure 5. Button icon for the trail generation

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THE CASE STUDIES-BASED ANALYSIS OF COLLISION PREVENTION

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Abstract. *The aim of the research is to offer the results of analysis related with the aspects and causing reasons of vessels collisions and to propose probable methods of their avoidance. The conducted research is backed by the appropriate database of the International Maritime Organization. In order to reach the stated objective, the first part of the paper presents the analysis of the real cases of collision of different types of vessels. Accordingly, the second part of the paper offers the analysis-based proposal of vessels' collision prevention.*

Key words: *analysis, collision, prevention, simulator, training, research*

1.Introduction.

Provision of safe navigation is the major task of the people and organizations involved in shipping. Accordingly, the importance of collision prevention is especially underlined by the IMO-developed COLREG, which covers the all possible risks related with collision prevention such as ship's speed, traffic in narrow channels, Traffic Separation Schemes, overtaking, crossing situation, conduct of vessels in restricted visibility, towing, pushing and head-on situation. But, despite of such important rules and the set of appropriate international obligatory conventions and rules, developed by the International Maritime Organization, notorious chain of marine accidents shows, that over the period 2011-2015, half of the casualties were of a navigational nature, such as contacts, groundings/strandings or collisions, which caused 43 cases of lost ships, fatalities occurred during collisions consist 15%, collisions represent 27% of the events involving cargo ships and are the main casualty event across all the service ship types. [1]

[1] Annual Overview of Marine Casualties and Incidents, 2016

Thus, the aim of my paper is to present the results of analysis dealing with the factors and causing reasons of ship collisions and to offer possible ways of their prevention.

The conducted research is based on the appropriate data of the International Maritime Organization – Lessons Learned (developed in order to increase awareness of seafarers to accidents for prevention purposes).

2. Collision Causing Reasons – Frequency Distribution Analysis

The following classification, focused on the essence of researched real cases, provides the background to detect the most frequent reasons of the vessels collision. There is no possibility to present the whole set of the studied cases (44 in total), that is why we provide only the limited number of them but keeping the same scale of their frequency and volume.

2.1 Collisions, caused by gaps in effective bridge management

- There was a lack of understanding of how to act in restricted visibility.
- No risk assessment or consideration of potential consequences was undertaken prior to opening up and ordering entry into the breached ballast tank with the ship at sea and proceeding at near full speed.
- The master of the cargo vessel was the only person on the bridge without a dedicated lookout while departing from a very busy port at night even though the vessel was properly manned and procedures were in place as to how the bridge should be staffed upon departure.
- There was no additional watchman on the bridge from 1300 until the time of the collision.
- When the main engine was operated in engine-room control mode, the only system protections to warn the crew of "wrong way" running of the engine were the bridge and engine control room console-mounted flashing light indicators
- The port operator had not undertaken a risk assessment, or developed contingency plans for specific ship handling manoeuvre in the port. Consequently, the pilot had no guidance regarding what actions to take if the berthing manoeuvre did not progress as he had planned.[2]

2.2 Collisions, caused by Insufficient or Missing Look-out:

- The OOW was distracted from keeping a proper lookout and was not using navigation equipment, such as radar, to perform adequate watchkeeping.
- There was no proper lookout in poor visibility and the ships were proceeding at too high a speed, given the prevailing visibility.

[2] The IMO Lessons Learned - Consolidated version contact, collision, http://www.imo.org/en/OurWork/MSAS/Casualties/Documents/Consolidated%20version%20of%20Lessons%20Learned/Consolidated%20version%20contact%20collision.pdf

- The skipper of the sport fishing vessel decided to release the deckhand from his task of lookout despite visibility being restricted to 300 m. The skipper of the sport fishing vessel was using a radar, but did not detect the pleasure craft.
- Another contributory cause to the collision was the lack of a lookout on the pleasure craft which was anchored in a shipping lane at night.
- The VTS operators were distracted by other duties and did not survey the radar screens.[2]

2.3 Collisions, caused by Misunderstanding of Oral and Non-verbal Information

- The communication between all parties involved was unclear and prone to misunderstanding and use of standard marine phrases was not practiced.
- The watchkeeper on board vessel 2 assumed that the other ship would take avoiding action so did nothing despite the fact that the two ships were approaching each other on an almost reciprocal heading so as to involve a risk of collision.
- Both ships transmitted their compulsory reports to VTS. But when the ships made their reports, there were a number of misunderstandings and reporting mistakes. In some reports the calling vessels' name was not mentioned. In others, it was not clear to whom the message was addressed to. So the ships did not perceive the messages accordingly.
- The CPP failure alarm was heard on the bridge, but the bridge team could not identify which alarm was sounding.[2]

2.4 Collisions, caused by Radar Failure:

- The radar on the trawler was not working and there was only one person on watch, who was navigating visually. Neither vessel made their intentions known in a timely manner.
- The tanker had her radar turned off. She was unable to detect the big ship in advance. Also the container ship did not use radar for evaluation of the situation.
- Watchkeeping personnel on both ships did not observe several COLREG '72 rules applicable to lookouts, use of anchor lights, appropriate use of the radar, and communication between vessels.
- The tanker's officer on watch relied on radar information to conclude that the bulk carrier would safely pass from starboard side.[2]

2.5 Collisions, caused by Poor Visibility

- In poor visibility and the ships were proceeding at too high a speed, given the prevailing visibility VTS took a passive approach. It only acknowledged messages but did not warn either vessel of the other's intention, despite the very poor visibility and the position of the dry cargo ship which had drifted southwards in way of the outbound traffic lane. The conditions of restricted visibility aggravated an already stressful situation for the bridge teams.[2]

2.6 Collision, caused by ignorance of appropriate warning signals producing

- The passenger vessel did not make the appropriate warning signals with her whistle or light and the evasive action taken was not early enough to avoid the collision.[2]

3. The Analysis-based proposal of the vessels collision avoidance.

Thus, the research development detects the factors, mainly causing collisions at sea, such as:

- Gaps in effective bridge management;
- Insufficient or Missing Look-out;
- Misunderstanding of Oral and Non-verbal Information;
- Radar Failure;
- Poor Visibility;
- Ignorance of appropriate warning signals producing.

As the investigation of the listed above cases shows, the majority of collisions happen because of simple but life-threatening mistakes in use of navigational equipment and understanding of the existed information (direct or indirect human factor/mistake).

Conclusion.

Thus, in order to provide safety of navigation, the master and OOWs shall prevent possible collisions on the planning and implementation stages developing situational awareness by:

- constant provision of effective bridge procedures to provide best practices in bridge management;
- paying special attention to ensure watchkeeping standards (look-out)
- using appropriate IMO Standard Marine Communication Phrases and paying special attention to appropriate understanding and adequate interpretation of non-verbal information;
- regular check of radar performance and appropriate interpretation of its information.
- tracking rapidly changeable weather conditions.
- strict adherence to COLREGs in using of the appropriate signals.

At the same time, one of the best ways to train the future seafarers and develop their safety culture and to raise safety awareness is to simulate the collision situation using the appropriate simulators, providing training in actions to be carried out in case of collision.

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3. Bridge Procedures Guide, International Chamber of Shipping, London, 2016

THE ANALYTICAL ESTIMATION OF GROUNDING CAUSING FACTORS

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Abstract. *The aim of the paper is to present the results of the analytical studying of major causing reasons of ship grounding and to propose possible ways of their avoidance. The source of the implemented research is based on the data (real cases of ship grounding related with different types of merchant vessels operating in different areas and operative situations) of the International Maritime Organization, The European Maritime Safety Agency and Marine Accident Investigation Branch. Thus, the paper proposes the results of study of the factors, frequently causing vessels' grounding despite the COLREGs, SOLAS and ship safety management system requirements, directly related to the provision of safety of ship handling. The assumption of the paper presents distribution of the causing factors regularity.*

Key words: *research, grounding, to avoid, actions*

1. Introduction

About 90% of the global business is implemented by the international shipping. Without it the import and export of cargoes on the range required for the modern global world would be impossible. Sea-based trade continues to enlarge, providing benefits for traders across the world through reasonable costs. There are over 50,000 merchant ships trading globally, shipping every kind of cargo.

The world fleet is registered in approximately 150 states, and implemented by over a million seafarers of almost every nationality.[1]

Shipping was one of the first businesses to introduce broadly applied international safety standards. Thus, due to its international nature, the safety of shipping is governed by the International Maritime Organization (IMO), which has proposed a complete scheme of global maritime safety rules. World shipping is one of the most strictly regulated activities and was one of the first to adopt constantly implemented international safety regulations. [2]

The rules concerning merchant shipping are established at the global range. Merchant shipping is essentially global, it is obvious that it is the subject to provide rules on issues, such as ship construction standards, navigational rules and sets of crew proficiency.

2. The Key Rules Managing Merchant Fleet Safety.

The following major international conventions developed by the International Maritime Organization and the International Labour Organization ensure safety at sea and marine pollution prevention. At the same time, numbers of other maritime documents and procedures related with specific matters are also in force.

Thus, the instruments, which provide safety at sea, cover activities of the merchant ships, shipping companies and the crew members.

2.1 The following rules deal with the merchant ships:

- SOLAS (the International Convention for the Safety of Life at Sea, 1974) provides a full set of minimum standards for the safe ship construction and the basic safety appliances (e.g. fire protection, detection and distinction; navigation, lifesaving and radio) to be provided on board. SOLAS also requires regular surveys and the issue of the appropriate certificates.
- MARPOL (the International Convention for the Prevention of Pollution from Ships, 1973/1978) sets up requirements to prevent marine pollution. MARPOL prevents pollution from different sources such as oil, bulk chemicals, dangerous goods, sewage, garbage and atmospheric pollution.
- COLREG (Convention on the International Regulations for Preventing Collisions at Sea, 1972) presents the major "rules of the road".
- LOADLINE (the International Convention on Loadlines, 1966) provides the minimum permissible free board, due to the season and the ship's operational area.

[1] http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade
[2] http://www.ics-shipping.org/shipping-facts/safety-and-regulation

- ISPS (the International Ship and Port Facility Security Code, 2002) establishes obligatory requirements to protect ships and port facilities at all stages during a voyage/passage.

2.2 The documents listed below deal with the shipping company:

- ISM (the International Safety Management Code, 1993) requires shipping companies to obtain a license to act. The companies as well as their ships must ensure the audits to guarantee that a safety management system is in action, including appropriate procedures and communication between crews and their shore-based management.

2.3 The instruments regarding the crew members:

- STCW (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978/1995/2010) establishes minimum standards of competence for seafarers.
- Under ILO 147 (The ILO Merchant Shipping (Minimum Standards) Convention, 1976) it is demanded from the local administrations to have tuned legislation on labour issues such as appropriate hours of work, medical issues and seafarers' working terms.

3. The analysis of the most frequent reasons of ships grounding.

Despite such comprehensive prevention of possible incidents, unfortunately their number is increasing. That is why the aim of the paper is to present the results of the analytical studying of the causing reasons of ship grounding and to propose the ways of their avoidance.

In order to realize the noted aim in the first part of my research I investigated “the IMO Lessons learned - Consolidated version grounding” – the collection of the real cases of ship grounding related with different types of merchant vessels operating in different areas and operative situations.

Backed by the results of the implemented analysis, I distributed the grounding causing reasons in the following manner (the frames of the paper don’t give possibility to present the whole set of the studied cases, that is why only the most attractive ones are given below):

3.1 Grounding, caused by improper actions taken by deck departments crew and pilot:

- The actions of the master, such as his request for full speed and full rudder angle, increased the loss of control of the ship, since the ship was moving in a narrow channel with little clearance underneath and at the sides.
- The pilot disembarked the ship before the ship left the channel, that increased the chance of an accident.
- The officers did not use a proper scaled paper chart. The chief officer overlooked the target displayed on the radar and did not carry out a proper lookout.
- No alternative passage plan had been made after the vessel deviated. Any deviations from previous passage plans should be made in writing and communicated to bridge team members.

- The master of the cargo vessel had joined the vessel two days before the accident. He was not familiar with the vessel's windlass and ground tackle. No other member of the crew knew how to use the windlass to anchor the vessel.[3]

3.2 Grounding, caused by difficult weather conditions:

- The ship anchored on a lee shore. There was no protection from the wind and sea in the anchorage area, and the ship's anchored position was upwind of the breakwater.
- The weather conditions were such that the ship was unable to maintain its position using anchoring equipment. [3]

3.3 Grounding, caused by ignorance of the IMO Standard Marine Communication Phrases:

- poor communication and cooperation between the master and the pilot during sailing in confined and restricted visibility water area caused accident. [3]

3.4 Grounding, caused by improper use of navigational equipment and poor knowledge of ship particulars:

- While transiting from the inner harbour to the main entrance channel, the vessel failed to execute a turn successfully and was set to starboard towards the side of the channel. The ship made contact with rocks on the edge of the channel. [3]

3.5 Grounding caused by fatigue:

- The watch system together with other functions allocated to the watchkeepers resulted in an excessive workload for the officer on watch. Fatigue with a resultant deterioration of safety awareness appears to having affected the behaviour of the officer on watch. No look out was posted on the bridge, no regular fixes were taken, no course monitoring was conducted and the watch alarm was switched off.[3]

Conclusion.

Thus, taking into account the essence of the listed above reasons, as the prevention of vessel grounding (one of the most dangerous accidents) we propose the measures to prevent grounding:

- planning and further tuning of actions undertaken by the deck department crew and the pilot through constantly developed passage/anchoring/mooring plan;
- appreciation of the ship particulars to ensure the best application of her handling characteristics;

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[3] http://www.imo.org/en/OurWork/MSAS/Casualties/Documents/Consolidated%20version%20of%20Lessons%20Learned/Consolidated%20version%20grounding.pdf

- protection from the wind and sea in the anchorage area to prevent the increased draught due to the ship's movements caused by the swell;
- strict control over possible fatigue through effective bridge resource management;
- regular check of conventionally required use of the IMO SMCP.

At the same time, in case the ship is grounded, the crew shall never forget about the **Actions need to be taken in case of Stranding or Grounding**, proposed by "Bridge Procedures Guide" developed by the International Chamber of Shipping.

- sound the alarm to muster the crew/passengers (7 short, 1 long);
- account for all personnel and check for injuries;
- stop engines and auxiliaries if grounding is severe;
- sound bilges and inspect void areas;
- take bearings and plot your position - then attempt to determine reason for grounding from the charts;
- survey the area around the grounding (from chart);
- determine the tide and tidal stream;
- check weather predictions for the area;
- sound around the vessel to determine the extent of the grounding
- check for hull damage (if severe damage has occurred, it may be best to stay grounded);
- display appropriate signal `vessel aground'.[5]

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ANALYSIS OF STUDENTS' VIEWS ON COLLISIONS AVOIDANCE
With focus on shortcomings of maritime educational system

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Collisions are a serious threat to ship's safety. We have decided to study this problem through the eyes of young officers – firstly because they are not affected by the 'old' mistakes, common among the people who have been working in this industry for a certain time, and secondly because they are the future of the maritime sector. The complexity of the issue makes it extremely hard to decide on any situation clearly in real time. The decision making is obstructed by ambiguous terms, such as 'good seamanship', and the outdated regulations.

We have used the knowledge elicitation method to extract the thoughts of our experts (students who have finished second of three-year programme to become officers). First, we have shown them an example (factors when two cars avoid a collision), then asked them to write or paint down their own take on the situation in which a vessel avoids a collision. Students had no constraints and were not allowed to communicate. The last part was an open discussion about the topic, connected with clarification of their notes and pictures.

As mentioned earlier, our experts' task was to describe the process of two ships passing. These are the factors they included.

Look-out

Rule 5 of COLREGs is short and seems straightforward. It singles out the importance of maintaining a proper look-out with all available means. This includes simple visual observation, mentioned by 89% of the experts. Proper look-out is fundamental when it comes to interpreting the situation around ones' vessel and determining any possible dangers. However, the OOW must realise that circumstances on the other ship may be completely different, and should never assume the other vessel's situation. Weather conditions, such as visibility, rain, snow, fog, dust, wind force, sea state, and many others have to be considered, as well as the manner in which they affect both our own and other vessel's ability to maintain the proper look-out. Our experts acknowledge that in case of restricted visibility one has to assure noticeability by using both lights and sound signals, as both

visual and audial observation must be kept at all times. Officer should not be afraid to inform the master about the ambiguous situation and to request his presence on the bridge, as it should be considered a sign of responsibility. All in all, there is no denying that look-out is one of the most basic and important duties on the bridge.

Radar

Radar is considered to be one of the most important and useful means of maintaining appropriate look-out, as required in Rule 5. When equipped with it, we should always include it in look-out duties and keep our visual observations in check, comparing what we see with echoes on the radar screen. This allows the OOW to constantly check the performance of the radar and its adjustment. Additionally, Rule 6 singles out 6 additional factors to be held in mind when determining a safe speed on vessels with operational radar, therefore reminding all mariners both of its importance and limitations. 78% of the experts mentioned usage of radar in preventing a collision, some of them also specified how bearing and distance to the ships in vicinity should be controlled. It is vital to remember about this, since there are many incidents caused by lack of situational awareness of the bridge team resulting from them making use of neither radar nor ARPA. This includes events in Singapore at the beginning of 2014[1], when 3 collisions had taken place during two weeks, all because the crews did use neither radar nor ARPA to avoid it. However, it is crucial not to rely solely on the radar readings and alarms, as mentioned in Rule 7c, which may be one of the reasons our experts mentioned additional navigational equipment.

Additional navigational equipment

67% of the experts believe that additional navigational equipment should be used to improve situational awareness of the crew. Most of them mentioned AIS, but some also listed ECDIS and GPS. Since having this instruments on board is compulsory for most vessels used in the merchant navy, they seem an obvious element of the proper look-out routine. While radar calculates the speed and course of other vessels, and therefore is susceptible to mistakes, AIS transmits information right from the source. So as long as the input is correct and the connected equipment is working properly, everyone around receives very precise information about the relevant object. It is important to actually use all available means to assess the situation, as information from only one source may be misleading.

[1] http://gcaptain.com/mpa-human-error-poor-judgement-caused-string-singapore-ship-collisions/; access on 17/08/2018.

Contact via VHF, VTS, etc.

Communication with other vessel was one of the very few factors mentioned by all of the experts. It can be interpreted as a part of "all available means" in Rule 5, which helps to understand an ambiguous situation. Those means are also mentioned in Rule 7 on risk of collision. However, contact between vessels via VHF or VTS is not mentioned directly in any rule of the COLREGs. Our teachers at GMU quite often advise students against using VHF communication in potentially dangerous situations. They usually list problems with understanding each other because of lack of proper level of maritime English among officers or incomprehensible accent. This particular issue had caused multiple accidents, such as the collision of m/v Baltic Ace with m/v Corvus J in 2012[2], where OOWs contacted via VHF to determine their course of action in a situation involving risk of collision. They agreed on a manoeuvre that contravened COLREGs. However, the intended actions of the Officers as communicated by VHF were not reflective of the action that was actually taken, possibly because of them failing to understand each other even though both were of the same (Polish) nationality. The issue with maritime English skills is currently acknowledged and well-documented within our community[3].

