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DEVELOPMENT OF DUBROVNIK AIRPORT THROUGH THE DEVELOPMENT OF WINTER TOURISM IN THE DUBROVNIK REGION

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ABSTRACT

This paper analyzes the tourist demand and the development of the Dubrovnik region through air traffic during the winter period. Air traffic in recent years in the world recorded high growth rates, especially in the part that relates to travel and tourism in the Dubrovnik airport. The air transport has the largest share in the development of Dubrovnik region tourism. But the traffic and demand apply only to the summer period. Number of serviced passengers through airport of Dubrovnik during the summer months is more than 1.3 million passengers, while traffic in the winter makes only 200,000. Tourism in the winter period is reduced to individual actions and events and is not strategically organized. In order to assess and predict the development of tourism in the winter through the development of air transport, it is necessary to analyze the type of passengers in the winter, offer accommodations to be provided in the winter, the turnover of foreign tourists in the winter, the short comings that limit development and tourism bid through the facilities of the winter. This paper discusses the advantages and disadvantages of the Dubrovnik region during the winter season also features the deficiencies of Dubrovnik Airport considering the forecast of foreign tourists. Also in paper will be present the resources and options that would in future contribute to increase passenger traffic during the winter period.

KEY WORDS

air transport, Dubrovnik region, foreign tourism, demand Dubrovnik Airport forecasting development possibilities

1. INTRODUCTION

The development of tourism from its beginnings to the present has been closely associated with the development of traffic. New technological developments are critical for the development of tourism, both at global and local levels. In order to establish a quality tourist services is very important transport infrastructure and transport facilities. Dubrovnik area is very attractive tourist destination and one of the preconditions for the realization of the tourism development is adequate infrastructure, transport facilities and organization of transport processes that comply with the requirements of tourist demand for quality services.

Air transport is particularly important for the evaluation of tourism potentials. Apart from the many advantages that this area has compared to other destinations, it should be emphasized and some restrictive among which stands out distinctly peripheral position in relation to the main source countries and poor road links. As one of the options to repair the limiting factors in the development of tourism in this area during the winter period has to be pointed out the role of air traffic which takes over most of the tourist business. In order to estimate the potential demand for air traffic during the winter, to spot trends and predict future trends, they had to analyze the available tourist facilities, recorded turnover of tourists and structure of tourists by country of origin in a given period. Also offered is a theoretical concept of tourism development during the winter period over Dubrovnik Airport.

2. ANALYSIS OF TRAFFIC AT THE AIRPORT DUBROVNIK

Start of civil aviation in the Dubrovnik region recorded the 1936th year when the airport was located in the village of Gruda at central of Konavle field. At the end of the '50s the rapid development of tourism in the Dubrovnik area and increased traffic demand far exceeded the capabilities of grass runway after which was decided to build a new, modern airport.

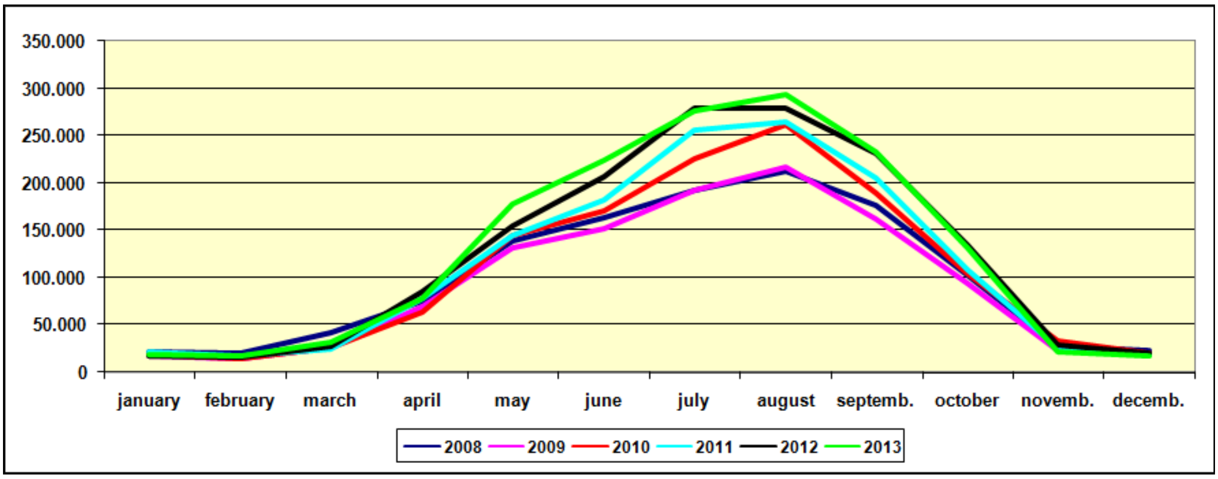

Chart 1. The total number of passengers per month since 2008 to 2013th. [6]

Construction work on the new airport started in 9th May in 1960 at location Cilipi. At the time of construction was planned to be located across the Dubrovnik airport in 1972. year transport 200,000 passengers and this figure has been reached already in 1964.year The Dubrovnik Airport recorded a continuous growth, and the record in 1987.year turnover was close to 1.5 million passengers. With such traffic Dubrovnik Airport ranked the third place in the former Yugoslavia. What is worth noting in connection with development of the Dubrovnik airport is the fact that more than 60 % of total foreign tourist traffic in the area of the peninsula, Korcula and Cavtat achieved thanks to high-quality air connections center of the Dubrovnik Riviera with Europe. Fast and systematic development of the Dubrovnik Airport is forcefully stopped 1991st during the war.