The manoeuvrability of the vessel

According to Rule 6 of COLREGs, the manoeuvrability of the vessel, among other things, should be taken into account when determining a safe speed in any conditions of visibility. Turning circles and stopping distances should be one of the first things that an officer boarding a new ship familiarizes themselves with. This is why they should be in a visible place on a wheelhouse poster, always available to the OOW. Therefore, no wonder that manoeuvrability was mentioned by every single of our experts as one of the most important factor, along with only few others. Some of the experts went as far as dividing it into several factors, such as engine and rudder control, realising that manoeuvrability is a more complex issue and that it is not to be ignored. According to the distance left to the other vessel, they have advised to manoeuver using only engine (altering speed to avoid collision) if there is enough time (some mentioned the distance of 3-5 NM from the other vessel as a moment to start the manoeuvre), only rudder (altering course in a way that is clearly visible to the other ship) if it is closer (around 2-3 NM from the other vessel), or both, if the situation requires it. Some, however, advised against manoeuvring only with speed, as this may not be clearly visible to the other ship. They repeatedly mentioned that one must know their vessel thoroughly before considering any manoeuvres.

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[2] *Report of the investigation into the loss of m.v Baltic Ace following a collision with m.v Corvus J at the North Hinder Junction Precautionary Area on the 5th December 2012*; The Bahamas Maritime Authority, 2016.

[3] O. Kalinkowska, S. Wantuła; *Human Factor in Maritime Accidents*, Prace Wydziału Nawigacyjnego Akademii Morskiej w Gdyni, 2016.

Weather

Weather is another of four factors mentioned by all of the experts. It seemed obvious for them to consider it in a situation involving risk of collision, and that OOW should adjust their actions accordingly. COLREGs most importantly mentions it in Rule 6 on safe speed, where in point a) it lists that when determining a safe speed all vessels must take into account the following:

"i) the state of visibility;

(...)

v) the state of wind, sea and current and the proximity of navigational hazards; (...)".[4]

As it can be seen, being able to observe and understand weather is a skill necessary for an officer. Meteorological conditions always affect both our and other's vessels, and therefore influence the decisions made on both bridges. However, the effects of the weather may differ on a different ship. Force 7 wind may not be an issue for a supertanker, while OOW on the bridge of a small vessel will be glad to remain standing, and performing a look-out duty will be very difficult. It is important to remember that, as both of these ships are subject to the same rules of COLREGs.

There is no doubt that meteorology should be taught at maritime universities, and it is an opinion shared by all of our experts.

Obstructions

Obstructions – such as wrecks – were mentioned by 33% of the experts. In the COLREGs, they are mentioned in point v) of rule 6a, under navigational hazards that have to be taken into account in determination of safe speed. It is an obvious and important issue, but one that can be assessed beforehand.

Circumstances

A wide term of circumstances was listed by 67% of the experts. This included mainly other vessels in vicinity, their intentions and manoeuvres. In COLREGs, similar factor is considered in Rule 6a point ii), stating as follows:

"(...) In determining a safe speed the following factors shall be among those taken into account:

a. By all vessels:

(...)

ii). the traffic density including concentrations of fishing vessels or any other vessels;(...)"[5].

What is so important in considering all of the vessels in vicinity is the fact that the rules of COLREGs are written for situations when the risk of collision is between just two ships. Thus the situation

[4] *Convention on the International Regulations for Preventing Collisions at Sea*, 1972, Rule 6.
[5] *Convention on the International Regulations for Preventing Collisions at Sea*, 1972, Rule 6.

complicates significantly when another ship enters the equation. A manoeuvre of giving way to one vessel may lead to a collision with another. To bring every other present vessel into the equation, one must consider possible manoeuvres and their results on our situation.

Geographical conditions

Numerous geographical factors were mentioned by 44% of our experts. Some of them, like depth or rocks, are included in Rule 6 of COLREGs, but others, like venture effect, are nowhere to be found in legislation. However, having been taught meteorology and oceanography for 2 semesters, we can assume that most of our colleagues do realise that such phenomena exist and need to be taken into account

Readiness for unexpected manoeuvres

In Rule 6 of COLREGs, the following sentence can be found:

"Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions."[6].

However, only one of the experts included readiness for unexpected manoeuvres in their mind map. This was unexpected for us, yet later, in the discussion phase, other experts confronted about it explained that it was obvious for them as a part of the wider term "good seamanship".

Lights

Navigational lights are another factor mentioned by all of the experts. They are an obvious part of COLREGs, taking up whole Part C of it, therefore it is no surprise that everyone included it in their mind maps

Sound signals

Mentioned by 44% of the experts, sound signals take up whole Part D of COLREGs. Apparently, they do not seem as obvious as lights, but that may be due to sound signals being used noticeably less frequently.

Good seamanship

Experts listed some factors that are not included in COLREGs, like mental condition (22%) and experience (44%) of the OOW, ship's technical condition (33%), aids to navigation (44%),

[6] *Convention on the International Regulations for Preventing Collisions at Sea*, 1972, Rule 6.

navigational aids (11%) and autopilot (11%). We can assume that some of them may be fitted under the umbrella term of "good seamanship". However, it is our belief that this term is too vague to be useful, and may cause trouble to young, unexperienced mariners, as there is no reliable source from which one could learn it. Additionally, what is considered good seamanship changes locally.

CONCLUSIONS

The study suggests that a change of approach within the schooling system would help to make the future officers more eligible and suitable for the moment when they are thrown in at the deep end. The difference between knowledge of Rule 5 and Rule 6 is clearly noticeable – while all the 4 factors covered by the former were always mentioned by at least 6 experts, the latter scored visibly lower, with 4 factors (out of 6): readiness for unexpected manoeuvres, obstructions, geographical conditions and circumstances being considered by 1, 3, 4, and 6 experts respectively. This is a clear result of our schooling system at GMU in which after 2 years of studying, we have only half of the semester of COLREGs classes, during which we have covered only first 5 Rules and Part C on lights and shapes. Considering that before this study all the experts have completed at least their first cadet practice, we believe that the subject of COLREGs should have been made clearer.

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An Analysis on Maritime Education and Training in China's Maritime University

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Abstract: In recent years, with the rapid improvement and development of science technology and society, the global maritime industry has undergone profound changes. The social status of crews has declined gradually and the willingness of maritime career of young crews has generally weakened. This situation adversely affects China's Maritime Education and Training(MET) and brings a lot of challenges. As a very important part of Higher Education in China. How to meet these challenges and improve MET has been paid close attention to.

As students of nautical science of a maritime university, the authors have been impressed deeply by the problems of China's undergraduate MET. From a student's point view, this paper will analyze the features, situation and problems of China's undergraduate MET, compare the similarities and differences of MET in maritime universities at the present stage between China and foreign countries. By drawing lessons from the advanced cultivation concept of foreign maritime universities, the authors will put forward suggestions on tackling

the problems of China’s undergraduate MET.

Keywords: Maritime Education and Training; undergraduate MET; maritime university

1 Introduction

In china, there are five leading bachelor degree awarding maritime universities :Dalian Maritime University, Shanghai Maritime University, Jimei University, Guangdong Ocean University and Wuhan University of Technology. In the United states there are seven maritime Academies that award bachelor degrees : United States Merchant Marine Academy, State University of New York Maritime College, California Maritime Academy, Maine Maritime Academy, Texas A&M University at Galveston, Massachusetts Maritime Academy (MMA), and Great Lakes Maritime Academies.

This paper reviews and compares the course of instruction at three university-level navigation officer maritime programs: Jimei University(JMU) and the United States’ ,Texas A&M University’ Texas Maritime Academy(TMA), and the United States Merchant Marine Academy(USMMA).

2 Comparison of MET between China and foreign countries

2.1 The orientation of education

The United States is an economically developed country, but also the world's shipping power. American shipping companies are all private enterprises, but it is interesting that its seven maritime institutions of higher learning are government-run public schools. Different from China's maritime education at all levels, the United States maritime education,

regardless of ordinary or vocational education, only undergraduate and above level of education. This monorail education and the US government will be the maritime industry as an important part of national economic security. At the same time, in the United States of higher education system, the maritime institutions of education is not large, and the funds to the main government funding. In the United States, maritime education is the implementation of the university, occupation, military education trinity model. The purpose of the educational nautical students is to serve the US Navy for the US Navy, and to receive a bachelor's degree, three (three-wheel), a naval reserve lieutenant or a second lieutenant of the Marine Corps. This type of education is ultimately designed to train students as senior officers, officers and landline shipping industry leaders.

2.2 Sea Training

While both TMA and USMMA are required to provide onboard training ,the experiences differ. Under US Law(46 CFR 310.3),TMA cadets (as well as other state maritime schools) must spend at least six months onboard a Training Ship in cruise status ,with a maximum of two months of training time spent onboard commercial vessels substituting for two months of the specified training ship cruise time. USMMA cadets are required to spend a total of 12 months on one or more merchant ships (46 CFR 310.59). The level of required onboard academic work varies between the two training systems, in part to the more independent nature of learning onboard merchant ships compared with training ships.

JMU students have two periods of sea going experience, the first occurring in the sophomore or junior year for a period of one month of observed practice. The objective of observation practice is for students to become familiar with the ship and shipboard routine in an environment that places an emphasis on guided learning. This period of seagoing experience happens on the JMU’s training ship “YUDE” .

The second period of seagoing experience takes place after the last semester of senior year, lasting for 12 months. During this period, the student sails on a commercial shipping company to fulfill their practice to get their Third Mate certificate.

2.3 Curriculum

Each of these programs combine subjects generally regarded as required university courses, as well as the more technically oriented subjects. Each program provides a mechanism for introducing their students to the culture of the school and maritime industry. JMU provides a one month program focusing on military training prior to the start of classes.

Both US institutions also have some type of indoctrination. TAMUG-TMA has a week-long Orientation Week, designed to prepare students mentally and physically for life at Texas Maritime Academy. Students learn how to wear a uniform, basic military courtesies and customs, basic watch standing and seamanship, and TAMUG-TMA traditions. USMMA has a two week “Indoc” that subjects candidates to an intensive regimen of physical , moral ,and regimental training.

Each of the universities in this paper also requires students to declare their major upon entry. While TMA go right into deck courses ,JMU’s first year ,and USMMA’s first term, provide a universal course of study, to allow students to make changes in their declared major if they find their interests have changed as they learn about the work of the seafarer and post-graduation opportunities (2011-2012 Catalog,2011).

Throughout their course of instruction, each program combines both general academic course and professional courses (2011-2012 Catalog, 2011; Catalog 134, 2011-2012, 2011).The professional courses are introduced in an order that allows the students to build upon prior knowledge. These early professional courses, such as basic safety training and lifeboatman, also prepare students to participate in practical sea training. These courses culminate in a series of courses, such as Bridge Resource Management (BRM), in the final 12-18 months that allow students to integrate prior knowledge and engage in critical thinking and decision-making in a variety of scenarios.

While both TMA and USMMA have a course of instruction that meets or exceeds the requirements of obtaining the operational level navigation license, the schools also set the stage for students to advance their license and pursue graduate level business degrees, through

such courses as accounting, marketing and economics. As with most US undergraduate university programs of study, developing critical thinking and decision-making competencies, and preparing students for life long-learning is de rigueur .

A unique element at JMU, but not present at the US institution , is the STCW requirement for seafarers to be proficient in Maritime English. JMU’s strategy to improve students Maritime English competency is accomplished by having the professional courses conducted in English, as well courses in English Composition and Maritime English. This places an additional learning burden on the students as they must not only learn the basic knowledge required by STCW, but learn it in a foreign language. The pay-off is that students gain a working knowledge of Maritime English.

3 Suggestions on China’s undergraduate MET

As one of the above, maritime education and training(MET), as a multi-level and multi-type education, should use different goals to show the characteristics of each level. Low-level maritime training class should be positioned as vocational education, should be with the good operation of the shipping industry for the purpose. High-level maritime education should be more aware of the completion of the training class of education, the more on the management of the shipping industry and a higher level of research above. In the development of institutional training programs, to reflect the characteristics of different levels of maritime education. Such as vocational education should be based on short-term training, purposefully taught skills and operational skills, as soon as possible to master the practical ability, into the maritime career. But also to take into account some of the higher level of the crew need to master the skills of familiarity and understanding for its future to continue to lay the foundation for learning. Finally, general education should be based on the training of senior officers as the goal, on this basis, elective management courses, training management level officers and even the shipping industry leader, or the future of university teachers.

Besides,China's maritime institutions should reduce the number of repetitive theoretical courses to reduce the time spent on the sea internship. However, due to China's hardware equipment is still relatively backward in the developed countries, all should strive to develop

a more reasonable program to achieve the combination of practice and theory to ensure that all students have enough internship time. For example, in the case of less resources, the students will be divided into several batches of teaching. In the case of shortage of internships, to strengthen cooperation between institutions and enterprises. In addition, in order to cope with the possible phenomenon of school-enterprise cooperation, nautical institutions can learn the way of education in the UK, so that students and enterprises in the case of employment agreement signed, and then sent to the internship, in order to get better Of the internship effect. In addition to the cooperation between schools and enterprises, our government should also increase the support and funding of navigational education practice, making the characteristics and advantages of nautical education in practice.

4 Conclusion

Although here are some differences on the curriculum, arrangement of practical course, and seagoing experience, all the systems carry out a plan according to the STCW policies and their national characteristics. While JMU concentrate on teaching theory based quantitative methods, it reflects the cultural needs of preparing students to continue their academic careers through master and doctoral degree programs. In the United States, the maritime education contains significantly less quantitative theory but more a more practical education, based in part on the belief that the students are being prepared for careers at sea and to become leaders in the industry.

While both Chinese and American system deserve some adjustment to provide a better equilibrium of theoretical and practical training, the expectations of the students must be kept in mind, as well as the safety of ships. While the experience gained through practical training schemes is invaluable and assists in better decision-making at sea, the theoretical areas of nautical education cannot be ignored in developing the theory needed later in their careers to develop theories based on their experiences to improve safety, efficiency and effectiveness.

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Implementation, Compliance, and Effectiveness of Maritime Labor Convention Regulations on Work and Rest Hours

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Abstract. Seafarers are exposed to various occupational health hazards on board ship, hence, are required to have adequate rest as fatigue has been identified a risk factor that could lead to unwanted injuries and accidents (Oldenburg, Jensen, Latza, & Baur, 2009; Oldenburg, Baur, Schlaich, 2010). In one recent study of seafarers working on board supply vessels serving the oil and gas exploration industry on the Norwegian continental shelf, Hystad, Saus, & Sætrevik (2013) found that excessive work demands influence the reported fatigue of seafarers. The right to enjoy adequate rest hours is protected by the International Labor Organization (ILO) Maritime Labor Convention (2006), which contains mandatory requirements governing maximum hours of work and minimum hours of rest for seafarers. The ILO-MLC was established as the fourth pillar of international maritime laws standing alongside Safety of Life at Sea (SOLAS), Marine Pollution (MARPOL), and Standards of Training, Certification, and Watchkeeping (STCW) Conventions adopted by the International Maritime Organization (IMO). It aims to ensure that all seafarers have the right to a safe and secure work place, clear rights to health protection, and decent working and living conditions on board ship (ISF Guidelines on the Application of the ILO Maritime Labor Convention, 2nd Edition). This descriptive study was conducted to determine the level of implementation, compliance, and effectiveness of MLC Regulations on Work and Rest Hours as experienced by cadets and seafarers who had been employed on board international vessels. Data were gathered through a set of survey questionnaires that were separately administered to six groups of respondents composed of Engine cadets, Deck cadets, Engine ratings, Deck Ratings, Engine Officers, and Deck Officers. The data gathered were analyzed and interpreted using the mean and standard deviation to determine the said objectives. Results revealed that the MLC Regulations on Work and Rest Hours is highly implemented and complied with and its level of effectiveness is high. The data further showed that despite the high implementation, compliance, and effectiveness of the MLC regulations on work and rest hours, certain problems were still experienced by the seafarers. These include lack of rest due to emergencies and inevitable operations, continuous work during maneuvering operations and transits (Deck cadets) and overhauling of machinery (Engine cadets), and shortage of manpower. Added to this, the cadets, in particular, had to apportion extended time for training and studying, as well as in responding to drills that were given during rest hours. The data also gathered reports on fiddling with records to cover certain violations on the implementation of rest hours. Moreover, the data revealed that compensatory rest hours were not granted in some vessels.

Keywords: ILO-MLC, rest hours, implementation, compliance, effectiveness, seafarer fatigue

1. Introduction

Seafaring is an occupation with specific work-related risks. Seafarers are exposed to a high diversity of occupational health hazards on board ship, hence, are required to have adequate rest as fatigue has been identified a risk factor that could lead to unwanted injuries and accidents [1]. Despite recent advances in injury prevention, accidents due to dangerous working and living conditions at sea, non-observance of safety rules and excessive work demands remain a leading cause of injury that is influenced by the reported fatigue of seafarers [2], [3].

The ILO Maritime Labor Convention (2006) is an International Labor Organization established as the fourth pillar of international maritime laws standing alongside the SOLAS, MARPOL, and STCW Conventions adopted by IMO [4]. It aims to ensure that all seafarers have the right to a safe and secure work place, clear rights to health protection and decent working and living conditions on board ship [5]. The MLC contains mandatory requirements governing maximum hours of work and minimum hours of rest for

seafarers based on ILO Seafarers' Hours of Work and Manning of Ships Convention 1996 (No. 180) [6]. All ships must maintain detailed records of work/rest hours for every individual seafarer on board to demonstrate compliance with ILO and IMO regulations. Non-compliance can result in detention [7]. Each member shall take account of the danger posed by the fatigue of seafarers, especially those whose duties involve navigational safety and the safe and secure operation of the ship. Ship owners must ensure that seafarers' working hours comply with the limits either minimum hours of rest must not be less than 10 hours in any 24 hour period, and 77 hours in any 7 day period: or maximum hours of work must not exceed 14 hours in any 24 hour period and 72 hours in an 7 day period using either option that the minimum hours of rest needed to comply must be divided into no more than 2 periods, one of these rest periods must be at least 6 hours in length, and the interval between consecutive periods of rest must not exceed 14 hours [8].

This study was conducted to determine the level of implementation and compliance of MLC Regulations on Work and Rest Hours on board ships and to verify its effectiveness as experienced by active seafarers.

2. Framework

The concept of this study is anchored on the MLC Regulation 2.3 (Hours of Work and Hours of Rest) put into force by the International Labor Organization (ILO) Convention which provides a framework for regulated hours of work, daily and weekly rest periods, and annual holidays. These regulations ensure high productivity while protecting workers physical and mental health (ILO Official Website 2015).

The respondents of this study are categorized into two departments: Deck and Engine. Both departments include seafarers such as cadets, ratings, and officers. This study aimed to determine the level of implementation, compliance, and effectiveness of the said regulation as experienced by these groups of seafarers.

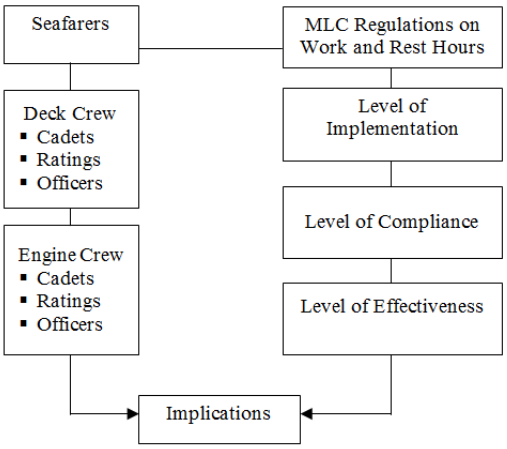

Figure 1 *Paradigm of the Study*

3. Objectives

This study aimed to determine the level of implementation, compliance, and effectiveness of MLC Regulations on Work and Rest Hours on board ships. Specifically, it sought to answer the following questions: (1) What is the level of implementation of the MLC Regulations on Work and Rest Hours as experienced by the seafarers? (2) What is the level of compliance of the MLC Regulations on Work and Rest Hours as perceived by the same groups of crew? (3) What is the level of effectiveness of the MLC Regulations on Work and Rest Hours according to their perceptions? and (4) What are the experiences of the seafarers on board related to the implementation of the MLC Regulations on Work and Rest Hours?

4. Methodology

The descriptive design using quantitative and qualitative approaches was used in this study. The survey method and interview were used to gather the data. The respondents for the study were composed of 40 Filipino cadets consisting of 20 Deck cadets and 20 Engine cadets who had worked as apprentices on

board for at least 12 months; and 40 active Filipino seafarers composed of 10 Deck officers, 10 Engine officers, 10 Deck ratings and 10 Engine ratings. Five respondents from each group were selected for the interview. The survey was conducted between August 27, 2015, and December 2016. All respondents were obtained through purposive sampling. A researcher-made survey questionnaire and interview guide which was validated by three experts in the field was used to gather the data. Its reliability was tested using Cronbach's Alpha. The mean and standard deviation were used to determine the level of implementation, compliance, and effectiveness of the MLC Regulations on Work and Rest hours as evaluated by the respondents.

Aside from the data computed from the seafarers' perception on the level of implementation, compliance, and effectiveness of MLC Regulations on Work and Rest hours, responses were gathered and transcribed to cite the experiences of selected seafarers who were selected for the interview. Answers were encoded, and thematic analysis was employed to allow the issues and concerns presented to emerge. Thematic analysis was done by first reading through the data, getting a feeling for what is being said, and identifying key themes and issues in each text.

5. Results

This section of the paper presents and discusses the results from the data gathered and the analyses conducted according to the sequence of the problems raised in this study. Various statements expressed by the participants during the interview are also presented here based on the themes of experiences that had emerged.

5.1 Level of Implementation, Compliance, and Effectiveness of the MLC Regulations on Work and Rest Hours

As a whole, Table 1 reveals that the Engine ratings' perception of the level of implementation of the MLC Regulations on Work and Rest Hours is higher than those of the other groups of respondents with respect to their departments having a mean score of 4.46 which is interpreted as "fully implemented." This implies that the engine ratings fully avail of the work and rest hours all the time.

The deck cadets and deck ratings obtained mean scores that are interpreted as "highly implemented." This means that the regulations on rest hours are implemented but not on all occasions. One of the deck cadet respondents quoted, *"Well, regarding rest hours, shipping is hard, but most of the time we comply with the necessary rest needed. It's just that, of course, there are personal factors like things you have to do during rest hours like washing your clothes and eating. Because of these, we cannot avoid not getting enough rest, but regarding rest hours allotted for the seafarers, most of the time we get enough rest needed."*

Table 1 Level of implementation of the MLC regulations on work and rest hours as perceived by the seafarers

Group	SD	Mean	Interpretation	Description
Deck Cadets	.70	3.92	Highly Implemented	Implemented in most occasions with everyone on board.
Engine Cadets	.48	4.32	Fully Implemented	Implemented at all times in all situations with everyone on board.
Deck Ratings	.51	3.74	Highly Implemented	Implemented in most occasions with everyone on board.
Engine Ratings	.39	4.46	Fully Implemented	Implemented at all times in all situations with everyone on board.
Deck Officers	.53	4.28	Fully Implemented	Implemented at all times in all situations with everyone on board.
Engine Officers	.41	4.36	Fully Implemented	Implemented at all times in all situations with everyone on board.

The mean scores shown in Table 2 indicate that, as a whole, the regulation is highly complied with onboard the ship. The highest perceptions are those of the Engine ratings and the Engine officers, which imply that, for them, everyone on board complies with it at all times in all situations. The rest of the respondents only think of it as highly complied, which implies that there are instances on board when the regulations are not strictly followed.

Table 2 Level of compliance with the MLC Regulations on work and rest hours as perceived by the seafarers

Group	SD	Mean	Interpretation	Description
Deck Cadets	.64	3.97	Highly Complied	Complied in most occasions with everyone on board.
Engine Cadets	.54	3.97	Highly Complied	Complied in most occasions with everyone on board.
Deck Ratings	1.04	3.53	Highly Complied	Complied in most occasions with everyone on board.
Engine Ratings	.37	4.60	Fully Complied	Complied at all times in all situations by everyone on board.
Deck Officers	.57	4.15	Highly Complied	Complied in most occasions with everyone on board.
Engine Officers	.66	4.28	Fully Complied	Complied at all times in all situations by everyone on board.

Table 3 reports that as a whole, the seafarers consider the implementation of the MLC Regulations on Work and Rest Hours as highly effective. This implies that, as a whole, they found it working on most occasions. This also means that there are instances when the implementation of these regulations is not effective. In his statement, one of the respondents revealed,

> "*Our ship keeps a record of work and rest hours of us on board through the computer software called DNV Navigator. But this record is not updated and properly maintained since the …* (identity withheld) *said that he would be the one to update it so that we will not be caught having violations when in port. He would just reflect there our regular working time but not our actual overtime…"*-Respondent 12

Table 3 Level of effectiveness of the MLC Regulations on work and rest hours as perceived by the seafarers

Group	SD	Mean	Interpretation
Deck Cadets	0.98	3.72	Highly Effective
Engine Cadets	0.60	4.02	Highly Effective
Deck Ratings	0.79	3.49	Highly Effective
Engine Ratings	0.69	4.24	Very Highly Effective
Deck Officers	0.77	4.11	Highly Effective
Engine Officers	0.60	4.31	Very Highly Effective
Total	**0.74**	**3.98**	**Highly Effective**

5.2 Experiences of Seafarers in Relation to MLC Regulations on Work and Rest Hours

In addition to the seafarers' perception on the level of implementation, level of compliance, and level of effectiveness of the MLC Regulations on Work and Rest Hours, this study also investigated on their experiences in relation to these regulations. Data for this purpose were gathered through a face-to-face interview with five focal persons from the group of deck cadets, engine cadets, deck ratings, engine ratings, deck officers, and engine officers who had been directly affected by such regulations.

Table 4 Thematic report of the experiences of seafarers which emerged during the interview

	Deck Cadets	Engine Cadets	Deck Ratings	Engine Ratings	Deck Officers	Engine Officers
Insufficient rest due to emergencies and inevitable operations, e.g., maneuvering operations and transits, overhauling and additional assistance in the machinery	✓	✓	✓	✓	✓	✓
Extra time allotted for the training and studies of cadets	✓	✓				
Drills and meetings during rest hour periods			✓			
Fiddling with records to conceal violations			✓		✓	
Insufficient compensatory rest in some vessels				✓	✓	✓

Insufficient rest due to emergency situations and inevitable operations. Table 4 reports a common experience among seafarers in relation to work and rest hours, that is, insufficient rest due to emergency situations and inevitable operations such as maneuvering operations and transits, overhauling, and additional assistance in the machinery. The data further revealed that despite the high implementation, compliance, and effectiveness of the MLC regulations on work and rest hours on board ships, there are instances when violations happen, and that internal arrangements are being made and understood among the crew involved to cover these violations during vetting inspections.

The following testimonies were recorded during the interview and transcribed verbatim. In conformance to research ethics, the identities of individuals, whether directly or indirectly mentioned, as well as sensitive issues not to be mentioned publicly, are intently withheld.

> *"I had worked for more than fourteen hours in one day. In that operation, we had provisions, services on the ship and were short of manpower so I exceeded to fourteen hours of work in a twenty-four hour period."* – Respondent 1

> *"As far as I can remember, I had worked for 18 hours because of berthing schedules, preparation for inspection and anchorage."* – Respondent 8

> *"I experienced working more than 14 hours a day, and it was an emergency, and we needed to overhaul our main engine before departure because we had to change the main engine's piston. Right after that, I was able to rest for only two hours because we were called to the engine room to attend to our duties for the departure of the vessel."* – Respondent 21

Extra time allotted for the training and studies of cadets. Table 4 also shows that, in the case of the cadets, extra time needs to be allocated for continuous training and studying. Cadets are required to undergo training on board to complete the educational requirements for a maritime degree (DOLE Department Order No. 130, 2013). On board, they needed to allow time to accomplish it aside from their actual working hours. For the cadets, Sundays and holidays are also opportunities for them to learn more on the bridge and in the Engine Room.

Drills and meeting held on Sundays. Another concern reported in Table 4 is that of the schedules of drills and meetings on board which affect their rest hours. According to their testimonies, drills and meetings are usually conducted during working hours. Due to overload of work and a lot of maintenance given by the ship management, they are specially scheduled on Sundays when they are supposed to be resting. This practice goes in contrary to the Conditions of Employment of Hours of Work and Hours of Rest

which states, "Musters, fire-fighting and lifeboat drills, and mandatory drills, must be conducted in a manner that minimizes the disturbance of rest periods and does not induce fatigue." [10]

Fiddling with records to conceal violations. Testimonies were also gathered during the interview as regards what they call as "fiddling with records to conceal violations." Although the respondents did not elaborate on this considering the issue to be controversial and sensitive, they implied that measures are usually done on board to cover for the violations that are made relative to work and rest hours.

Bhargava (2016) offers a related term for this. He explains that indeed, there are violations of rest hours, practically on most ships and that the only corrective action followed on board is **fudging of rest hours**, leaving the crew extremely fatigued, overworked, anxious and in an intoxicated like situation due to lack of sleep. He presented several reasons why this is done on board ships. One of this is "short manning" or ship owners restricting crew to numbers as per minimum manning certificate. According to him, this cost-cutting measure naturally puts additional workload on crew and additional hours are worked to meet the deadlines. This point of view was affirmed by the respondents in the following statements during the interview.

> *"Because of cost cutting, some vessels lack the required number of crew onboard which resulted in insufficient manpower. This is experienced by some ships in doing certain jobs. As a consequence, other deck ratings are required to assist in finishing the job even if it is their time to rest."*-Respondent 25

> *"I had this experience during our transit in Panama Canal. The Captain gave us an emergency order to stow six loose ropes on the forecastle and poop deck. In our ship, there was only one Pumpman, one Bosun, three ABs and a deck cadet, so we did not have an OS to help us, and one AB was resting well because he would then be in charge of steering the ship. We started working at 10 pm so that's the start of heaving up the anchor and we ended up resting the next day until we finished the transit in the Panama Canal, so it was more than 24 hours of working. There were still a lot of situations where we experienced too much lack of rest and over fatigue."*-Respondent 26

Insufficient compensatory rest. Paragraph 13 underStandard A2.3 of the ILO Handbook Guidance on implementing the Maritime Labour Convention, 2006 provides, "The competent authority may authorize or register collective agreements permitting exceptions to the limits set out. Any exceptions shall, as far as possible, follow the standards set out in this but may take account of more frequent or longer leave periods or the granting of compensatory leave for watchkeeping seafarers or seafarers working on board ships on short voyages." The data from the interview revealed that their vessels are adherent to providing the crew compensatory rest hours. However, in some vessels, compensatory rest hours are not adequately provided. According to their officers, this happens because there is only one officer on board assigned to do the job, so no matter how difficult, the job still needs to be done. The claimed reports on insufficient compensatory rest could be attributed to inadequate number of manpower to handle critical work in some vessels.

6. Conclusions

Seafarers are exposed to dangers posed by fatigue especially those whose duties involve the safe and secure operation of a ship. The implementation of the ILO-MLC 2006, particularly Regulation 2.3 on Hours of Work and Hours of Rest is intended to ensure that seafarers have regulated hours of work or hours of rest. According to this regulation, "establishing either maximum hours of work or minimum hours of rest is essential in order to protect seafarers against fatigue due to excessive demands on their time and to ensure in the interests of safety, that hours of work and overtime (even if voluntary), in particular, does not exceed levels that are compatible with the safe and efficient discharge of duties on board (p. 24)."However, even if this regulation has been found to be highly implemented, highly complied with, and highly effective in most of the ships of varying types and routes, there are still instances and situations when the terms of these regulations are not perfectly met, thereby still exposing seafarers to excessive work and inadequate rest hours. In heavy situations and critical operations, excessive time can still be required from the crew, regardless of whether they are properly rested or not. There seems to be a need for alternative measures to

fully ensure that all the crew gets adequate rest as protected by the regulation, particularly during emergency situations and inevitable operations. And because there are still reports where adherence to the regulation is not practiced, a more stringent implementation and monitoring needs to be imposed to prevent fudging of rest hours and seafarer fatigue.

7. Recommendations

Leaning on the results of this study, it is recommended that, as much as possible, reorientation on the Regulations on Work and Rest Hours should be provided before seafarers, particularly cadets, are sent on board so that they could gain information about their rights, and awareness on the management of fatigue. A more transparent record of work and rest hours should be observed, maintained and updated so that seafarers who have worked more than their maximum required hours will not be overlooked and will be given hours of compensatory rest. The implementation of seafarer's maximum work hours and minimum rest hours should be reported clearly to the ship owners so that the problem of shortage in manpower will be addressed and acted upon. There is also a need for management officers on board to provide appropriate guidance to the crew about these regulations in hours of work and rest and manage these appropriately. In situations where long transit periods are expected, the management team should allocate enough rest prior to the commencement of the transit, and distribute equally the workloads to all available manpower to lessen the magnitude of individual fatigue. Whenever and wherever possible, drills, mustering and meetings on board should be scheduled by the Master within the crew's working period in order to minimize disturbance to rest periods. In cases where excessive workloads cannot be avoided and drills should be urgently complied, advance planning of the job allocation and training period should be done to avoid disturbance in work hours. Additional crew members can help minimize the inadequate rest hour of seafarers on board for they can take turns in undertaking different duties, jobs and responsibilities.

8. Acknowledgment

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PERCEPTION OF HIGH SCHOOL STUDENTS TOWARDS MARITIME COURSES

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Abstract. The study determined the perceptions of high school students towards maritime courses in the Philippines. Quantitative-descriptive research design was utilized in this research. The respondents were the sixty (60) high school students from the John B. Lacson Foundation Maritime University-Molo, Philippines. The study employed a researcher-made questionnaire to gather data that were needed for analysis. The statistical tools employed were the mean, percentage, frequency, t-test, and ANOVA. The level of significance for inferential test was set at .05 level. Results of the study revealed that the high school students had "positive" perception in maritime courses. The most prevalent perception in maritime courses was "to give my family a better life" and the least perceptions were "want to be known in our community" as well as "I want to gain much power". There were no significant differences on the perceptions of the high school students towards maritime courses when the respondents were classified according to different categories such as age, sex, residence, and monthly family income.

Keywords*: perception, high school students, and maritime courses.*

1. Background of the study

Using perception studies, many individuals may see the world at different aspects (Gauthier, 2012). Perception may affect the ability to provide consistent quality service. Perception is influenced by understanding, knowledge, and continuous education (Zeilani, 2016). Perception of any subject, specifically, classroom environment may exercise an indirect influence on achievement by boosting interest and self-concept (Toslo, et al., 2016).

Every researcher in every scientific field is forced to address some philosophical questions. In this regard, this study aimed to find out the perceptions of high school students towards maritime courses as the profession they are going to take after graduating in high school.

2. Statement of the Problem

The study aimed to find out the perceptions of high school students towards maritime courses.

Specifically, this study aims to answer the following questions:

1. What is the level of perception of high school students towards maritime courses when taken as a whole group or when classified according to age, sex, residence, and monthly family income?

2. What are the most prevalent perceptions of high school students towards maritime courses?

3. What are the least prevalent perceptions of high school students towards maritime courses?

4. Are there significant differences in the perception of high school students when classified according to age, sex, residence, and monthly family income?

3. Conceptual Framework

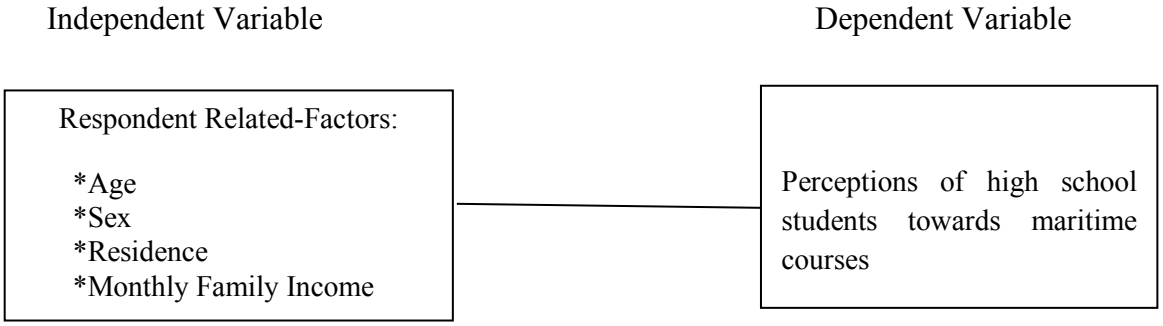

Figure 1. **Perceptions of high school students towards maritime courses as influenced by certain related-factors.**

4. Hypotheses

There are no significant differences in the perceptions of high school students towards maritime courses when classified according to different categories such as age, sex, residence, and monthly family income.

5. Significance of the Study

This study will be beneficial to the following:

School Administration. The result of this study will provide the school administration with the information of the perception of high school students towards maritime courses.

High School Students. This study will guide the high school students upon engaging in a maritime related course.

Researchers. This study can also be used as a basis of the researchers for the future investigations.

6. Purpose of the Study and Research Design

The purpose of this study is to determine the perceptions of high school students towards maritime courses. This investigation was employed to obtain information concerning status of phenomena. It is directed towards determining the nature of situation, as it exists at the time of the study (Teddie&Tashakkori, 2009; Creswell, 2011; Gray, 2014; Leedy&Ormrod, 2016).

According to Gay (1992, in Teddie&Tashakkori, 2009; Creswell, 2011; Gray, 2014; Leedy&Ormrod, 2016), quantitative-descriptive research involves collecting data in order to test hypothesis to answer questions concerning the current status of the subject and the study (Sebastian, 2015; Mamhot, 2016; Francisco et al., 2016).

7. Participants

The participants of this study were the sixty (60) high school students of John B. Lacson Foundation Maritime University-Molo- Maritime High, Philippines.

The proportional sampling method was used to choose the participants in the study. According to different experts in research, research sampling obtains samples that would fairly represent the different strata of the population to obtain a broad-based consensus of conclusions about population (Teddie&Tashakkori, 2009; Creswell, 2011; Gray, 2014; Leedy&Ormrod, 2016). To achieve fair sampling of the number of participants, the samples were drawn through a lottery technique (Sebastian, 2015; Mamhot, 2016; Francisco et al. (2016).