The development and rise of the airport was returned to the very begging. From December 1992. air traffic was established with Croatia Airlines. Continued systematic development and improvement of the airport led to the opening of two new terminals. Terminal "A" opened in 2006, terminal and "B" which opened in 2010, international flights and the domestic arrival. This will continue its continuity of development started in 1962.year during which he became one of the main pillars of the progress in the southern Croatian. Chart 1 show the movement of the total number of passengers in the period of 2008-2013 year. Analyzing traffic per month Dubrovnik Airport has the most traffic during the summer season. During the winter period there is flight to Munich, Rome and London.

Analyzing the passenger traffic at Dubrovnik Airport from 2009. to 2013 year (Table 1) show the prevalence of the UK market in passenger traffic. Traditionally represented the German market and French market are constantly in "Top 5".

Domination of Croatian market was interrupted 2009 when the UK take over market with 224,800 handling passengers compared to 182,800 passengers from the Croatia market. Further growth trend of travelers from the UK continues to 2010. year until the 2011th year showed a slight decline of 5 % (from 238,000 to 224,849 handled passenger) while the domestic market after a long time increased by 22 % (161,000 to 208,512 handling passengers).

Table 1. The total number of passengers by destination since 2009 till 2013 with a total turnover of more than 1 %

COUNTRY	2009	2010	2011	2012	2013
CROATIA	182,800	161,000	208,512	200,690	164,954
GERMANY	117,200	124,000	144,027	161,320	152,500
SLOVENIA					
BELGIUM	34,530	35,600	29,197	27,808	35,294
ISRAEL	13,700	17,300	18,785		
UNITED KINGDOM	*224,800*	*238,000*	*224,849*	323,596	358,092
CZECH REPUBLIC	18,370				
FRANCE	133,500	145,000	145,969	158,189	161,302
ITALY	33,000	54,000	64,589	40,261	48,094
AUSTRIA	22,600	24,300	46,067	50,089	32,066
SPAIN	72,600	95,000	103,283	89,885	76,728
RUSSIA	21,570	29,000	42,885	43,356	33,686
IRELAND	49,750	48,000	52,056	56,609	59,638
NORWAY	49,650	58,000	52,995	47,753	69,602
SWEDEN	30,000	32,000	28,726	46,845	53,012
USA	12,100	13,500			23,270
SWITZERLAND		22,100	17,014	24,925	30,026
NETHERLANDS	12,000				
HUNGARY					
FINLAND	13,000	23,000	20,212	33,018	46,992
POLAND	12,100	19,100	18,507	31,963	47,936
TURKEY		30,200	42,885	25,479	
UKRAINE		13,000			
DENMARK					19,246
GREECE					16,582
JAPAN					15,636

Table 2 shows the 31 company and their impact on the overall traffic at the Airport Dubrovnik at 2013. Share of conventional carrier is about 66% in terms of handled passengers. As expected the greatest share of operations and the number of passengers carried has a domestic company Croatia Airlines The share of low-cost companies accounted for approximately 34% in terms of handling passengers and 22 % in terms of number of operations. The largest share of the low-cost carrier has Easy Jet airline with 1,098 operations and 153,134 handled passengers.

Table 2. The total number of passengers by destination since 2009 till 2013 with a total turnover of more than 1 %

OPERATIONS 2013				
COMPANY	OPERATIONS	PAX ARR/DEP	TOTAL TRAFFIC IN %	TO /FROM
CTN- Croatia Airlines	4,328	389,397	25,58	
EZY-Easy Jet	1,098	153,134	10,06	UNITED KINGDOM
NAX - Norvegian Air Shuttle	746	105,292	6,92	NORGE
EXS-Jet2com	526	73,753	4,85	UNITED KINGDOM
DLH-Lufthansa	718	75,240	4,95	GERMANY
MON-Monarch Airlines	426	73,374	4,82	UNITED KINGDOM
BAW-British Airways	530	62,117	4,08	UNITED KINGDOM
AUA-Austrian Airlines	426	61,561	4,05	AUSTRIA
EIN-Aer Lingus	308	46,546	3,06	Ireland
BIE-Air Mediterrane	324	46,777	3,08	FRANCE
VLG-Vueling Airlines	308	46,081	3,03	ESPANA
GWI-Germanwings	290	35,207	2,32	GERMANY
FIN-Finnair	274	35,683	2,35	FINLAND
TVP-Travel Service	184	30,565	2,01	Poland
SAS-SK Norge	300	32,247	2,12	SWEDEN
TOM-Thomsonfly	158	26,994	1,78	UNITED KINGDOM
TVS-Travel Service	168	20,719	1,36	Czech Republic
AFL-Aeroflot	252	17,954	1,18	Russia
PRI- Primera Air	98	16,273	1,07	SWEDEN
FPO-Europe Air Post	128	14,907	0,98	FRANCE
TVF-Transavia France	114	15,211	1,00	FRANCE
TCW-Thomas Cook Belg.	98	13,876	0,92	Belgium
IBE-Iberia	114	14,198	0,94	ESPANA
ELO- Eurolot	182	9,453	0,62	Poland
GMI-Germania Airlines	94	9,750	0,64	GERMANY
ABR-Air Contractors	68	8,736	0,58	Ireland
JAF-Jetairfly	88	8,932	0,59	Belgium
JAT-Jat Airways	174	8,347	0,55	Serbia
CFG-Condor	88	7,591	0,50	GERMANY
BEE-Flybe	36	2,183	0,15	UNITED KINGDOM
BGY-Bingo Airways	34	5,436	0,36	POLAND
TSO-Transaero Airlines	52	5,514	0,37	RUSSIA
LOWCOST	3,814	521,279		
operations (%)	22,06%			
Total pax (%)		34,27%		