The participants were categorized as to Age (17 & below, 18 7 above), Gender (male, female), Residence (rural and urban), and Monthly Family Income (low, average, high).

The distribution of the participants is shown in Table 1.

Table 1
Distribution of the Participants

Category	Frequency	Percentage
A. Entire Group	60	100
B. Age		
Young (17 years old & below)	50	83
Old (18 years old & above)	10	17
C. Gender		
Male	40	67
Female	20	33
D. Residence		
Urban	52	87
Rural	8	13
E. Monthly Family Income		
High (20,001 & above)	25	42
Average (15,000 – 20,000)	22	36
Low (15,000 & above)	13	22

8. Research Instrument

The instrument was designed by the researchers to set up the personal profile of the student respondents to indicate their age, gender, residence, and monthly family income. The items in the questionnaire were answerable by agree, uncertain, and disagree. The scales were 3,2, and 1 respectively and the level of the students' perception was determine using the range of the distribution of scales as indicated below in the succeeding tables.

9. Data Gathering Procedure

There were sixty (60) high school students who served as the respondents of the study. The participants answered the survey questionnaire organized and distributed by the researchers. The researchers explained the instruction to the participants make sure that they understood properly before answering the questionnaire on perception in maritime courses.

When the task was duly accomplished, the questionnaires were retrieved, processed, tabulated, and were submitted to data analysis.

10. Statistical Data Analysis

The data obtained for the study were analysed according to specific questions and to test the null hypothesis.

For descriptive analysis, mean and standard deviation were used. For inferential analysis, the t-test and ANOVA (Analysis of Variance) were used. The level of significance was set at .05.

11. Results

The results revealed that as an entire group, the level of perception about maritime courses is "positive" with the mean score of 2.16. As to age, young (17 years old & below) and old (18 years old &above) participants have "positive" of the maritime courses with the mean scores of 2.17 and 2.10 respectively. When classified according to gender, male and female participants have "positive perception" with mean scores of 2.14 and 2.24 respectively. As to the type of residence, participants from urban and rural have "positive perception" with the mean scores of 2.17 and 2.15 respectively. As to the income of the participants, low, average, and high income-participants have all obtained "positive perception" about maritime courses in the Philippines.

Data are shown in Table 2.

Table 2
Level of Perception of High School Students towards Maritime Courses

Category	Mean	Description
A. Entire Group	2.16	Positive
B. Age		
Young (17 years old & below)	2.17	Positive
Old (18 years old & above)	2.10	Positive
C. Gender		
Male	2.14	Positive
Female	2.24	Positive
D. Residence		
Urban	2.17	Positive
Rural	2.15	Positive
E. Monthly Family Income		
High (20,001 & above)	2.17	Positive
Average (15,000 – 20,000)	2.20	Positive
Low (15,000 & above)	2.10	Positive

Scale	Description
2.51-3.00	Highly Positive
2.01-2.50	Positive
1.51-2.00	Negative
1.00-1.50	Highly Negative

Data revealed in Table 3, that the most prevalent perception about maritime courses is "I need to give my family a better life" with the mean of 2.52 and this means that the participants have "high perception" about the maritime courses in the Philippines. This is followed by the following

items such: (a) “I want to travel around the world” with the mean score of 2.43, (b) “It is common to our family” with the mean score of 2.23, (c) “I want to have a high salary with the mean score of 2.22, (d) “In order to feed my own pleasure” with the mean score of 2.20, (e) “I want to wear the ‘spick and span’ uniform with the mean score of 2.20, (f) “I want to be more attractive” with the mean score of 2.10, (g) “I have been influenced by my peers” with the mean score of 2.02, (h) “I want to be known in our community” with the mean score of 1.88, and (i) “I want to gain much power” with the mean score of 1.88.

Based on the data stated in Table 3, “I want to gain much power” was perceived the least with the mean score of 1.88. The respondents considered this item as “negative”.

Data are shown in Table 3.

Table 3
Different Perceptions of High School Students towards Maritime Courses

Perception about maritime related courses	Mean	Description
I wanted to have a high salary	2.22	Positive
In order to fed my own leisure	2.20	Positive
I have been influenced by my peers	2.02	Positive
I want to be known in our community	1.88	Negative
I want to gain much power	1.88	Negative
It is common to our family	2.23	Positive
I want to travel around the world	2.43	Positive
I want to wear the speck and span uniform of a maritime related course	2.20	Positive
I need to give my family a better life	2.52	Positive
I want to be more attractive	2.10	Positive
Entire Group	**2.16**	**Positive**

Scale	Description
2.51-3.00	Highly Positive
2.01-2.50	Positive
1.51-2.00	Negative
1.00-1.50	Highly Negative

Differences in the Perception of the Participants as Classified according to age, gender, and residence

Table 4 presents the t-test results in the perceptions of high school students towards maritime courses when grouped according to age, gender, and residence.

Table 4
t-test Results of Perceptions of High School Students Towards Maritime Courses Grouped According to Age, Gender, and Residence

Categories of Variables	Mean	t	df value	Sig.
A. Age				
Young (17 years & below)	2.17	.171	58	.865
Old (18 years & above)	2.10			
B. Gender				
Male	2.14	-.912	58	.366
Female	2.24			
C. Residence				
Urban	2.17	.138	58	.891
Rural	2.15			

p< 0.05

The t-test results revealed that no significant differences existed in the perception of high school students towards maritime courses when grouped according to age, t (58) = .171, p> .05, gender t (58) = -.912, p> .05, and residence t (58) = .138, p> .05.

Therefore, the null hypothesis, which states that there are no significant differences significant differences existed in the perception of high school students towards maritime courses when grouped according to age, gender, and residence, was accepted.

The data are shown in Table 4.

Differences in the Perception of the Participants as Classified according to Monthly Family Income

Table 5 presents the One-Way ANOVA (Analysis of Variance) results in perception of maritime courses in the Philippines when grouped according to monthly family income. As shown in this table, no significant differences existed in the perception of maritime courses when the participants were grouped according to monthly family income, F (2, 57) = .234, p> .05. Therefore, the null hypotheses which states that there is no significant difference exited in the perception of maritime courses when grouped according to monthly family income, was accepted.

Table 5

One-Way ANOVA in Perception of High School Students towards Maritime Courses Grouped according to Monthly Family Income

	Sum of squares	df	Mean squares	F	Sig.
Perceptions					
Between Groups	.077	2	.038	.234	.792
Within Groups	9.353		.164		

**p<0.05*

** Significant difference at 0.05 level.*

11.1 Summary

1. The high school students of JBLFMU-Molo, Philippines who were the respondents of this study had positive perception towards maritime courses.

2. The students perceived that maritime courses would "give their family members a better life" as the most prevalent perception here in the Philippines. The least perceived of maritime courses is to gain much power.

3. As to the differences in the perception in maritime courses, it was found out that there were no significant differences among high school students towards maritime courses when they were grouped to different categories such as age, gender, residence, and monthly family income. This means that every high school student has their own perception towards maritime courses.

12. Conclusions

Based on the findings of this study, the researchers conclude that:

The perception in maritime courses is "positive" because they believe that through these courses they could help their family members to attain favorable life in the Philippines.

Each high school student differs from each other; they have their own perception of the maritime courses. It is also known that the students come from different places, have gender-biases and influences, and come from different backgrounds, which lead to their different perceptions of the maritime courses in the Philippines.

13. Recommendations

In order to be part of the maritime world where there is a much more opportunity, the following are recommended:

1. The person in-charge of students' marketing shall conduct activities that focused in information and dissemination to the high school students about the importance and significance of maritime profession. Such activities may lead the students to know early on whether they want to engage themselves in a maritime world or not.

2. The administration shall give the high school students exposure through talks and seminars so that the students who want to engage in a maritime world shall prepare themselves specifically in the aligning of subjects offered by senior high school before they enroll in any of the maritime courses in college. This may help the students to know better the nature of the possible work of their chosen maritime course. This will lead them to prepare themselves for the future real situations.

3. The researchers suggest more studies to further determine other related factors influencing maritime courses in the Philippines.

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Identifying Efficient Learning Strategies for Maritime Vocabulary

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Abstract. By analyzing weekly maritime English learning progress reports for university students, this paper and my presentation has three goals:

1) To identify the difference in learning contents between students with high TOEIC scores and students with low scores

2) To track changes in study contents during the progression of their studies

3) To identify the best learning strategies for increasing vocabulary of Maritime English

Key words: Keywords: Learning style; Learning strategy; Learning strategies; Motivation; Language learning

1. Introduction

Many learners seem not to understand the importance of practice when it comes to learning the skills required for study (Najeeb, 2012). Many learners do not master learning strategies on their own sufficiently to make impressive gains in their language learning. Therefore, an element of strategy training is necessary (Bruen, 2001).

This presentation introduces efficient learning strategies for maritime vocabulary. The results of this study can be implemented at maritime institutions throughout the world as a way for students of Maritime studies to effectively improve their Maritime English vocabulary. The benefits of the study results are twofold: students can adapt their learning styles to get more knowledge effectively, which in turn also increases their motivation. If these measures are implemented, Maritime students will become more effective learners, and improve their opportunities to actively participate in a prospering Maritime industry. The effects are beneficial not only for the Japanese Maritime Industry, but also for the Global Maritime Industry as a whole.

2.Methology

In this study, the data of Rooks' 2012 study is used. 137 Japanese University maritime students in four separate classes participated in the study. Of these participants, sixty two students had previously taken the TOEIC test, and thus were divided into high and low proficiency groups. The mean TOEIC score of the high proficiency group was 632, and the low proficiency group was 435. The analysis of all participants' recorded data is regarding their study contents and habits outside the classroom. The participants kept mandatory study journals over an eight-week period, and were checked for completion by the teacher each week. The data was collected during the Spring Term of 2012, from mid-April until mid-June. In this study, the students' study contents are classified into the following groupings:

External Factors

1. Other People (1. homework 2. Presentation practice/preparation)
2. Materials (1. Review class content/materials 2. reading/textbook/English content practice)
3. Tests (1. study for TOEIC 2. study for test or exam)

Internal Factors

1. Self-Motivating Strategies (1) (1. speaking practice 2.listening practice)
2. Self-Motivating Strategies (2) (1. improve/study vocabulary 2. grammar/translation study)
3. Self-Motivating Strategies (3) (1. writing/journal practice 2. watched video/movie content)
4. Demotivating influences (1. No study 2. Busy, part time job/social, other 3. busy, other school work)

Other (1. Improving study habits/study time 2.Communicating with foreigners/travel abroad)

Table 1　Major academic events during the data collection

1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week
normal activities	presentation	short essay	mid-term report	listening test	normal activities	short essay/ midterms	major report

3.Results

In these graphs, “H” means students with high TOEIC scores and “L” means students with low scores.

Figure 1 differences in “Other People”

between higher and lower proficiency group

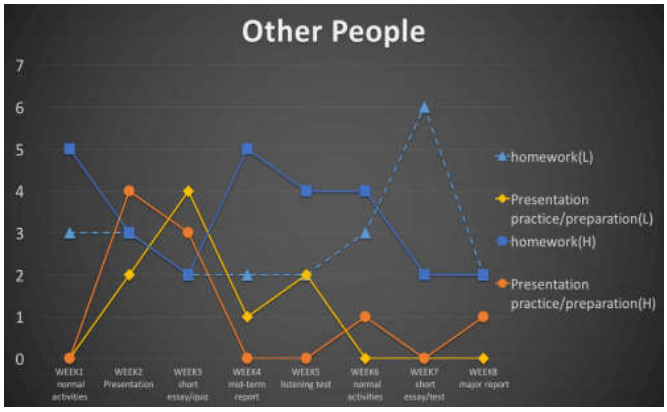

Figure 2 differences in “Material”

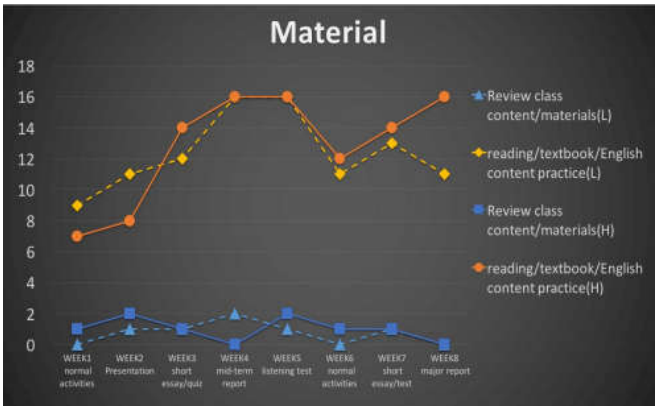

Figure 1 illustrates that H took more time to do their homework more than L through most of the week and all students took more time to do their homework than to do presentation practice/preparation.

Figure 2 illustrates that H took more time to review class content/materials and to do reading/textbook/English content practice more than L through most of the week and all students took much more time to do reading/textbook/English content practice than to review class content/materials. H took more time to do their homework and reviewed class content/materials than L through most of the week, so they seem to understand well what they learned in class and acquired new vocabulary. H took more time to do reading/textbook/English content practice than L through most of the week, so they seem to acquired more new vocabulary than L.

Figure 3 differences in "Tests"

Figure 4 differences in "Self-Motivating Strategies (1)"

Figure 3 illustrates that L took more time to study for TOEIC and test or exam more than H and all students took more time to study for TOEIC than for test or exam. Test of English for International Communication (TOEIC) is commonly used by many companies for recruitment and promotion purposes (Butler, & Iino, 2005). Students can't acquire maritime English vocabulary when they study for TOEIC, but they need to study TOEIC because is is needed for recruitment, so tests or exams held in maritime English class is important for students to acquire maritime English vocabulary.

Figure 4 illustrates that H took more time to do speaking practice than L and all students took more time to do listening practice than to do speaking practice. This is a serious problem for students because lack of time to speaking practice means lack of using vocabulary what they learned. In Japan, there are few native English speaker and time to speak English for students is very limited, so they should find more ways to speak English with native English speaker, time to speak English and chance to use vocabulary what they learned.

Figure 5 differences in "Self-Motivating Strategies (2)"

Figure 6 differences in "Self-Motivating Strategies (3)"

Figure 5 illustrates that all students took much more time to improve/study vocabulary than to do grammar/translation study.

Figure 6 illustrates that H took more time to watch more video/movie content than L. It seems that it is important to watch more video/movie content to acquire more new vocabulary.

Figure 7 differences in "Demotivating influences"

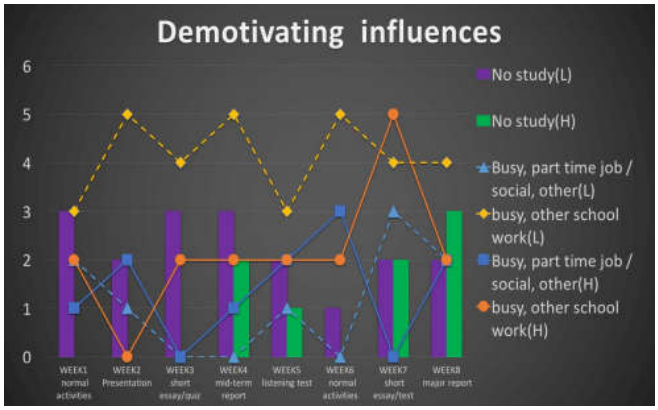

Figure 8 differences in "Other"

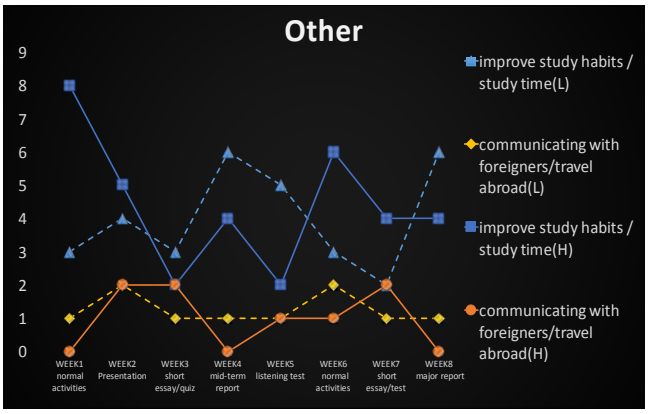

Figure 7 illustrates that H took more time to study English than L. It seems that time to study English is related to the TOEIC score directly. It seems that it is important to take as much time as possible to learn English to acquire more new vocabulary.

Figure 8 illustrates that H took more time to improve study habits/study time than L and all students took more time to improve study habits/study time than to communicate with foreigners/travel abroad. It seems that improving study habits/study time is related to English skill and in order to acquire more new vocabulary, it is important to improve study habits/study time. Less time to communicate with foreigners/travel abroad is related to less time of speaking practice illustrated in Figure 4. This is also a serious problem for students because lack of time to communicate with foreigners/travel abroad means lack of using vocabulary what they learned. They should find more ways to communicate with foreigners/travel abroad, time to speak English and chance to use vocabulary what they learned.

4. Conclusion

The main findings that can be taken from this study are:

1) In order to acquire new vocabulary, students should take as much time as possible to learn English.

2) Students should take time to do their homework and review class content/materials to understand well what they learned in class and acquired new vocabulary.

3)Students should take time to do reading/textbook/English content practice to acquire new vocabulary.

4) Students should find ways to communicate with foreigners/travel abroad, time to speak English and chance to use vocabulary what they learned.

5) In order to acquire new vocabulary, students should watch more video/movie content.

6) In order to acquire new vocabulary, students should improve study habits/study time.

These are efficient learning strategies identified in this study. Learning vocabulary, applying what they learn, reviewing what they learn and improving study habits/study time are important for efficient learning strategies.

Logbooks are also useful for acquiring vocabulary. Students see the value in the vocabulary logs and are motivated to focus on their lexical development (Rooks, 2013). Logbooks play a central role in three ways: they help learners to capture much of the content of learning, support the development of speaking, and provide a focus for assessment (Najeeb, 2012).

The optimal learning strategies are different from each other and students should find their own learning strategy that is best for them. Learners need to be given the skills to be able to seek out materials and resources outside the classroom to enable them to improve their recognition of what is relevant and what is not. They need to be able to recognize that these research skills are important and transferable and can be utilised when they go on to further study (Najeeb, 2012). The more positive their language learning beliefs, the more language learning strategies they reported on using (Ghavamnia, Kassaian, Dabaghi, 2011).

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The Motivations Behind Studying Maritime English

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Abstract. How motivated are seafarer trainees/cadets to learn Maritime English as a Foreign Language (MEFL)? This paper/presentation has two main goals: to do a comparative analysis of effective education of Vietnamese, Filipino, and Japanese maritime students, and to develop ways to implement better language-learning practice in Japan, where motivation to learn MEFL can be low. Through this research, the author would like to change Japanese maritime students' consciousness of studying English because it is necessary for maritime students to speak English fluently in the maritime industry for their future. Through a comparative analysis, the differences among these countries will become apparent, and successful strategies for learning Maritime English and increasing motivation may appear.

Key words: Maritime English; Learning English;

1. Introduction

The vessels of Japanese companies are using English as the main language of communication because of an increasing number of foreign crew (Nagao, 1978). Japanese seafarers need to use English for their jobs to communicate with other people. Despite

this, many Japanese students have lower motivation to study English in their university life than in their high school life because Japanese university students have no high-risk examinations of English in spite of having an opportunities to use English in course work (Rooks, 2012). They have no recent purpose to study English. This presentation will compare the Maritime English education system among Japan, Vietnam and Philippine to conclude what is the effective education of Maritime English. The methodology of this study operates under the hypothesis that the more effective education students receive, the higher their motivation is. This study also hopes to investigate what types of education are the most effective to raise the motivation of Maritime students studying English. The first part of this paper will give background information about various English education systems. The second part of the study will focus on analysis of interviews with Maritime institutions in Vietnam and the Philippines in order to identify successful aspect of Maritime English education that may be integrated in Japan.

1. Primary and Secondary English Education

Before I start to compare the maritime English education system, it is important to research and compare the Primary and Second education systems because the students have studied English since they start to go to Primary school. At first, I compare the difference of Primary and Secondary education system in English class by using four factors, which is the start year of learning English, the time of class in a week (each grade), the language used in class, and the examination system for university.

Table 1 General comparison of English Education among three countries in this study

	Start learning English	Education system (P-M-H)	Primary and Secondary English Class Hours	Teaching English through English	The university Entrance Examination
Japan	5th grade*	6-3-3	P 0-0-0-0-2-2 M 3-3-3 H 6-5-5	From university (particularly	Nation-wide exams (L .R.G.V)
Philippine	1st grade	6-4-2 Or 7-4-2	P7.5-7.5-7.5-5-5-5 M 5-5-5-5 H(No data)	From primary English	No nation-wide exams (R.W.G.V)
Vietnam	6th grade	5-4-3	P0-0-0-0-0 M 3-3-3-3 H 3-3-3	Not taught by English in any school levels	Nation-wide exams (R.W)

Source: Current trends and Issues in English language Education in Asia, 2008

Note: * Japanese government is going to start compulsory English class from 5th grade from 2020

P=Primary; M=Middle School; H=High School;

L=Listening; R=Reading; G=Grammar; V=Vocabulary; W=Writing

Table2 English test's score of all people who had TOEIC test

	TOEIC Score
Japan	516
Philippine	709
Vietnam	507

Source: report on test takers worldwide 2016

Table 1 shows the difference of education systems among three countries. Filipinos are the earliest to start learning English and they dedicate much time to the study

of English. When they enter an elementary school at 6 years old, they start to use English. On the contrary, Japanese and Vietnamese don't learn until entering junior secondary (Yeon Hee Choi, Hyo Woong Lee, 2008), (Japan is going to start studying English from 5th grade in 2020)[4] Table2 show the TOEIC average score of people who have a test in 2016 (Not only Maritime workers and students). The Philippines is the highest of the three countries, so the amount of Time and time to start studying English are important factors of different English skills. And also English class in the Philippines is taught in the target language (English) differing from Japan and Vietnam.

The nationwide exam is standardized, while individual schools make original tests suited for target students levels. When Filipino students would like to enter the university, they need various skills of English: Reading, Writing, Grammar, and Vocabulary. It is clear that Filipinos have a lot of opportunities to use and learn English and they sythesize skills through Primary and secondary school. Filipino students cannot avoid studying English because students have to get predefined English scores when they want to enter and graduate the university, or start to work at a good company.[5]

2. Maritime English Education system

I research about Maritime English education by interview for Vietnam Maritime University (VMU), Maritime Academy of Asia and the Pacific, Philippines. I listed the factors of effective education, which are Frequency, Methodology, Materials, and Educational objectives. I asked 14 questions to research about Maritime English Education in South-East Asia. Data is still being collected from the Philippines, so this paper will focus on the Japanese education system and Vietnam Maritime University.

A. Vietnam Maritime University

Vietnam Maritime University (VMU) is the education organization

where students who want to be seafarers go and study in Vietnam. VMU has a course of navigation and marine Engineering. VMU offers 2 undergraduate English programs, which are English language and Business English. VMU also offers many short classes for Maritime English whose term is about 3-5 months. These classes are mandatory for all Navigation and maritime Engineering students. In VMU, E-lecturing and Maritime English books are also used as materials in Maritime English classes. In classes teachers focus on 4 skills, which are listening, speaking, reading, and writing, and students are evaluated by tests and group presentations. There is an exchange program and foreign students visiting VMU. Vietnamese students take time to do homework about 3-5hours every week. TOEIC is used the data to asses student proficiency and the score is 450.And the average score of Navigation and Engineering student is 500-600, and the advanced classes is IELTS6.0-7.5.

B. Kobe university

Kobe University is located in Kobe city, Hyogo prefecture, Japan. There are two courses to be seafarers. One is the Navigation course, the other is Engineering course. Kobe university offer 7 classes to be seafarers Writing1, Writing2, Comunication1, Comunucation2, Maritime English1, Maritime English2, Maritime practical English. These are the mandatory class for navigation and Engineering students. In Kobe University, English-central and Maritime English textbook are used as materials. Through these classes, teachers make a point of speaking, writing, reading, and presentation skills, and students are evaluated by tests and presentation at the end of semester. There is an exchange program, the students visiting sister school in a few weeks and foreign students visiting Kobe university.

3. Conclusion

I compared the Primary, Secondary, and Maritime University education system among three countries. (Maritime University is just only two countries between Vietnam and Japan.) By comparing two countries in this paper, Japanese education system is similar with Vietnamese one in aspects of the start learning, the custom without using English in their life and the activities in Maritime classes. It seems that the Japanese and Vietnamese Maritime education is effective for improving English from the viewpoint of many resources taken in Maritime English classes, and students have a lot of chance to improve their English by taking special programs or advanced classes. But they can not improve their English unless they learn much positively because there is only 1 or 2 mandatory classes in a week and almost resources are optional. According to Philippine's primary and secondary school education, it takes much more time to touch with English to acquire the English skills. Philippine English starts from 1st grade and English is taught through English. It seems that English is used as a part of their life or education in Philippine and these system makes the whole level of English go up from the result of Table2. I have a suggestion that Japanese maritime English Education should offer the opportunity to use English not only classes, for example on board training, research activity, and in Non- English classes. If Japanese Maritime English education have much more opportunities to practice English by using in existence resources and program, education of Japanese has much more effective than ever before and connect to the motivational of students studying English.

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PRACTICAL APPLICATION OF KNOWLEDGE BY ASTRONNOVIGATION FOR THE DISCOVERY OF NEW ASTEROIDS IN THE SOLAR SYSTEM

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Abstract. *In this article we introduce the training, the research work applied in the observational campaigns organized by the International Astronomical Search Collaboration, and the final results. Presented are the discoveries of 27 new asteroids, which are located in the Main asteroid belt between Mars and Jupiter.*

Keywords: *equatorial coordinates, astrometrical calculations, asteroids.*

1. Introduction

Astronavigation is one of the sciences, which are being assimilated in order to prepare the students for successful management of the vessels. Its purpose is to define the place of a ship and the corrections of the compass in open sea. Furthermore, the astronavigation uses the methods and results of the spherical and practical astronomy. That gives the opportunity to define the coordinates of some sky objects. The knowledge of these two sciences expands the knowledge and skills of the future captains, and causes a big interest and motivation for studying. The learning of the different astronomical coordinate systems and equatorial coordinate system gives the opportunity of solving a variety of practical astronomical tasks [1]. One of them is defining the coordinates of fast moving astronomical objects. Solving this task is in the base of a national program for searching, discovering and tracking of asteroids in the Solar system. For 3 months the students from the Astronomical student society at NVNA worked on the program IASC. After conducting the research on the astronomical images,

obtained from big telescopes in the USA, the equatorial coordinates of over 500 asteroids were defined and 20 more asteroids were discovered. The next steps in this work is the defining of their orbits. That way the students are learning to solve tasks regarding the determination of the coordinates of moving objects, initially on the sky, and after that in the marine areas of our planet.

2. Practical application of astronautical education

At the Naval Academy, Varna astronavigation is studied for 45 hours. In the process of learning, conclusions are being drawn from the theory of spherical astronomy, the visible movement of lights, systems for measurement of time, astronavigation tools and the theory of the astronomical observations, rules for performing the basic ways of determination of the coordinates of a ship and the repair of a compass. The students are expected to determinate the place of the ship and the repair of the compass by using tables and measuring equipment, and to work with a navigational sextant.

One unusual practical exercise is to determinate the coordinates of moving objects in the Solar system. For the solution of this task one needs to know the elements of the Solar system, the different coordinate systems, especially the equatorial coordinate system, and the process of obtaining and processing astronomical images [2]. In order to take part in the observational campaigns of IASC, the mastering of the professional astronomical software ASTROMETRICS is required. With its help, animations from a couple of astronomical images are created, flying objects are identified, new asteroids are found and their equatorial coordinates, right ascension and declination are defined. After that, a special report containing the full information of the results of the measurements and the made calculations is prepared and is sent to the IASC center, and after that it is sent to Minor Planet Center, Harvard University, Figure 1.

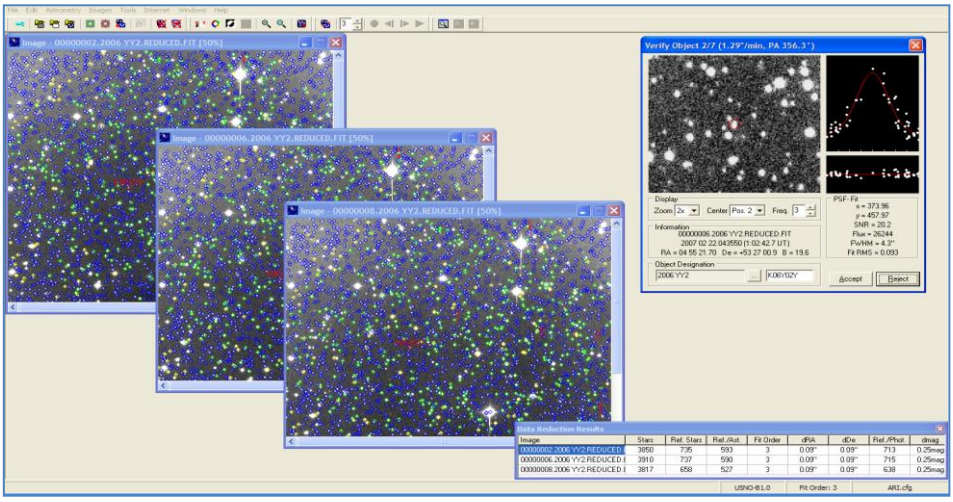

Figure 1. ASTROMETRICA – the professional astronomical software for detecting the asteroids and obtaining the equatorial coordinates

After processing the measurements, MPC sends information about any new objects found, and the obtained coordinates of known asteroids are used to define their orbits more accurately.

3. International Astronomical Search Collaboration

The International Astronomical Search Collaboration (IASC) is an educational outreach program for high schools, colleges and universities. It provides high quality astronomical data to students around the world. Students are able to make original astronomical discoveries and participate in hands-on astronomy. The research work of the students is organized into observational campaigns with a duration of 45 days. Observations for different companies are made by the big telescopes of Hardin-Simmons University (Abilene, TX), Lawrence Hall of Science (University of California, Berkeley), Sierra Stars Observatory Network (Markleeville, CA), Tarleton State University (Stephenville, TX), Yerkes Observatory (University of Chicago), Pan-STARRS (Institute for Astronomy, University of Hawaii), Faulkes Telescopes Project (Wales), G.V. Schiaparelli Astronomical Observatory (Italy), Western Kentucky University (Bowling Green, KY), Target Asteroids! (University of Arizona), Mt. Lemmon SkyCenter (University of Arizona), Las Cumbres Observatory Telescope Network (Santa Babara, CA), Catalina Sky Survey, University of Arizona. The biggest telescope used to receive astronomical images is the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS). Pan-STARRS located at Haleakala Observatory, Hawaii, consists of astronomical cameras, telescopes and a computing facility that is surveying the skyfor moving objects on a continual basis, including accurate astrometry and photometry of already detected objects. Students from the Student Astronomcal Society and the Student Space Society by

Nikola Vaptsarov Naval Academy have passed theoretical and practical training with regards to working on the researching program, carried out by the astronomer in the Planetarium of the Naval Academy, ass. Prof. Dr. Veselka Radeva.

4. The work of the student astronomical society in the observational campaigns of International Astronomical Search Campaigns

From the 19th of May to the 17th of June 2017, the students took part in two observational campaigns: Bulgaria-Luxembourg Asteroid Search Campaign and International Asteroid Search Campaign. From 17th June to 15th July 2017 the students participated in the International Asteroid Search Campaign. From 16th July to 15th August 2017 the students participated in the International Asteroid Search Campaign. Along with the Bulgarian students, many other students from universities around the world took place in these campaigns. During the campaign, astronomical observations with professional telescopes were made. The received astronomical images were placed in the web-pages of the teams. The students downloaded the images, worked on them using the astronomical software Astrometrics, found the moving objects, defined the vector coordinates and prepared a report for Minor Planet Center Figure 2.

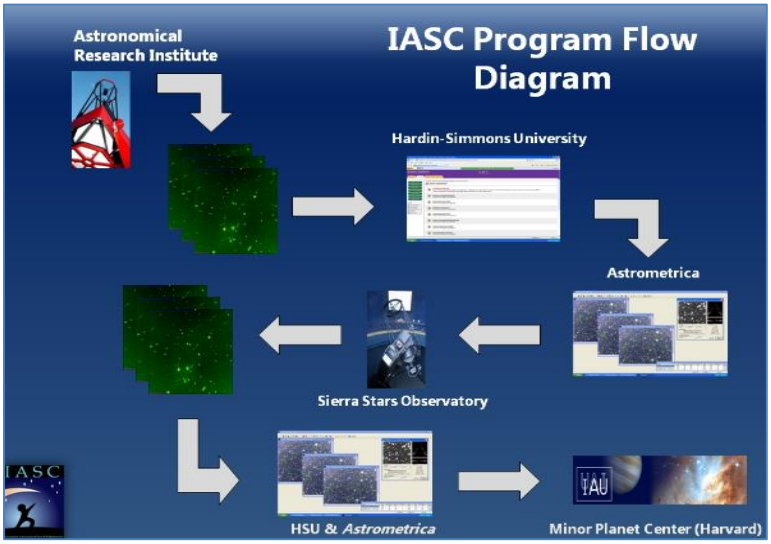

Figure 2. The process of detecting moving asteroids

The reports were sent to the leader of the Bulgarian teams Dr Radeva, who checked the accuracy of the measurements and only then the reports were sent to the Program Center. During a single campaign, a few dozen astronomical images were processed.

5. Results from the research of the astronomical images.

In the three campaigns, held in the months of May, June, July and August, the following students took part – Anton Dimitrov, Marian, Dimidov, Georgi Vidolov, Adriana Ivanova, Dimitar Traev, Svetoslav Georgiev and Konstantin Nikolov. The results of the three observational campaigns are listed in Table 1. A total of 360 astronomic images were processed. The equatorial coordinates, right ascension and declination of 1720 asteroids were determined, and in this way their orbits around the Sun were refined. 27 new asteroids were discovered, located in the main asteroid belt between Mars and Jupiter. More observations are required to calculate the orbital elements of the new asteroids. After determining the orbital elements of the asteroids, the opportunity to name each of the discovered asteroids will be given to the discovery team. The new asteroids initially receive provisional names containing letters and numbers such as "P10Bqf0".

In Table 1. are listed the following: the number of astronomic images processed, the number of known asteroids for which the equatorial coordinates were established, the newly found asteroids, the dates of their discovery and their discoverers.

Table 1. Results from the Asteroid Search Campaign held from 19 May to 17 June, 2017.

Observational Campaign	**19 May – 17 June 2017**		**17 June – 15 July 2017**	**16 – 15 August 2017**
	Bulgaria-Luxembourg	**International Asteroid Search Campaign**	**International Asteroid Search Campaign**	**International Asteroid Search Campaign**
Processed images	100 images	100 images	96 images	64 images
Famous asteroids, whose coordinates were measured	500 known asteroids	500 known asteroids	400 known asteroids	320 known asteroids
Main Belt Asteroid Discoveries New Asteroids Preliminary discoveries	1. P10Bqf0- 05/19/17 2. P10BqfR - 05/19/17 3. P10Bqmr - 05/19/17 4. P10Bqqf - 05/19/17 5. P10Bqqr - 05/19/17 6. P10Bqui - 05/19/17 V.Radeva, M.Dimidov, K. Nikolov & A. Dimitrov 7. P10Bpvi - 05/19/17 8. P10Bgfv - 05/19/17		1. AZD0001 –06/21/17 2. AZD0002 - 06/21/17 V.Radeva, M. Dimidov, G. Vangelov, A. Dimitrov 3. AZD0074 - 06/21/17 4. AZD0075 - 06/21/17 5. P10BDuY - 06/21/17 6. P10BDyf - 06/21/17 7. RDD0001 - 06/21/17 8. RDV0003 - 06/21/17	There aren't new asteroids in the images

	9. P10Bqmq - 05/19/17 V. Radeva, A. Dimitrov & M. Dimidov 10. P10BrZa – 05/21/17 11. P10Bs55 - 05/21/17 V.Radeva, M. Dimidov, K. Nikolov & A. Dimitrov 12. P10Bx2x – 05/27/27 13. P10BxDa - 05/27/27 14. P10BxmN - 05/27/27 V.Radeva, M. Dimidov, A. Dimitrov 15. P19BxAW- 05/27/27 V.Radeva, A. Dimitrov 16. P10BxGu - 05/27/27 17. P10BxNc - 05/27/27 18. P10BxoZ - 05/27/27 19. P10BxDs - 05/27/27 V.Radeva, M.Dimidov & A. Dimitrov	V.Radeva, M. Dimidov, G. Vangelov, A. Dimitrov	

Conclusion

The participation of the students in the International Asteroid Search Campaigns helped them to further develop their astronomical knowledge after undertaking an Astronavigation course. In addition, they gained ability to use professional astronomic software. The result of their research was the finding of 27 new asteroids located in the Solar System. The processing of the results greatly motivated the participants and encouraged them to expand their skills beyond their curriculum, thus increasing the quality of their education.

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The Importance of Training Vessels to the Education of Mariners

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Abstract: The United States of America is unique in the fact that most of its Merchant Officers earn their credentials through graduating from a maritime academy which utilizes a training vessel to obtain a significant portion of the required sea time. These vessels provide a unique platform to provide an opportunity to advance the knowledge and experiences of the students who travel onboard through guided instruction and experience opportunities. Although utilizing a training vessel is not an uncommon method for training mariners throughout the world, the utilization of a training ship to obtain the required time is unique within the maritime academies of the United States. These training vessels are an integral part of the education structure for the US maritime academies, primarily due to the opportunities they present, enabling these cadets to manage the ship themselves as well as participate in evolutions they might not have been able to on an operating ship. This paper discusses the advantages and disadvantages of this training ship method which has enabled thousands of Mariners to go to sea as officers for over 100 years allowing these mariners go out to sea with the experience needed to take the watch and ensure the safety of the ship and crew.