3. OVERVIEW OF THE DEVELOPMENT OF TOURISM IN THE DUBROVNIK REGION

The city of Ragusa or Dubrovnik is based on maritime trade in the Middle Ages existed as the only eastern Adriatic city-state. With its wealth and skilled diplomacy, Latin / Slavic Ragusa / Dubrovnik achieved a remarkable level of development during the 15th and 16 century. Dubrovnik has a unique political and cultural history (the Dubrovnik Republic the Statute from 1272.). The city has a world-famous cultural heritage and beauty (inscribed on the World Heritage List of UNESCO). The city is one of the most famous cities of the Mediterranean. Apart from its outstanding natural beauties and well-preserved cultural and historical heritage, Dubrovnik also offers high-quality visitor opportunities. It is also the city of hotels, of high ecological standards and tourist programs, and is equally attractive in all seasons. In order to explain the situation in Dubrovnik tourism and make assumptions for further development will be analyzed in Dubrovnik region through a number of arrivals and overnight stays in the region, capacities and offer content (Chart 2). The relationship between the number of tourists and the number of nights is a very important indicator for defining the type of destination. In the case of the Dubrovnik region is in a slight increase in both indicators. Graph 1 shows the relationship between arrival and overnight stays of 2009-2013 year. From this it can be seen that the ratio of rates is far larger in proportion to arrivals which shows that tourists are moving much more. These results show a decline of typical "weekly" rest referring to weekend shifts tourists. When you divide the number of days with the number of arrivals we get round figure of 4.8 tells us that the average retention tourists in Dubrovnik area. The increase of low-cost carriers withdrew behind the trend of travelers who are less retained on a specific destination even Dubrovnik.

In 2012, GDP, gross domestic income (GDP Gross Domestic Product) at the Croatian was around 10,300 euro per capita. Compared with other countries in Southeast Europe respectable income is not stagnating for many member countries of the European Union, Slovakia, Poland, Romania and Bulgaria. Compared with Western European countries, where the average gross income is around 30,000 euro per capita, Croatia is fare behind.

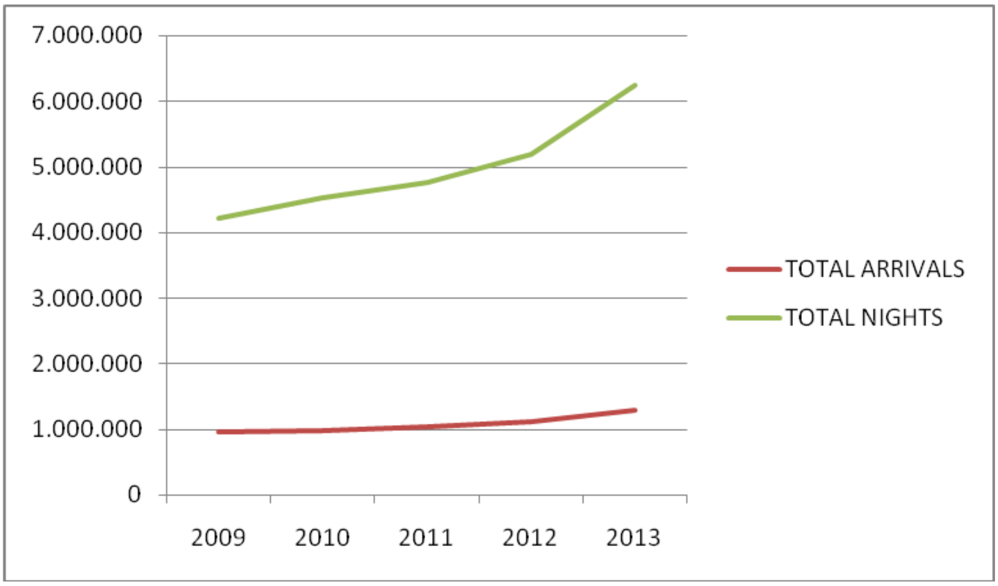

Chart 2. Tourist arrivals and overnight in Dubrovnik-Neretva County [6]