Keywords: Training Vessels, Maritime Education, Experience

The Importance of Training Vessels to the Education of Mariners

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For millennia, merchant mariners fueled the growth of the world economy by establishing trade routes for nations to buy, sell, and trade goods on a global scale. Dating back 1000 BC, before the invention of the compass, the Polynesians navigated the Pacific Ocean Island chains in order to expand and develop trade routes between colonies (Wayfinders, n.d.). The navigational techniques developed by the Polynesians, concentrated on their knowledge of the trade winds and the effects the small islands had on the direction of wind and current. These practices were passed down on ships by song, from Master to youth, for decades until more strict techniques, such as celestial navigation, were developed (Wayfinders, n.d.). Fast forward thousands of years to the present, the techniques which the Polynesians developed still stand as the foundation of basic seamanship and navigation. These techniques established also formed the stepping-stones for nations to build upon, allowing the development of merchant fleets, the exploration of the new world, and the evolution of extensive foreign trade to develop.

For nations to continue trading, it was required that mariners be trained on basic navigation and seamanship skill sets. It was common practice for a youth to join working ships and develop as a sailor or ship's officer over years of hands-on experience. However, the issue of an inexperienced crew member in a working environment was magnified during war. Therefore, Admiral Stephen B. Luce, USN developed a training program for U.S sailors on retired Navy ships during the American Revolution in the late 1700s (The stewardship report, 2011). These training ships acted as platforms for sailors to develop fundamentals that would be applicable to all ship platforms, regardless of assignment. Simultaneously, there was a decline in the merchant marine and overall professionalism of ship's officers in America. To resolve the issue, the New York Chamber of Commerce lobbied for a Nautical School to be established in New York and requested of Adm. Luce to grant the Nautical School a training ship, the USS St. Mary's (The

stewardship report, 2011). The Nautical School enrolled its first class in 1874 and offered the fundamental training necessary to develop ship's officers by combining both formalized training in a classroom setting as well as on the training vessel. Since then, the United States of America has been utilizing these training vessels as a critical training platform within the curriculum as they serve the purpose to train sailors on the fundamental techniques and practices necessary to cultivate a strong merchant fleet. Although the maritime training schools in the United States of America all follow different training plans onboard the ship, utilizing different rotations of duties or training evolutions, they tend to all follow similar methodology when it comes to the training of their cadets, allowing for this guided training of mariners in a safe environment to work effectively.

Today, training ships in the United States serve to give the future American Merchant Marine Officer a generalized training that will give them a solid foundation of experience and understanding on what is required and what they will experience as a 3rd Officer (M. Sobkow, Personal communication, 2017). While the American training ship experience lacks the cargo aspect that every commercial shipping experience has, not every cadet coming off commercial cadet shipping will experience the same type of cargo system. The Training ship offers a controlled environment to help develop and foster the American cadet. This allows the cadet to learn and mature as a seaman on their own and in a positive upward trend towards the license. Additionally, due to the operations of the ship, a commercial cadet shipping experience might be at anchor or tied up at the pier for the duration of the cadet's stay, reducing the navigation or operation based learning opportunities. On the training ships, voyages are planned so that they go through busy traffic separation schemes, rivers and many other navigational wonders solely for the purpose of giving cadets both deck and engine alike experience with ship handling and maneuvering. Whereas with commercial cadet shipping, most cadets will not experience these opportunities unless the ship is ordered by the company to transit these types of waterways. The learning of the cadets while commercial cadet shipping is not the priority of the officers and crew onboard as the operation of the vessel comes first, causing the cadet to often be considered a second thought or simply an extra hand. However, on training ships, the sole focus of the vessel is on training cadets and preparing them for sea.

There is no normal day onboard a training ship, cadets are constantly rotating through evolutions, training or watches. Onboard the Training Ship Empire State, some cadets will stand

watch, others will work on their assigned ship rate or assist those rates for the day. A ship rate is a designated duty or responsibility associated with the operation of the ship which a cadet can earn. Some examples of ship rates include the Safety Rates which are responsible for maintaining the Lifesaving Equipment, the Navigation Rates which plan and develop the Voyage Plans, and the Bosun Rates which maintain the docking and cargo equipment. A variety of classes are taught onboard as well. One of these classes is called Focus Training which is training focused on shipboard learning and a variety of aspects related to being a ship's officer that are difficult to experience on land. This includes loading wounded individuals into lifeboats, refilling SCBAs, utilizing mooring winches or the Appleton crane, along with many other exercises. These classes, watches, and evolutions, allow cadets to reinforce what they are learning at sea in a more practical environment.

Onboard a training ship, first and foremost cadets will learn the fundamentals. They learn to chip and paint correctly, stand lookout and be wipers in the Engine Room. While in this controlled environment with professional mariner oversight they learn to work their way up. This gives the cadet on their first cruise the experience of doing "unlicensed work". This first experience shows them how the unlicensed crew would operate on a ship and shows them to respect those who will work below them. At the same time, this gives the upper-class cadets, leadership experience which is critical for a Deck or Engineering Officer. They have to maintain the engine plant, keep the course and avoid collision all with the assistance of the underclass standing the unlicensed watches. As the upper-class practice their abilities to make decisions and develop their leadership, licensed officers are also present, ensuring the watches are stood properly and that cadets are giving the proper orders, ensuring the safety of the vessel and all those onboard.

All training ships also have a unique watch for their first class which allows them to practice being the Officer On Watch. On board the Training Ship Empire State, these watches are called the Cadet Watch Officer (CWO) and the Cadet Watch Engineer (CWE). These two positions allow a first class cadet to run the watch and gain the experience of controlling a watch in a controlled environment, whether at sea, anchor or alongside the pier. This allows for growth of the entire watch team, not just the CWE or CWO as the CWE and the CWO leads the entire watch team towards a successful completion of the watch.

Celestial Navigation is also a subject which is preached onboard training ships. While, it is may not be seen as prevalent in the industry today, the training evolutions focused on Celestial Navigation which are implemented on board these training ships allows these future Deck Officers to have a solid grasp on a back-up navigation system if there was ever an error to occur with their computerized navigational aids. This is accomplished on these training ships by requiring the Deck Cadets to constantly navigate through the use of the sun, stars, moon and land when applicable. When the training ship sails with land in sight, Pilotage watches are put into effect. A pilotage watch is conducted by having cadets go up to the Aft Chartroom and practice taking ranges and bearings. Training ships also allow the students to utilize the Navigational equipment such as the RADARs, AIS, VHF radios, and ECDIS systems while on watch. This allows the cadets to have hands on experience with these navigation aids in a practical environment.

Although there are many instructors on board a training ship, most incorporate the aspect of having the upper class cadets train and instruct the underclass. On board the Training Vessel Empire State, upper class cadets also stand instructor watches in both the engine room and aft chartroom. In the aft chartroom watch, a first class cadet will supervise and ensure all navigation done on the watch is correct. In the Engine Room, the cadet instructor teaches the underclass cadets anything and everything they need and should know. This position benefits both the growth of the upper class and underclass. Underclass build a more solid grasp of the material and upper class cadets develop leadership though guiding the underclass and ensuring the material they are teaching is correct. Third Officers are expected to instruct other crew members a variety of safety related material such as Safety Management System walk-throughs, engine systems or navigation. This evolution of cadet instructors helps prepare the students for this eventual responsibility.

With a considerable time on board spent at sea and no strict requirements on maintaining an ETA, training ships have more opportunities to practice lowering and recovering the Lifeboats. This allows Cadets the ability to actually drop a lifeboat on a ship that is underway in a structured environment that is not rushed with work schedules. With lifeboats in mind, some of the United States of America's training ships have open lifeboats as well, allowing them to observe the operation of a variety of systems. This provides the cadets all the tools required for a well rounded lifeboat experience, allowing them the ability to drop any gravity davit lifeboat

they will see. It is also easy to conduct Man overboard drills, allowing all cadets to learn and witness how to maneuver the vessel for a Williamson Turn and lower the Fast Rescue Boat. This drills also make it easy for the cadets to ride in the Fast Rescue Boat and practice the retrieval of a person through the use of a rescue dummy.

Weekly, onboard emergency drills are also held and utilized for more extensive training purposes. Damage Control Lockers filled with cadets get to don fire gear and to experience a drill. This allows for upper class cadets to lead the Damage Control locker with oversight from a licensed officer. Although officers are standing by as a guide and would take over in the event of an emergency, the majority of positions for drills are held by the cadets. Fire scenarios and duties of these assigned cadets are simulated on station, on the bridge, and in engine room. Boat Captains and personnel with responsibilities are generally upper class cadets who soon will be leading these drills on commercial ships.

On board a training ship, unique evolutions are held such as allowing deck cadets learn how to properly rig a pilot ladder according to IMO standards. For example, the Training Vessel Empire State has a licensed Mate who usually is a pilot, guide each cadet through rigging a pilot ladder properly. While the training ships are activated for relatively short period of time throughout the year, the vessels remain at the school, tied up at the pier. The vessel offers wealth of knowledge being around all year as being a practical platform for training purposes readily available. Cadets learn to stand in port watches, maintain the ship through weekly maintenance labs and work on the ship. This year round access to a vessel for the duration college education is a critical piece to the education of the cadets as well.

The future of the maritime industry has always been a bright and prosperous one. From the early days of sailing to the new age technology which help with cargo operations and navigation with the easy push of a button, the industry continues to be at the forefront of new ideas and technology. So what does our future hold? With our industry continually growing and moving towards technology for answers, the future training programs will include increasingly more simulators both on shore as well as on our new training ships. This can be seen on board the training ships of today such as the recent navigation simulator which was recently added to SUNY Maritime's Training Vessel Empire State. Similar to a training vessel, simulators provide a controlled environment to instruct students and provide countless opportunities for hands on training evolutions. With simulators and machinery that mimics that of what cadets will see on

both their time as a licensed officer, the cadets are provided the opportunity to have hands on training that will give them the confidence to make tough decisions along with the leadership skills necessary to be the officer the industry requires. Imagine, commanding a massive vessel in a densely populated channel where your decision making skills cannot harm a vessel or personnel but will show you the results in real time! As the dawn of digitization comes upon the industry, simulators are seen as the future of our day to day tasks in the commercial world so having the technology on a training platform with instructors to guide your thought process is ideal for the creation of the Merchant Officer. Other ideas that have been discussed at great length are to utilize medium sized vessels to train cadets. Professor Matthew Germann points out that these types of vessels would allow for a training structure which would utilize short voyages with a low number of cadets onboard, allowing instructors to show the cadet how to properly navigate small channels or harbors as well as the maintenance and housekeeping for the entire ship. From the safe navigation of the vessel, the powering of the amenities onboard and the crucial ordering, loading and cooking, this smaller platform provides the students the opportunity to learn all critical operations onboard the vessel (M. Germann, personal communication, 2017). As we look towards the future, the current training vessels are slowly aging and approaching the end of their usable life, with the average age being around 35 and the oldest being the Training Vessel Empire State at 55 years old (Tyler, 2015). Discussions between the State Maritime Academies and the US Maritime Administration are being made in regards to their replacement and the next generation of training vessels. This has included the discussion on the development of a new state of the art vessel which is specifically designed to train the future of the industry which keeps the concept of training primarily in mind.

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The concurrent jurisdiction generated by the collisions between two vessels in the open waters.″

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Abstract. The UN Convention on the Law of the Sea(UNCLOS), which was established in 1982, prescribes that the flag state has a compulsory jurisdiction to the vessel which he owns in the open water. This idea internationally has been established as the general rule. On the other hand, in case two vessels of different flag states collide in the open waters, a problem that flag states have the concurrent jurisdiction has been occurred. The problem means that which countries' law, the vessel which collided or was collided, should be applied to the collision in the open waters. I research on judicial precedents about the changes of judgements.

Keywords: Concurrent jurisdiction; collisions; open waters; flag state.

Chapter 1 Introduction

What kinds of legal problems will arise when vessels of different flags conflict with each other on the high seas? I will work offshore as a seafarer from next year. Therefore, I have been interested in the international rules on collision accidents and the existence of problems and chose this theme.

Chapter 2 Dispute settlement by flag state doctrine

In this chapter, I introduce precedents of crash cases and injuries cases on the high seas.

(1) Principles of flag state doctrine

Article 97 of UNCLOS regulates that flag states shall deal with criminal procedures for crew members for collision accidents on vessels on the high seas. In other words, (1) the criminal jurisdiction over crew members of foreign vessels, which have collided with the Japanese vessel on the high seas and damaged it, is exercised by the flag state of the foreign vessel or the country to which the crew belongs, (2) Japan can not exercise criminal jurisdiction over crews who are foreigners with criminal responsibility for the crash case concerned.

(2) The case of the Roots Incident

In 1926, a crash of a Turkish vessel and a French vessel occurred in the public waters. The International Court of Justice (ICJ) granted Turkey's criminal jurisdiction as having no international law prohibiting the flag state of the vessel where the outcome of the crime has occurred in the domestic territory and prohibiting it from prosecuting it.[1] However, the maritime industry repeated strong criticism against this ruling, and now the idea of this ruling has been denied.

(3) Texaca incident

In 1966, the Texaca of the Liberian flag vessel on the high seas collided with the Japanese flag vessel, and the crew was injured. The court stated that as long as the conduct occurred outside the country, as long as the outbreaks occurred in the country, the Japanese Criminal Law is applied as domestic offenses.[2]

(4) “Daiichi Horyomaru” Incident

In 1985, a tanker with a Liberian flag vessel collided with a fishing boat of our country on the high seas, the fishing boat sunk, and five crew members have been missing. The Japan Coast Guard concluded the investigation by concluding that Japan has no jurisdiction for criminal jurisdiction, according to the provisions of the High Seas Treaty regulating flag state doctrine.[3]

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[1] Takeuchi, Mari (2011) “国際法判例百選*[100 international law cases selected]”,* 42-43, Tokyo : Yushindo.

[2] Japan Ocean Association(1993)”公海上での衝突 II *[Collision in high seas]”,* 98-98, Tokyo: Japan Ocean Association.

[3] Japan Ocean Association(1993)”公海上での衝突III*[Collision in high seas]”,* 98-100, Tokyo: Japan Ocean

(5) TAJIMA incident

In 2002, a Japanese navigator was killed by a Filipino crew in a tanker registered in Panama. At that time the Japanese Criminal Law did not prescribe punishment provisions in cases where Japanese were murdered by foreigners on foreign vessels on the high seas. As such, Panama which is the flag state exercised criminal jurisdiction and the innocence of the defendant was finalized in Panama. With this incident, Japan revised the Japanese Criminal Law, foreign criminal provisions of non-citizens were added to criminal law.

Chapter 3 Problems and Solutions of Flag Nationalism

UNCLOS regulates that a "genuine relationship" must exist between a flag state and a vessel, but there is no definite definition. If the harmful vessel has a weak relationship with the flag state, it seems that there is no problem even if it is claimed that the damaged vessel refuses punishment by the Flag State Act of the harmful vessel, because of the absence of its genuine relationship. However, in the interpretation and precedents of the Convention, the lack of a genuine relationship between a vessel and a flag state justifies that other countries deny the nationality and flag of the vessel and interfere with the vessel at public offshore or port etc. It is supposed not to be a reason. [4]Also, there are problems with sub-standard vessels which are not sufficiently managed by the flag states such as the structure and equipment of the vessel, management of labor, etc., and do not conform to international treaties. In case of collision with these vessels, damaged vessels are not relieved in many cases. Even if it collides with such vessels and suffered damage, it is impossible to punish a harmful vessel by the Flag State Act of the damaged vessel. Isn't this too preferential treatment for harmful vessel?

Chapter 4 Proposal and verification for applying national law of victimizing vessels

Based on the discussion from Chapters 1 to 3, in this chapter, when a collision accident occurs on the high seas, I will consider the measures to apply the case by applying the Flag State

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Association

[4] Chiyuki, Mizukami(1994)"船舶の国籍と便宜置籍*[Nationality and convenience of vessel]*", 198-227, Tokyo-Kobunsha.

Law of the damaged vessel.

(1) Strengthening of criminal law for punishment of foreign crime

The 2003 criminal law amendment stipulates the provision of foreign criminal punishment that the Japanese Criminal Law can be applied when Japanese people suffer damage in a foreign country. However, if the flag state of the collision vessel is a country that ratifies the treaty, Japan can not punish foreign burglars without the consent of the flag state.

(2) Request cooperation to flag state of harmful vessel to seek surrogate punishment and arrest of criminal

In theory, it is possible to punish foreigners with the Japanese Criminal Law, but in fact it is not allowed to punish unless the flag state of the harmful vessel permits and does not deliver the accused to the flag state of the damaged vessel. Although it is possible for Japan to seek surrogate punishment and cleansing in the flag state of the harmful vessel, this method also depends on the action of the flag state, and it can not protect the crew of the damaged vessel after all.

(3) Concluding criminal delivering treaties between two countries

Japan is an extremely few country that has concluded a criminal delivering treaty worldwide. If we conclude this Convention, which has only been concluded with the US and South Korea, with major flags of convenience (FOC) in the world, it will be possible to request the handover of the offender.

Chapter 5 Conclusion

First, the Japanese Criminal Law can not punish overseas offenders without the cooperation of the flag state. Second, not only Japan but also FOC are members of the treaty. Third, it is difficult to revise the agreed flag state doctrine which many countries support due to the shipping practices and economic policy. From these three points, Japan should conclude a criminal delivering treaty with major FOC in order to make it possible to punish a perpetrator based on the Flag State Act of the damaged vessel in the case of a collision between different vessel's vessels on the high seas.

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RESEARCH THE PROBLEM OF MARITIME LIENS IN MARITIME TRANSPORTATION

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Abstract. Maritime lien goes back a long time in Maritime Law. It is rich in content, which makes it the most compelling research topics in the theory and practice of the world maritime laws. Countries develop their own system of maritime lien suited for them according to their national conditions. In order to eliminate the contradictions and conflicts of national laws on maritime liens, the international community has developed a three International Convention on maritime liens, which are International Convention for the Unification of Certain Rules of Law Relating to Maritime Liens and Mortgages of 1926, International Convention for the Unification of Certain Rules Relating to Maritime Liens and Mortgages of 1967, and International Convention on Maritime Liens and Mortgages of 1993.

Vietnam's system of maritime lien refers to the 1993 convention, and is basically consistent with the convention. Moreover, in 1990 Vietnam published Maritime Code of Vietnam, in which regulated in procedures the exercise of maritime liens.

However, the implementation is still difficult. In addition, the absence of a separate law relating to maritime liens also needs to be considered. This study compares the maritime liens in Vietnam and some other countries in the world, thereby providing solutions to problems of maritime liens in Vietnam.

Keywords: International Convention for the Unification of Certain Rules of Law Relating to Maritime Liens and Mortgages of 1926; International Maritime Organization (IMO).

1. Introduction

Some changes to maritime liens have taken effect in Vietnam, affecting owners and their donors around the world. The Supreme People's Court of Vietnam has clarified the provisions on arrest of seagoing ships in the Vietnam Maritime Code effective July 1, 2017 and supersedes all previous provisions of law relating to the arrest of seagoing ships. Concerned with maritime liens.

Vietnam is not a party to the International Convention for the Unification of the General Rules Relating to Maritime Liens and Mortgages, 1926, as well as to the International Convention for the Unification of General Rules relating to Maritime liens and mortgages, 1967. However, Vietnam's maritime liens are simulated by the 1993 Convention.

The International Convention on Maritime Liens and Mortgages of 1993 have rules for maritime liens at article 4:

1. Each of the following claims against the owner, demise charterer, manager or operator of the vessel shall be secured by a maritime lien on the vessel:

(a) Claims for wages and other sums due to the master, officers and other members of the vessel's complement in respect of their employment on the vessel, including costs of repatriation and social insurance contributions payable on their behalf;

(b) Claims in respect of loss of life or personal injury occurring, whether on land or on water, in direct connection with the operation of the vessel;

(c) Claims for reward for the salvage of the vessel;

(d) Claims for port, canal, and other waterway dues and pilotage dues;

(e) Claims based on tort arising out of physical loss or damage caused by the operation of the vessel other than loss of or damage to cargo, containers and passengers' effects carried on the vessel.

2. No maritime lien shall attach to a vessel to secure claims as set out in subparagraphs (b) and (e) of paragraph 1 which arise out of or result from:

(a) Damage in connection with the carriage of oil or other hazardous or noxious substances by sea for which compensation is payable to the claimants pursuant to international conventions or national law providing for strict liability and compulsory insurance or other means of securing the claims; or

(b) The radioactive properties or a combination of radioactive properties with toxic, explosive or other hazardous properties of nuclear fuel or of radioactive products or waste.

And also at article 5 about Priority of maritime liens:

1. The maritime liens set out in article 4 shall take priority over registered mortgages, "hypothèques" and charges, and no other claim shall take priority over such maritime liens or over such mortgages, "hypothèques" or charges which comply with the requirements of article 1, except as provided in paragraphs 3 and 4 of article 12.

2. The maritime liens set out in article 4 shall rank in the order listed, provided however that maritime liens securing claims for reward for the salvage of the vessel shall take priority over all other maritime liens which have attached to the vessel prior to the time when the operations giving rise to the said liens were performed.

3. The maritime liens set out in each of subparagraphs (a), (b), (d) and (e) of paragraph 1 of article 4 shall rank *pari passu* as between themselves.

4. The maritime liens securing claims for reward for the salvage of the vessel shall rank in the inverse order of the time when the claims secured thereby accrued. Such claims shall be deemed to have accrued on the date on which each salvage operation was terminated.

2. Maritime Liens in Vietnam Maritime Code:

Basically, maritime liens were defined by Vietnam in the 1990 maritime law in Articles 30, 33 and 34 but there was no particular section on maritime lien, not to mention the definition of maritime liens, no priority order for maritime liens. Then, by 2005, Vietnam maritime code was modified, divided into clearer sections and titles. In particular, the maritime liens set out in Sections 7, 36 to 39 specifing what the maritime lien is, the priority order of the right to hold, the claims arising and the statute of limitations. In brief, it can be said that the 2005 VML was finalized and match with the international convention on maritime liens and mortgages 1993.

Therefore, following a process of amendment and addition to the 2005 Civil Code, maritime liens are the same as those in VRS 2005, Section 6, Articles 40 to 43 as follows:

Article 40. Maritime liens

1. A maritime lien is the right of the claimant who make claims listed in Article 41 of this Code, to take priority in compensation against shipowners, demise charterer, manager or operator of the ship, with respect to the ship which give rise to the said claim. Maritime claim is a claim made by one party to request the other party to implement his obligations relating to maritime activities.

2. The maritime claims secured by a maritime lien on the ship set out in Article 41 of this Code shall take priority over the claims secured by registered mortgages, or other charges.

3. A maritime lien shall be enforced by the court by arresting the ship that gave rise to the said maritime lien.

4. The claimants has the claims as stipulated in Article 41 of this Code shall be secured by a maritime lien on the ship even the ship has been mortgaged or the shipowner has used the ship as security to conduct other transaction based on a contract.

5. Maritime lien shall not be extinguished by virtue of the change of the shipowner, the demise charterer, the operator of the ship whether the buyer of the ship has the knowledge of or without the knowledge of the ship in connection to a maritime claim secured by a maritime lien.

Article 41. The maritime claims secured by a maritime lien on the ship

1. Claims for wages and other sums due to Master, officers and other members of the ship's complement, including costs of repatriation and social insurance contribution payable on their behalf

2. Claims in respect of loss or personal injury occurring in the operation of the ship

3. Claims for ship's tonnage dues, maritime safety fees, pilotage dues, harbour dues and other port charges.

4. Claims for reward for the salvage of the ship

5. Claims based on tort arising out of loss or damage caused by the operation of the ship.

Article 42. Priority ranking of maritime liens

1. The maritime liens set out in Article 41 of this Code shall rank in the order listed, provided that maritime liens securing claims for reward for the salvage of the ship shall take priority over all other maritime liens which have attached to the ship prior to the time when the operations giving rise to the said liens were performed.

2. The maritime liens set out in each paragraph of Article 41 of this Code shall rank pari passu as between themselves. Where they could not be paid in full, the debts in the same paragraph shall be paid in proportion.

3. Claims arising from one and the same occurrence are deemed to have come into existence at the same time.

4. Maritime lien on sea-going ship arising from the last voyage has priority over that from previous voyages.

5. Claims arising from a contract of labour relating to several voyages are settled simultaneously with the claims arising from the last voyage.

6. The maritime liens securing claims for reward for the salvage of the ship listed in paragraph 4 Article 41 of this Code shall rank in the inverse order of the time when the claims secured thereby accrued.

Article 43. Extinction of maritime liens by lapse of time

1. The maritime liens shall be extinguished after a period of one year since the time such maritime lien come into existence.

2. The time when maritime lien comes to existence shall be determined as follows:

a. For claims relating to salvage remuneration: from the day of termination of the salvage operation;

b. For claims relating to compensation for damage caused by collision of ship or by other marine accident: from the day when such damage was caused;

c. For claims relating to debt: from the day when they fell due.

3. The maritime lien shall be extinguished when debts giving rise to maritime lien are fully paid by the shipowner, charterer or ship operator. But such maritime lien remains in force as long as the sum of money paid is still in the hand of the Master or other person who is authorized on behalf of the owner, charterer or operator of the ship to pay debts in connection to maritime claims.

4. When courts fail to effect the arrest of the ship in Vietnamese internal waters or in territorial waters to protect the interests of a creditor having its residence or principal place in Viet Nam the time limits defined in paragraph 1 of this Article shall be terminated after thirty days from the date of arrival of the ship at the first Vietnamese port, and maximum not later than two years from the date when such maritime lien comes into existence.

Claimant	Type of Claim
Tower	Unpaid towage Damage to towboat Unpaid freight Breach of charter Demurrage
Barge Owner	Damage to barge Demurrage Breach of charter Unpaid freight
Cargo Owner	Cargo damage Breach of charter Breach of contract of affreightment
Supplier	Unpaid fuel, lube, oil and other necessaries
Fleeter	Unpaid fleet charges Damage to fleet property
Stevedore	Certain stevedoring services
Insurer	Unpaid insurance premiums
Repair facility	Unpaid repairs, dry dock

3. Compare the maritime lien's state of Vietnam to others in the world

Maritime liens are only carried out when:

+ The debt is money, charges or other amounts of the shipments are aboard.

+ To retain the goods are on board, or they have to be unloaded at the port warehouse, but still within the control of the carrier. Circumstances beyond the 2 conditions above are not applied ship-owners terms seizure of whether the contract or bill of lading clauses mentioned the restaurant holds or not.

Comparison

- Philippines list of maritime liens more extensive

• Application of priority Straight forward

• wages does not include emoluments, repatriation and social contribution

• Recognize Foreign maritime liens

- Australia only 4 maritime liens

• Prima facie ranking guiding principles maybe displaced by equity

• Wages includes emoluments, repatriation and social contribution

• Does not recognize

In summary, the implementation liens goods, must be based on the specific situation in places of detention in order to carry out the treatment. Each country has rules, different procedures, which can therefore be done to hold relatively simple goods easy but there are places that can not be done, or done but must be passed court procedures more complex. When in trouble on the issue of detention of goods, should first consult the Association sponsored the ship-owner (P & I Club) for Association P & I often have expert understanding of the issues related to the procedure Meeting holds the world's ports

4. The reality of maritime liens

Vietnam's detentions have not been fully implemented. Vietnam does not have a specialized court to handle maritime lawsuits, and there are no specialized maritime magistrates. Although Vietnam's maritime code is built in line with international maritime conventions, implementation is still difficult. In addition to the Vietnam law, Vietnam does not have many other legal documents providing more detailed guidance on maritime liens. Arrest procedures are not clearly defined. Evidence is that in the five years from now, from 2012 to 2016, the number of seizure cases based on maritime liens is minimal, because of insufficient authority and evidence of arrest.

Countries develop their own system of maritime lien suited for them according to their national conditions. In order to eliminate the contradictions and conflicts of national laws on maritime liens, the international community has developed a three International Convention on maritime liens, which are International Convention for the Unification of Certain Rules of Law Relating to Maritime Liens and Mortgages of 1926, International Convention for the Unification of Certain Rules Relating to Maritime Liens and Mortgages of 1967, and International Convention on Maritime Liens and Mortgages of 1993. It created ra conflicts about the law, and the choice of the choice are very difficult.

"Proper law" is the decision as to which territorial law is to govern the contract, defines the obligations of the contractual parties and determines whether the contract is valid and legal. It also determinates the effects and conditions of discharge. Selection of the "proper law" to adjudicate the marine contract is a difficult task in Admiralty Jurisdiction because the issue of whether enforcement of the maritime lien is allowed by international law may turn on interpretation of the law of the country where the litigation is. So, the question is over the priority of the law where the lien was created (lex loci), as opposed to the law of where the court exercising jurisdiction (lex fori).

The answer is found in the application of a multiplicity of contract analysis process. The court will weight and analyze all related factors between the transaction and the respective legal systems by a case-by-case analysis. The factors may include: (a)the need of the international system; (b)the protection of justified expectation; (c)ease in determination and application of the law to be applied; (d)relevant policies of other interested states; (e)the place of the wrong; (f)the law of flag; (g)the allegiance or domicile of the injured party; (h)the law of forum; (i)the place of the contract; (j)the allegiance of the defendant ship-owner and so on. The prefect decision will result from a balance between the relevant factors.

5. Conclusion:

The first part of this paper described a wide variety of ways to exercise a maritime lien, so it is likely to cause unnecessary confusion. With a maritime lien case, depending on the degree of progress, there are two ways of executing the maritime lien. One is separating exercise, meaning that during the exercise of maritime lien, the maritime claimant applies for court seizure of the ship that caused the maritime claim. If the parties provide guarantees, the maritime claimant gets the repayment based on the guaranteed funds. If there is no sufficient and satisfactory guarantee made by anyone, the maritime claimant applies for court auction of the ship, and gets compensated from the auction proceedings in accordance with the legal order. The other one is joint exercise, meaning when the ship is applied for auction, the registration of rights is applied as well.

Related behaviors are followed in chronological order: arrest, litigation, auction, registration of rights, and action for affirming rights. In judicial practice, generally, it is not accepted to re-seize the ship after it has already been applied for seizuring by someone else.

Therefore, for the executing the maritime lien independently, if the debtor does not provide guarantees, after that the lien holder can bring up the litigation or court arbitration, and then apply for the auction. The problem is that when jointly exercise the maritime lien, the lien holder cannot apply again for arresting the ship, thus the concept of "maritime lien shall be exercised through the court seizes the ship causing the maritime lien" is fundamental. The crux of the problem is whether or not the lien holder has to personally initiate the seizure procedure when the ship has been seized by the application of others.

Overall the Convention is a very good development and therefore should be ratified or at least national law should be enacted similar to it and do away with the less desirable provisions because it:

- Promotes uniformity
- Careful regulation in the registration and more better protection to security holders
- Add more protection to seamen
- Logical order of priority in ranking liens especially on salvage
- Resolve the problem relating to oil, nuclear and other hazardous substances

However, to resolve maritime disputes which arise in the various claims, the Vietnam Courts have necessarily to rely on laws which are developed internationally, particularly the Judgments of English Courts for deciding various disputes before it, in as much as, a substantial part of the Maritime Law requires to be interpreted by reference to these foreign judgments. If the shipping and maritime law is passed in the Indian Parliament then the Vietnam Admiralty Law and Practice will be more or less on par, with the Admiralty Law practiced internationally by all major States in the world.

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Construction and implementation of a magnetometer as a learning platform for marine survey

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Abstract

The paper presents the construction of a relatively simple fluxgate magnetometer and its adaptation for marine magnetic surveys; the purpose of it being to map large ferromagnetic objects on the sea bed, that could pose a danger to navigation and/or the environment. Among various types of magnetometers used for magnetic surveys, the fluxgate ones are the most convenient in terms of cost and complexity of construction, providing also adequate performance for the stated purpose. The constructed device constitutes also a learning platform for persons interested in acquiring the skills of performing a marine survey, without much of the constraints imposed by a larger system.

Introduction

Magnetic surveys at sea have been employed successfully for mapping ferrous objects (1) on the sea bed, for mapping geological features of the sea bottom, and for mapping archeological structures (2). For the purpose of this paper we will focus on large ferrous targets on the sea bed that could pose a hazard for navigation and the environment. Such targets are recently sunken vessels, lost or thrown cargo at sea (containers, barrels), other large underwater iron based structures

Magnetometers are devices that can measure the magnetic flux density of the Earth. In SI (international system of units) the magnetic flux density is expressed in Tesla (T), or in practice in nanoTesla (nT = 10^{-9} T). For example the Earth's magnetic field has an average value of 50,000 nT, while a small permanent magnet can easily surpass this value by over 2000 times. Magnetometers can signal the presence of ferromagnetic objects (iron, steel, nickel, cobalt, etc.) because they disturb the value and direction of Earth magnetic field. The most common types of marine magnetometers in used today are the fluxgate and proton precession ones (3).

The fluxgate magnetometer is based on the transformer effect (4). As in a transformer there are two separate windings on a high magnetic permeability core. An alternating electric current passes through the primary coil, driving the core into an alternating state of saturation: saturated, unsaturated and inversely saturated. When an external magnetic field is present and the

core is in a highly permeable state (unsaturated), the external magnetic field induces a secondary current in the sense coil whose strength is proportionally to the intensity of the external magnetic field. This second signal is extracted from the sense coil, converted into direct current voltage, and processed by specialized circuitry into meaningful information (magnetic flux density).

The proton magnetometer uses as a base for its function the precession movement of protons. Protons particles contained in a fluid oscillate at a speed whose value depends only on the value of the ambient magnetic field (5). Normally the precession movement is not synchronized between protons and thus a canceling effect occurs. In a proton magnetometer a proton rich fluid is magnetized with the help of a coil, which stops their procession movement and orients them in the same direction. When the magnetization stops all protons resume their normal precession movement but in the same direction for a short period of time (a few seconds). The combined effect of all protons produces a small electrical signal in a sense coil. This signal is amplified, it frequency measured and used to determine the value of Earth's magnetic field intensity.

Proton magnetometers can provide better resolution than the fluxgate ones but require high precision frequency measurement electronics and this makes them harder to build for the non-professionals. For our build we chose to use fluxgate sensors as they are commercially available, affordable and provide sufficient resolution for the purpose we intend to follow.

The main components of a marine magnetometer system are the tow fish that contains the magnetic field sensing sensors, and the control unit where the signal processing electronics are held. The tow fish is towed behind a boat, connected to the boat by a nonmagnetic tether line, long enough so that the magnetic signature of the boat is not pick-up by the magnetic sensors. Usually the tether line length is controlled with the help of a winch that is remotely operated by the magnetometer operator. He monitors with the help of sonar, the see flor depth in front of the tow fish, in order to avoid hitting it with the tow fish. The control unit houses the signal processing electronics, the data logger, the GPS receiver, and the computer output ports for real time mapping. The GPS receiver has a real time offset equal to the distance between the location of the GPS receiver on the boat and straight length to the position of the tow fish.

The goal of this paper was to adapt a rather simple fluxgate magnetometer for conducting marine magnetic surveys in order to map large ferromagnetic targets that could constitute a hazard to navigation and , or the environment. Moreover due to its ease of construction and low cost it is also suitable as a learning platform towards more complex magnetometers systems.

Construction

In what follows there is presented the construction and implementation of a fluxgate marine magnetometer intended to be used for mapping large ferrous objects on the coastline seabed and as a learning platform towards more complex marine magnetometer systems.

The basic design used in this marine magnetometer is borrowed from an article written by John Becker in the 2004 July edition of Everyday Practical Electronics (6) magazine from United Kingdom. The design uses two commercially available FGM 3 sensors from Speake and Co, in a gradiometer arrangement. For the purpose of our project we will use the sensor arrangement in a horizontal position. The sensors operate from a 5 volt power supply, with the output giving a 5 volt rectangular pulse whose period is directly proportional to the field strength (giving a frequency which varies inversely with the field) (7). The circuit provided by John Becker uses a PIC16F877-20 operated at 20 MHz by and external crystal. The microcontroller is used to

monitor the output frequencies of the sensors and store the values to a non-volatile serial memory, from where they can be later downloaded to a personal computer for analysis and graphical display. An alphanumeric crystal display output is also provided for monitoring in real time the values detected by the sensors. A GPS feature is also available for recording the geographical location at the start and at the end of each recording session although with today's advances in the accuracy of global positioning system it would be more desirable to associate the GPS position to each of the readings. The basic electronic design chosen for this magnetometer provides sufficient flexibility in order to adapt it to marine surveys but also to upgrade it with better specification parts and software.

Figure 1

In figure 1 it is shown the control unit, on the left side the main printed circuit boards and on the right side the front panel whit the control switches. The second PCB from the top of the housing is that of a secondary power supply for the LCD backlight. Between the two printed circuit boards there is the battery holder. We used a three cell Li-Ion, 1000 mAh, rechargeable battery. For the connection of the magnetic sensors we used a multi-pin microphone type connector, a serial nine pin socket for the computer connection, and an USB connector for the optional external GPS unit. On the front panel we have the alpha numeric display, all the standard switches from the original design, and 2 LED's (rate led- indicates the frequency whit which the microcontroller takes samples from the magnetic sensors and rec led – indicates when the record function is active) The recorded the data can be downloaded and visualized as a magnetic map whit a free of charge software, written under visual basic 6; the software although not recently design can be made to work under Microsoft Windows 7.

Figure 2

In figure 2 there is shown the sensor assembly in a horizontal position as it will be secured in the tow fish. In order to achieve maximum benefit from the two sensors they have to be aligned whit each other as precise as possible. If they are not precisely aligned, they will not sense the same value of the magnetic field and they will be direction sensible it rotated around there own axes. The materials used in the sensor assembly have to be totally non-magnetic otherwise the functioning of the sensors will be disrupted. For the described construction we have used right angled aluminum section as it also provides good rigidity and convenient alignment. The distance between the two sensors is approximately 0.5 meters. Screened cable was used in between the two sensors, in order to avoid the signal from the bottom sensor interfering with the response of the top sensor. Four-way screened cable was also used to connect the sensor assembly (tow fish) to the control unit. Each of the sensors is provided with local decoupling. The right angled aluminum section is to be mounted inside a small (20 mm internal diameter) PVC pipe for added rigidity the later will be housed inside the tow fish. Due to the fact that the towline and consequently the signal cable is very long, there will be considerable signal strength loses that will prevent the control unit receiving any usable signal from the sensors in the tow fish. This requires that the signal from the magnetic sensors to be amplified in order to overcome loses due to cable length. A separate signal amplifier has to be housed and powered from inside the tow fish. Moreover the sensors themselves have to be powered from inside the towfish.