4. ANALYSIS OF THE CURRENT SITUATION BEDS IN DBK

Accommodations offer tourist in Dubrovnik and its surroundings is mostly described private placement, which has about 33,000 available beds Around 17,000 beds are available in hotels , 2 * , 3 * , 4 * and 5 * star. According to the Ministry of Tourism for the year 2013 Dubrovnik County has 1,783 beds in hotels of the category 2, 6987 beds in 3 categories, 3,911 beds in hotels of category 4 and 4649 beds in hotels five categories. In Dubrovnik, we have 2013 years 104 days of full occupancy (or 28 % occupancy) hotel capacity. Some of the hotel are (four and five star) working all year. For villas and hostels and private accommodation accounts for about 12,000 beds which amounts to about 36 % of total capacity. The aggregate accommodation in Dubrovnik beds, mostly in the hotels, while in our city you can find high quality accommodation and in private accommodation in rooms and suites, beautiful villas, unique marinas, excellent youth hostel, and for those who love the holidays in nature and some great camps which accounts about 5,200 beds.

5. TRANSPORT CONNECTIONS

Dubrovnik is not directly associated with any one of the Pan- European transport corridors but was conceived with close transport corridor "Vc" that connects Eastern Europe over Bosnia and Herzegovina, Hungary, and Ukraine. View the Pan - European transport network in south-eastern Europe is shown in Figure 1 Transport corridor " V " has a total length of 1,600 (miles). It's links the Adriatic Sea to Eastern Europe with the end destination customers in Ukraine. It is divided into two traffic corridors "Vb" and "Vc" (Figure 1).

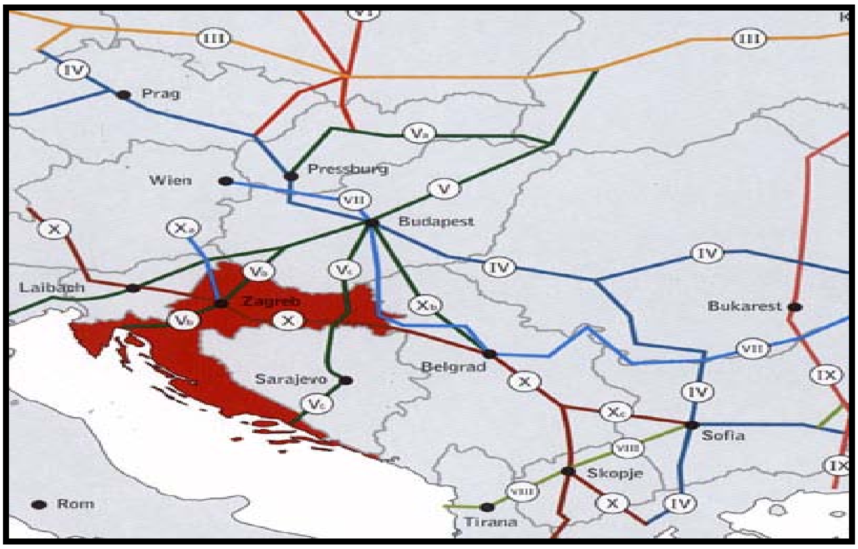

Figure 1. Pan European Transport Corridors. [8]

There is also the Adriatic highway as part of the Adriatic Ionian corridor that should go from Trieste (Italy) to the south of Greece as another advantage in better connection Airport Dubrovnik and the Dubrovnik region.
Disconnection of Dubrovnik which is conceived with the very south of Croatia the separation of the northern territory of Bosnia and Herzegovina infection that has access to the sea makes a journey by car or bus quite difficult takes a lot of time compared to competing locations. The figure 2 shows the number of border crossings between the competing destinations. Airport Podgorica and Tivat Airport, which is located southeast of Dubrovnik in Montenegro which is share one border crossing. But to the north to Mostar and Sarajevo in consideration must be included two border crossings. And if you travel to the northern part of Croatia again should take into account the two border crossings that seems quite complicated at

border crossings during the summer season, which has resulted in an unnecessary waste of time due to procedures at border crossings and moodiness customers. These problems in the foreseeable future will be solve with construction of the highway to Dubrovnik which is including a bridge to connect two parts of Croatia. Completion of this project would greatly improve traffic communication Dubrovnik region and reduce travel to and from Dubrovnik Airport (Figure 2).

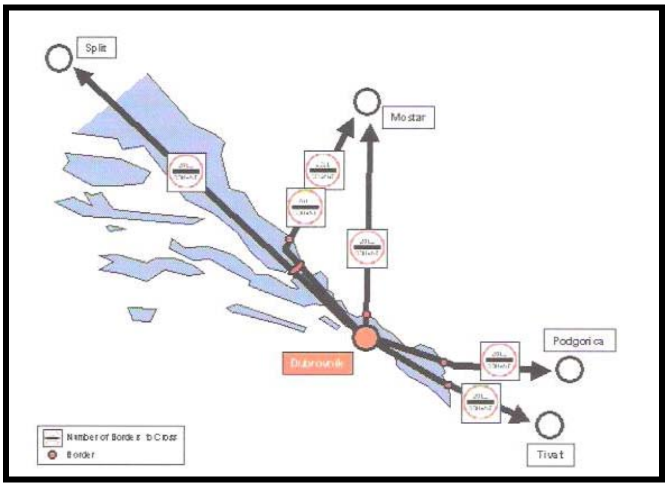

Figure 2. Border crossings with neighboring countries and competing airports. [6]

Road connections to Dubrovnik and the Dubrovnik airport to the surrounding region and competing airports is difficult because border restrictions and because. In this area there is no connection to the main highway is a state road D8 physical condition and capacity does not meet demand conditions. For travel on a section of 100 km with Montenegro should take into account the minimum two -hour drive by car (bus 3 hours) and retention at the border crossing. Also according to Mostar and B&H takes about 2.5 hours (3 hours bus) ride towards Sarajevo 4 hours (bus 5 hours). To split it takes 3.5 hours by car (bus 4.5 hours). The figure shows the temporal distance from Dubrovnik to competing locations (Figure 3).

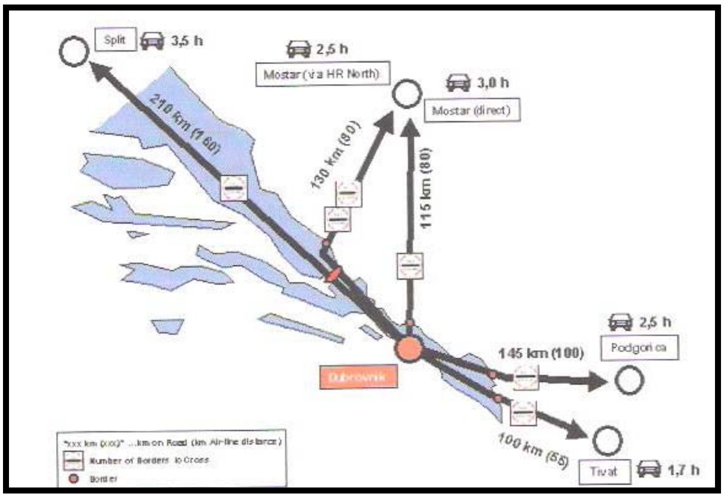

Figure 3. Weather Dubrovnik distance to the competitive airports. [6]

For longer travel time to and from Dubrovnik focuses on air transport. The road network with poor supply and train that has just to plate and does not exist in the City of Dubrovnik and the airport are not very attractive offers for traveling tourists and business people.

6. DEVELOPMENT OF TOURISM IN WINTER PERIOD

Competitive positioning at the global tourist market presumes monitoring and adaptation to contemporary trends through which requests, new market opportunities.

The town of Dubrovnik, at the southern point of the region is a famous tourist destination worldwide and it shows the highest values of tourism indicators (the administrative territory of the town also stretches to the nearby small archipelago.

The offer based on cultural tourism is more and more requested at the global tourist market and investments in this form of tourism are highly profitable. Croatian Tourist Board has used cultural resources only for branding national tourist offer. National cultural heritage also presents the potential for synergy action of all tourism aspects with the aim to prolong the tourist season. It is necessary to identify market with special cultural interests since guests eagerly visit manifestations or cultural – historical monuments. National tourist cultural offer is insufficiently and inadequately presented on the global level. It also indicates oversights of Croatian Tourist Board. Adequate marking and registration of cultural - historical monuments by placing informative notices, adapting working hours of museums, castles and other sights would significantly increase income, but also the synergy with other forms of tourist offer. On local level, diverse manifestations are frequent, but there is a lack of national interaction and connection. Nowadays Dubrovnik is mainly focused on maritime tourism. At that time, mountain hiking, cultural and pilgrimage tourism, visits to native village represented a significant part of tourist traffic. Ecotourism is tourism of the future. It enables economic growth of less developed and protected areas. There are two important tourist segments that should be aimed: small groups with special interests for ecotourism that spend all holidays in that way; majority that spends holidays at sea, but also wants to visit hinterland. That is the synergy potential of this segment of tourist offer. Ecologically produced food is an additional component that nowadays makes this form of tourism competitive. Dubrovnik region presumptions for the production of ecological food and their direct export via catering establishments should be systematically developed and used in the promotion of national tourist offer.

Sky tourism in Dubrovnik is undeveloped in comparison to other forms of tourism. There are presumptions for this form of tourism as well additional presumptions of the winter tourism development is sporting success of Croatian skiers. Promotion of this form of tourist offer is risk for lack of snow in winter months. In case of such weather conditions, there are many other back-up tourist facilities to be offered.

Adventure tourism - this category comprises also "Robinson" tourism as well as any tourist offer that includes possibility for different pleasant and less pleasant surprises. Tourist segment that selects this offer adventure, challenge, climbing, diving, hunting etc. Dubrovnik region has diverse natural potentials for development of wide-range offer of the adventure tourism in coastland and hinterland (rafting, canoeing, kayaking, paragliding, free climbing, off-road etc.).

Thematic tourism is the catalyst of economic development in tourist developed countries. Very often it's based on 3-E principle: Entertainment, Excitement, Education and it includes offer and facilities that combine those three elements. On that example it's possible to elaborate a whole range of thematic offers that are presumption of a whole-year national tourist offer.

The first part of our thesis was the theoretical analysis of the available studies done in tourism product development. We discovered four new approaches to tourism product development: Co-creation, Story-telling, Authenticity and Meaningful experience. We also used one of the results: Holistic tourism product co-creation, from integrated tourism development.