Figure 3

Shown in figure 3, is the actual tow fish constructed to house the sensor assembly described above. It is mostly intended to be used in shallow water (no more than 50 meters in depth). The exterior shell is manufactured from heavy duty PVC pipe with an external diameter of 75 mm and a working pressure of 16 bars. Overall length is 1.15 meters. At the back of the tow fish we have three stabilizing fins mounted at an angle of 90 degrees of each other. On top of the tow fish there is installed a hook-up rail with multiple connecting holes for obtaining the best horizontal balance when towed. At the left end of the hook-up rail is located to cable strain

through which the signal cable will pass and go alongside the towline to the control unit in the boat. All the materials used in the construction of the tow fish are also non-magnetic.

Implementation

In order to test the reliability of the magnetometer system (tow fish and recording unit) a test grid (figure 4, not to scale) was surveyed for two times on Lake Siutghiol from Constanta, Romania. The dimensions of the survey grid were 20 meters length by 12 meters wide, with a total of 7 survey lines. The magnetic measurements were taken with the magnetic probe orientated in west-east direction; this was done in order to minimize the influence of Earth's magnetic field on the recorded readings. For testing the first magnetic reading was taken with the grid perimeter clean of any significant ferrous target. For the second magnetic reading, a ferrous target was introduced in the grid perimeter. This method helped in determining if the magnetometer probe was able to detect the anomaly produced in the Earth's magnetic field by a a medium test target (standard oil barrel) in shallow water (4-5meters). The sensor assembly was towed behind a boat following the grid pattern shown in figure 4, at about 5 km/h. For precise positioning a GPS unit was connected to a laptop on the boat running Google Earth software. A secondary set of virtual lines was used to determine the position of the tow fish by taking into consideration the length of the tow line. At the beginning of each new survey line the record function was switched on, and switched off at each line end, this mode of operation signaled to the recording unit when a survey line begin and ended.

Figure 4

In figure number 5 there is shown the tow-fish being prepared for deployment, and in figure number 6 there is show the tow-fish being towed behind the boat.

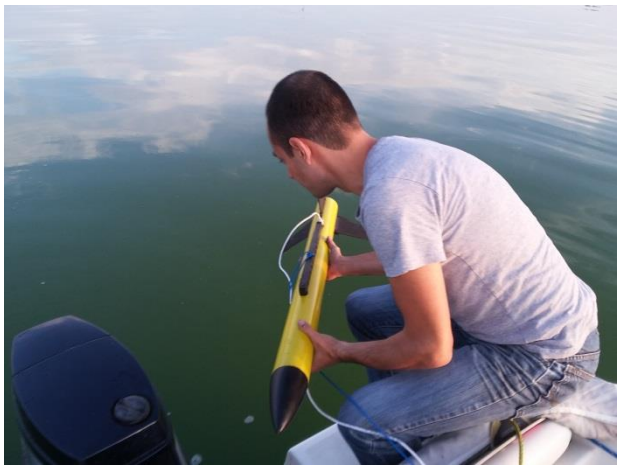

Figure 5

Figure 6

After each set of recorded data was saved, it was converted in order to be graphically displayed. For this purpose I used third party software GeoSurveyer2dowloader for saving the data from the recording unit and GeoSurveyer2 (8) for graphically displaying the data. Below in figure 7 and figure 8 there is presented the graphical interpretation of the scanned area. From left to right the image without test target and the image with the test target. The intensity of the magnetic field is colored in increasing order from dark blue, light blue, green, light green, yellow, orange and red. In figure 8 by comparison to figure 7 there is clearly visible in red a magnetic peak resulted from the presence of the test target. In both pictures there are various low intensity magnetic anomalies, mostly highlighted in yellow; one reason for some of these parallel anomalies could be a slight yaw of the tow fish.

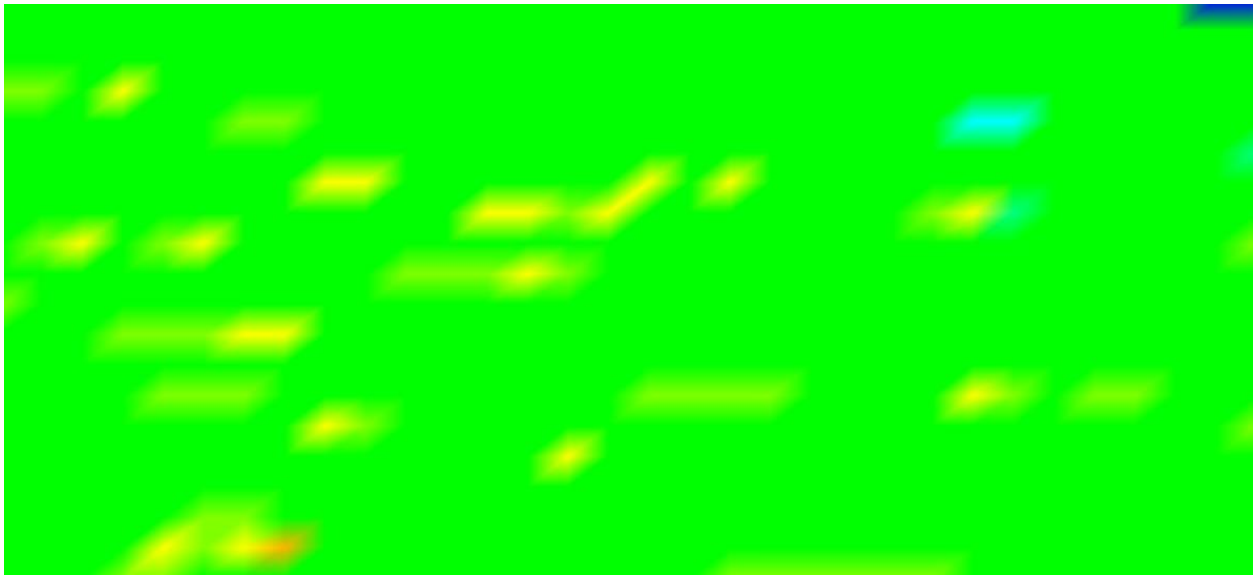

Figure 7

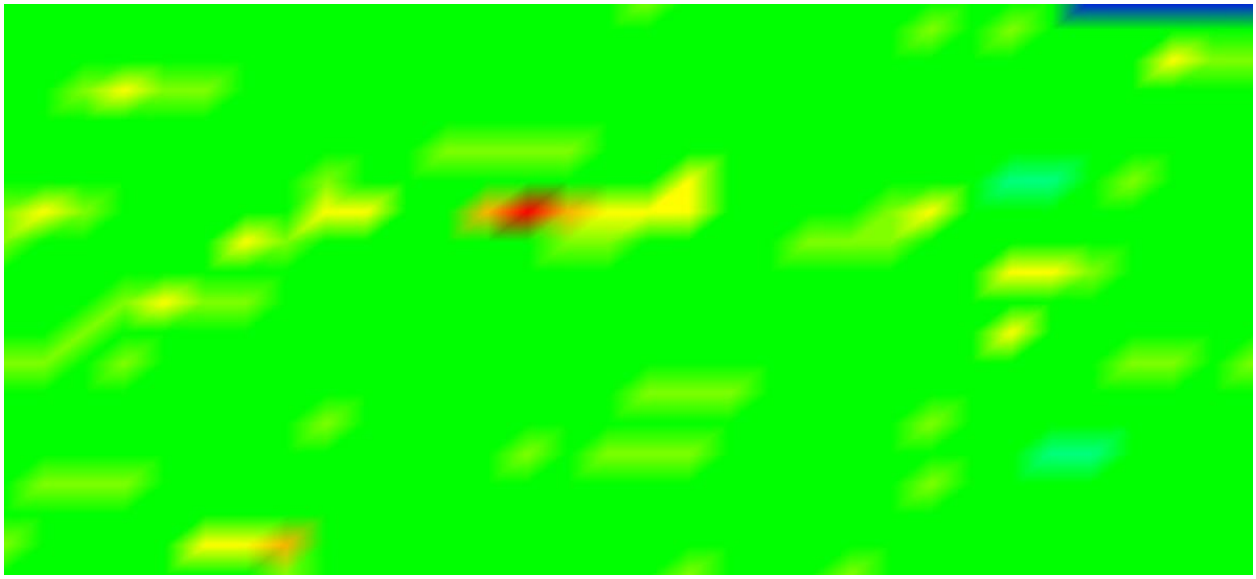

Figure 8

Final thoughts

I believe that the described magnetometer has a good potential to be used for the purpose of learning magnetic marine survey and to be a stepping stone towards more advanced marine magnetometers. For the moment I will continue to experiment with the unit presented in this paper, in order to obtain best performance from this setup. As improvements I'm already thinking of adding an onboard power supply for the tow fish in order to permit the usage of longer towing cables and to implement an "in the field" method of sensor alignment. Moreover during the tests it was observed a slight yaw movement of the tow-fish when being towed by the boat; this is very likely due to improper positioning of the center of gravity and center of pressure.

This project is yet to be finished and will still require some work until I will have gained enough experience in order to move towards more advanced projects like a proton magnetometer, but overall I'm pleased with the results obtained.

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Scientific research (Life rafts survival tests)

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Abstract: A group of students from Gdynia Maritime University and Gdynia Naval Academy participated in a life rafts survival tests. Volunteers stayed in life rafts, which were towed by a stern of SAR vessel: "Kapitan Poinc". They were supplied in primary life raft equipment food supplies, water supplies and pyrotechnics. The purpose of survey was enduring 12 hours in conditions very close to being a survivor.

Key words: *Life raft, survival, SAR,*

1. Introduction

A Group of students from the first, second and third year of navigation from Gdynia Maritime Academy and Polish Naval Academy would like to check, how they, future officers, can handle with situation hard situation, where all means fail and they will have to save their lives escaping to the life rafts. For this purpose we gathered the group of 18 students, 10 men and 8 women which would like to participate in the scientific research.

The main goal of experiment was to check how students, who have theoretical knowledge about rescue procedures at sea will use it in real threat situation.

We would like to know their mental, psychic condition and their own opinion after 12h in the life raft.

2. Technical description

We had two life rafts. First was CSM company, second one STOMIL company, their capacity were 10 persons. Life rafts had equipment according to the SOLAS convention. STOMIL life raft was open at the ship deck, so that everyone can see how this procedure looks like. We decided to divide group of students into a Male and Female rafts. Women took place in STOMIL life raft and Men in CSM life raft.

The Basis of our research was SAR vessel m/s “Kapitan Poinc”, which crew took care of us. M/s „Kapitan Poinc” performs service moored in the Port of Gdynia, ready for rescue ships and persons 365 days, 24 hours per day. It’s length is 49,8 meters, width 13,6 meters, drought 4,6 meters, engines 2 x 1920 horsepower, maximum speed 13 knots, basic crew 11 persons, can pick up 272 survivors, ice class 1L.
During the scientific research air temperature was thirteen Celsius degrees, water temperature eight Celsius degrees, state of the sea three to four in the Beaufort scale.

3. Research plan

- Labyrinth examination and Cardiograph examination were realize by Dr Molisz before and after being at the life,
- Putting on immersion suit and customize to the body
- Jump into the life raft or into the water and swim to the life raft
- Adapt into the life raft and ta king comfortable position in it
- Using a radar reflector according to the manual
- Using Hand flares, Parachute rockers, Floating smoke
- Simulation swimming using paddles to the person in water
- Pick up unconscious and conscious person to the life raft
- Rain simulation

4. Scientific research process

After leaving Port of Gdynia, students were examined by doctor. Next each of participants had to put on immersion suit and check is it all his equipment. Next step was to open a STOMIL life raft and look inside to make sure that all needed things that SOLAS convetion required are in. Both life rafts were launched and students due to instructions SAR vessel “Kapitan Poinc” get in. After taking their position about 400 meters far from the ship we start an observation. Two hours later first three women said that it’s over for them and they would like to go out, due to sea sick. Students were asked to use a radar reflector, task was finished fully succeed and we can see them in the ship radar. Crew simulate the attendants raining weather by activate fire water cannon at the ship. After four hours next women said that she want to go out from life raft.
After five hours four man said that due to sea sick they also want stop research and go out. After five and a half hours next three women and two man would like to leave the life raft complaining of malaise. We decide to move last women from the life raft to the men life raft, where were still four men. At the CSM life raft are now 5 persons (four men and one woman). Next students were informed that in the water is something similar to the human body, their task was to swim there, using only paddles. They struggle with his exercise for about an hour, because of strong wind and high waves. After half an hour since last task they were ask to use pyrotechnics material. Each of it was used correctly and visible from a far. Last exercise was to pick up unconscious and conscious person to the life raft. Two beholders put on immersion suits, jump into the water and after getting close to the life raft, the students have to pick up them. Participants manage easily with

this task. After about seven hours last students resigned from the research due to bad mental and physical condition, and were took on board

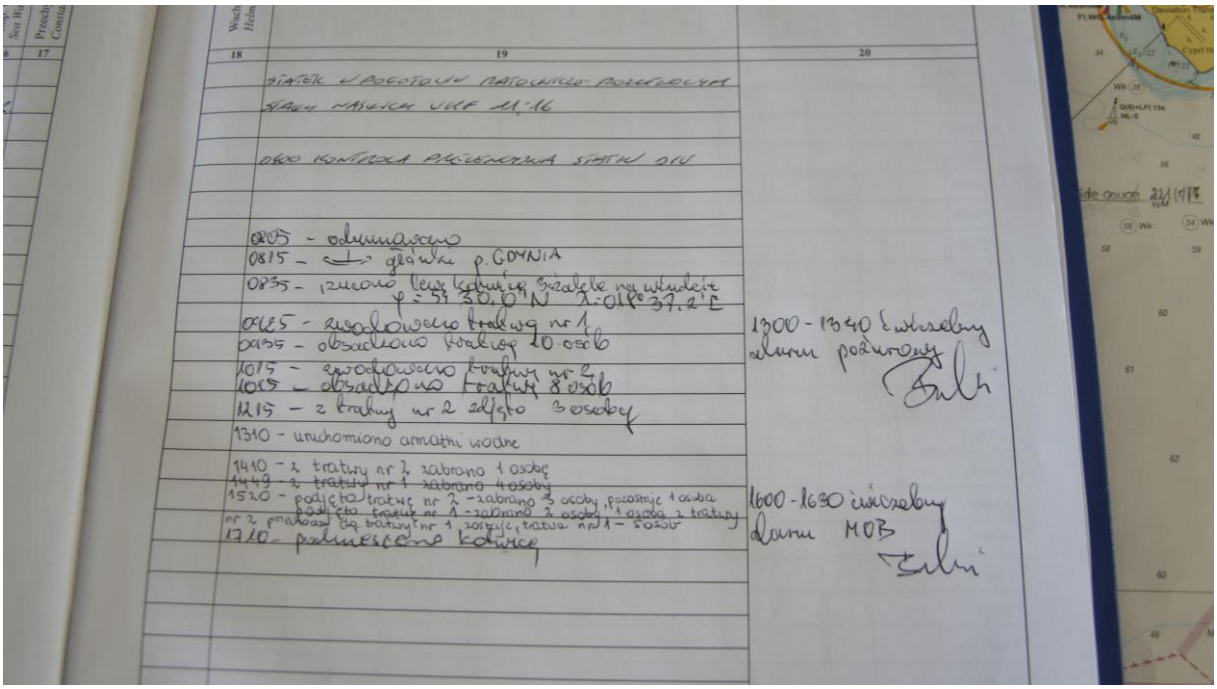

Photo 1. Vessel Logbook, where crew wrote time when each of the students take on borad from life raft

5. Observation behavior of the participants

The crew and beholders notice some serious mistakes which students made during the research:

- Getting off immersion suit during test (mainly gloves and hood),
- Mental unpreparedness to spent twelve hours at sea,
- No idea what to do during experiment
- Drinking not enough water
- Mental resignation
- Closing the life raft (no air circulation inside)

However we see a lot of assets.

- Support each other
- Teamwork
- Dealing with the knowledge how to use equipment

Additionally after research we asked participants to tell us what was the most positive and negative aspects during the test.

Positive aspects:

- Atmosphere
- Check theoretical knowledge in practice
- Sunny weather
- Jumping into water
- Taking care of colleagues in worse condition

Negative aspects:

- high waves
- rocking the life raft
- fear
- smell of the rubber inside
- cold
- seasick

6. Medical results

The examination included questionnaires, vestibular testing and examination of the cardiovascular system. Cardiovascular parameters such as pulse, stroke volume, blood pressure, were evaluated with impedance cardiography (ICG). On the life rafts intensity of seasickness was evaluated with MSAQ (Motion Sickness Assessment Questionnaire.
We can see cardiovascular parameter changes, which appeared due to seasick, stress and hypothermia

Table 1. Cardiovascular parameters measured with impedance cardiography (ICG). Statistically significant differences ($p<0.05$) are **in bold**.

Parameter	Before life rafts	After life rafts	P value
Heart rate	**78.6**	**70.1**	**0.002**
Systolic blood pressure	123.6	123.5	0.973
Diastolic blood pressure	73.7	74.2	0.768
Mean arterial blood pressure	85.2	85.6	0.863
Systolic volume index	**55.6**	**60.5**	**0.003**
Cardiac output index	4.3	4.2	0.230
Systemic vascular resistance index	1505.0	1567.1	0.145

Table 2. Correlation between results of MSAQ and cardiovascular parameters from impedance cardiography. Spearman's rank correlation coefficient is presented. Statistically significant differences ($p<0.05$) are **in bold**.

Parameter	Overall	Gastrointestinal	Central	Peripheral
Heart rate	-0.273	-0.249	**-0.478**	**-0.711**
Systolic blood pressure	-0.354	-0.370	**-0.532**	0.100
Diastolic blood pressure	0.299	0.173	0.283	0.140
Mean arterial blood pressure	0.184	0.101	0.113	0.189
Systolic volume index	**0.525**	0.347	0.419	0.365
Cardiac output index	0.411	0.305	0.180	-0.113
Systemic vascular resistance index	-0.176	-0.167	-0.082	0.442
Pulse pressure	**-0.476**	**-0.579**	**-0.584**	-0.008

7. Conclusion

For each participant this life raft survival test was first confrontation theoretical knowledge of lifesaving with reality. The purpose of the research, survival twelve hours at the life raft was not succeed, due to hard weather, students mistakes and lack of practical prepare for survival at the life raft. However fact, that they decide to challenge themselves in this kind of event is very satisfied and we make sure that if any of them find out in serious danger they will know what to do. Medical results are interesting, because we can see that even short period of time affect the human body. What's important participants during event deal perfectly with pyrotechnics, fast put on immersion suits and rescue survivals from water, therefore we are sure that students know how to keep alive at the life raft and correctly use equipment at it.