6.1. Joint action and cooperation

To start with, the improved facilities have stimulated tourism, and the expansion of tourism has stimulated transport. Accessibility is the main function behind the basics of tourism transport. In order to access the areas that are mainly aimed, tourists will use any transportation mode. However, air transport is the main mode for international tourism, which normally entails travel over long distances. One dimension concerns the openness to tourism through travel visa restrictions, which vary substantially depending on the countries of origin of tourists.

"Holiday spenders" usually make enough contribution to the local economy that governments are more than willing to invest in efficient road networks or airport facilities, especially in locations that have limited economic opportunities other than tourism. There are however significant differences in the amount of spending per type of mode, namely between cruise and air transport tourism.

6.2. Co-financing through municipalities, cities and counties

The model for tourism development has continually evolved over the past 20 years. In leisure tourism during the nineties, tour operators were all-powerful. For the most part, they understood what their clients wanted in terms of a vacation and they simply had to had create the "package", source the bed-stock and ground arrangements, source the flights (charter) and sell it all at a price the market would pay. Tourism destinations worked on their infrastructure, accommodation, attractions and facilities and promoted these to the tour operator product managers in order to sell allocations. Broadly speaking the roles became established thus: The Tourism Authority was responsible for the brand awareness of the destination in each target market: with the public, trade, press etc• The Hoteliers were responsible for ensuring bed stocks in the destination and selling allocations to tour operators in each target market. The tour operators were responsible for selling their contracted room allocations and pairing these up with transport: largely they did this via travel agents. Travel agents sold these packages to the clients The model worked well for years and still continues to work today in certain areas. Then, fact that changed fundamentally the dynamics of the travel industry is the internet, which all parties in target markets have access and connectivity like never before.

6.3. Publicity in cooperation with air carriers and tour operators

Effective partnerships with airlines (Low Cost carriers). Embracing the enhanced distribution which the web brought, airlines could now sell directly to consumers without the distribution costs associated with travel agents and tour operators. Relieved of this significant cost, the rise of low cost carriers accelerated, frequently rendering their involvement in the old model un-necessary.

The result is that today, in countries where internet penetration is high, low cost carriers can sell seats without the need for travel agents or tour operators (for the most part) meaning that significant part of the former packages are today booked by clients themselves. In this increasingly web-driven world, how can hoteliers market themselves to the masses? The low cost carriers have established that there will always be a market for those who wish to pay as little as they can for a vacation and that for the right price, such consumers are happy to travel anywhere in order to have a different experience. When the cost of transport was the most significant aspect of a holiday cost, the destination was an important choice and often a limiting one. With transport costs right down, there is now a much greater choice of destination. Also, with the significantly reduced tickets costs consumers are now able to spend more on their accommodation, frequently upgrading their accommodation choices. In many cases, hoteliers are striking deals with the airlines in order to promote their properties on the airlines' websites. A cursory glance at any low cost carrier website will highlight that a consumer can purchase flights, hotel accommodation, car hire, ground transfers and in many cases excursions all on the one site. Low cost carriers are now the new breed of tour operators for the future and their attention to costs should ensure their survival.

6.4. Regional action between airports

Croatia network of airports, across the coast form an integral part of the national economic infrastructure and are important to connecting communities. More than almost any other country, Croatia relies on an efficient and reliable aviation sector and airport network for its citizens to remain physically 'in touch' with each other and the rest of the world. There are 5 international airports in at a distance of about 650 kilometers. As such, airports are deeply linked into most economic activities, with these linkages increasingly driven by growth in leisure tourism and the regional expansion of strategic resource and agricultural activities. By offering in which would be included companies that offered tickets to fly to one airport and back from other airport and on the other side there are tourist board with offering a high-quality tourist facilities, would enable improvement in airport traffic during the winter period and also connects the region

7. CONCLUSIONS

Options transactions in the meeting, lately increasingly demanding tourist needs, determined by the size and condition of transport infrastructure. Given the complexity of tourism, tourists use different modes of transport depending on many factors among which the distance tourist destinations of generating markets. Transport availability may be a limiting factor but also stimulating the development of tourist destinations during the winter. Due to the extremely high speed, comfort and affordable price, the most important milestone in the development of tourism was marked air traffic. Tourists enabled travel and vacation in the outermost international tourist destinations. In order to emphasize the importance of the role of air transport in tourism development, and establishing links above concepts which have great significance in the consideration of the future of our tourism development, conducted a survey and analysis of the characteristics of tourist traffic and air traffic in tourist arrivals to the Dubrovnik area. In the current unfavorable condition of the road network to air traffic in the further development of tourism should take more and bigger share of the tourist traffic, especially for more distant destinations in central and southern Dalmatia. Possibilities for the development of Dubrovnik Airport are based on action and cooperation possibilities, publicity in cooperation with air carriers and tour operators and Co-financing through municipalities, cities and counties

Airport should be an important part of the tourism market which directly affect at quality and prices of services, which would greatly contribute to the development of tourism.

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ANALYSIS OF THE EFFECTS OF LOW-SULPHUR FUEL OIL ON MARINE DIESEL ENGINES OPERATION

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ABSTRACT

The purpose of this paper is to discuss and analyse the problems occurring when using low-sulphur fuel oils in marine diesel engine operation as well as the measures taken to prevent damage to individual engine components. The paper discusses the effects of low-sulphur fuels on marine diesel engine operation.
Exhaust gas emissions are often directly related to the impurities contained in fuels that are being used. High level of sulphur oxides *SOx* and nitrogen oxides *NOx* in the emissions of exhaust gas is an inevitable result of using heavy fuel oil - HFO. Maximum emissions of these oxides are regulated by *IMO* (*International Maritime Organization*), according to [3].
Requirements for reducing *SOx* emissions in certain areas of navigation have resulted in using low-sulphur fuel oils in diesel engine operation. Using *HFO* with high sulphur contents has become unacceptable after adopting the regulations brought by Annex VI of the *International Convention for the Prevention of Pollution from Ships* (*MARPOL* 73/78), designating some seas as particularly sensitive areas (*Emission Control Areas - ECA*), and after introducing the monitoring of emissions from ships in *ECAs*.
Maximum allowed sulphur content in fuel in European *ECAs* amounts to 0.1 % for ships in ports and all inland waterways across the *European Union*, whereas *California Air Resources Board* (*CARB*) applies the regulation limiting the sulphur content in fuel to 0.1 % within 24 nautical miles of the California's coastline, according to [1], [3].

KEY WORDS

Low - sulphur fuel, lubrication, combustion, leakage, viscosity

1. INTRODUCTION

Annex VI of the *IMO MARPOL* 73/78 convention was adopted in 1997 and entered into force in 2005. The regulations related to *SOx* were described in regulations 14 and 18. According to these regulations, the sulphur content was limited to 4.5% and below in global area, whereas in *SOx Emission Control Areas* (*SECA*), such as the Baltic sea and the North sea, the sulphur content was limited to 1.5% and below, according to [1].
At the 57th session of *Marine Environment Protection Committee* (*MEPC 57*) of the *IMO*, held in April 2008, a proposal to review *SOx* controls was studied.
The agreement was reached on the proposal to control *SOx*, by limiting sulphur in fuel oil to 0.1% in 2015 in *Emission Control Areas* (*ECA*) and by reducing it to below 0.5% in 2020/2025 in global area.
National laws were ratified in February 2004 to conform to Annex VI. The *EU Directive* established detailed regulations related to sulphur content in fuel oils in Europe, while similar regulations were established by the *California Air Resources Board* in the *USA*, the *Los Angeles Port Authority* and the *Long Beach Port Authority*, according to [1].
Vessels at anchor within the area of the *Port of Los Angeles* and the vessels entering or leaving the port are required to use fuel oils in generators and

other auxiliary engines as specified by the regulations defined in *Clean Air Program* (*CAP*) of the *Port of Los Angeles*:

1. Speed of vessel is restricted to maximum 12 knots within 20 nautical miles of the port. Expansion of *SECA* is under consideration in line with the recommendations of the *South Coast Air Quality Management Direct* (*SCAQMD*) authority.
2. Low sulphur gas oil (*LSGO*) can be used voluntarily as the fuel oil when at anchor in the said port.
3. Low sulphur marine gas oil (*LSMGO*) to be used as the fuel oil for diesel generators within 40 miles of the said port. However, the difference in price of conventional oil (*MDO/MGO*) and *LSMGO*, and the expenses arising from the modification of fuel tanks are refunded from the *CAP* fund. The use of *LSMGO* as fuel oil in main engines in the same areas is also being studied, according to [1].

The control on sulphur content in fuel was agreed upon at the session of *MEPC* 57 in April 2008:

1. General requirements

The sulphur content in marine fuel oil used in general areas should be as below:

- Existing value: 4.50% m/m
- After 1st January 2012: 3.50% m/m
- After 1st January 2020: 0.50% m/m

However, the period for reducing the value to 0.50% m/m is to be decided after studying the global supply system for low-sulphur fuel oil by 2018, and the increase in CO_2 emissions with the production of low-sulphur fuels. If the results of the study are negative, then the period for reducing the control value to 0.50% m/m will be extended to 2025, according to [1].

2. Emission Control Areas (*ECA*)

The sulphur content in marine fuel oil in *ECA* to be as bellow:

- Existing value: 1.50% m/m
- After 1st March 2010: 1.00% m/m
- After 1st January 2015: 0.10% m/m

At the *MEPC* 57 it was also agreed that the requirements for properties of fuel oils will not apply only to the sulphur content as regulated by Annex VI, but also to other fuel properties affecting the safety of the ship and the environment. The *MEPC* 57 approved the proposal to reduce the existing control value of *NOx* [g/kWh] from 15.5% to 21.8% according to the rated engine speed [rpm] as from 2011. The proposal referring to newly built ships was agreed upon at the *12th Meeting of the Bulk Liquid* and *Gas Sub-Committee* (*BLG12*) held in February 2008. The *BLG12 Sub-Committee* approved the draft proposed by Japan, to reduce the existing control value by 80% in specific sea areas, according to [1].

2. EFFECTS OF USING LOW-SULPHUR FUEL OIL ON MARINE DIESEL ENGINES

At the request of *California Air Resources Board* (*CARB*), following a series of problems that occurred on ships due to fuel switching after the introduction of regulations on using low-sulphur fuel oils within 24 miles of the californian coastline, a research was conducted from 2009 to 2010, according to [3]. The research findings indicated that fuel switching causes:

- Loss of propulsion and operation instability as the engine reduces speed to come to dead slow or slow astern, resulting in rpm fluctuations or stopping the engine, whereas the engine operation was stable at higher rpm,
- Failures to start events, including difficulties in starting the engine or inability to start the engine due to low pressures in fuel systems, low viscosity of fuel, problems related to high-pressure fuel pump operation, fuel injection, leakage of oil in the fuel system, leakage of sealing rings,
- Inability to reach maximum speed, inability to reverse the engine ahead/astern, most commonly due to low pressure of fuel

injection or malfunctions in injection timing.
Based on the observation and analysis of the difficulties detected in California, *American Petroleum Institute* (*API*) published *Technical Considerations of Fuel Switching Practices* in 2009.
According to this study, possible causes of the difficulties may be recognised by the following events, according to [3]:

- Temperature of fuel during fuel switching causes sticking of the components of high pressure fuel pumps and injectors due to thermal shock, increase in fuel viscosity and reduced lubrication of high pressure fuel pumps,
- Non-compliance of the fuel in use and changes caused by sticking of high pressure pumps and fuel injectors,
- Use of inadequate oil for the lubrication of bearings and cylinder liners resulting in excessive wear of the liner and piston rings,
- Liner lacquering as a result of insufficient lubricating oil film.

2.1. Problem of liner *lacquering* when using low-sulphur fuel oil

Lacquering is a colouring effect due to black fuel oil without any effect of wear or quantity of lubricating oil consumed. Since anti-polishing rings, see figure 1, according to [1], began to be used in 1990s, the oxides of the piston crown and unburnt oil have been prevented from rubbing against the cylinder liner, and the colouring effect has reduced considerably.

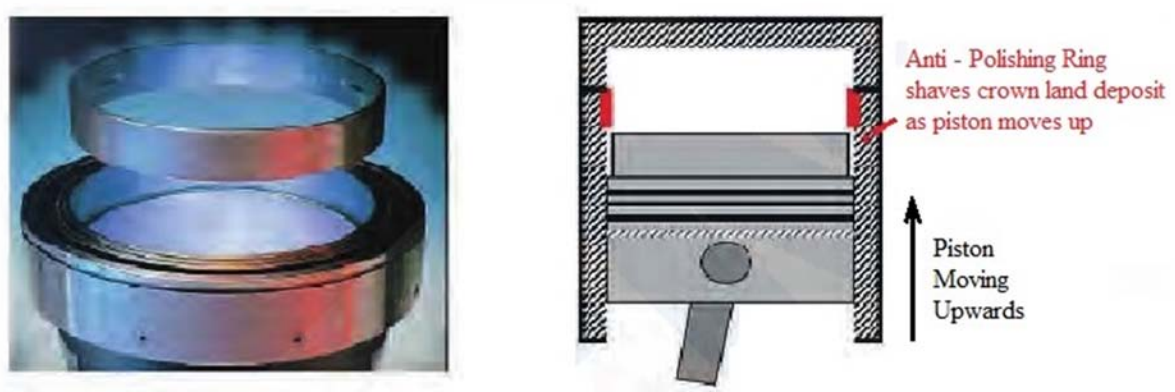

Figure 1. Anti-polishing ring

The problem of liner *lacquering* is a cause for concern when using low-sulphur fuel oil (*LSFO*) as it is harder to maintain the necessary lubricating oil film across the surface of the liner. This may lead to increased oil consumption. However, the process of lacquering ceases when the engine is switched back to *HFO*. The use of high-quality lubricating oil with improved thermal stability at high temperatures reduces the effects of fuel and the effects of flame on the cylinder liner surface, according to [1], [6].

2.2. Problems related to the high pressure fuel pumps

Since sulphur has lubricating ability, the use of *LSFO* leads to concern that lubrication of fuel pumps may be inadequate. The viscosity during fuel injection may change from that of *HFO* 10-20 [mm^2/s] to that of marine gas oil (*MGO*) 1-3 [mm^2/s], and become an issue. Although the lubricating ability of marine fuel oil and sticking of fuel pump require particular attention and the

situation should be continuously monitored with care, problems are not insurmountable.
The engine manufacturers have tested the use of fuel with agents added for enhancing lubricating oil during trials, and have also performed trials with fuel oils having several hundred ppm of sulphur content without any problems, according to [1], [5].
When the engine is changed over from heated heavy fuel oil (*HFO*) to unheated marine gas oil (*MGO*) or marine diesel oil (*MDO*), malfunctions in the high pressure fuel pump may occur due to vaporisation of the fuel oil because of heat.
Also, there is concern that the fuel oil may leak easily in the fuel pump with *HFO* specifications during *MGO* operation. The fuel leakage into the oil sump tank as the engine operates in *MGO* mode, according to [1], may have the following effects:

- Decreased viscosity of lubricating oil which, in severe cases, may adversely affect the lubrication of bearings,
- Drop in flash point, which may trigger an explosion in the crankcase,
- Since this fuel has low aromatic properties, it is not compatible with some kinds of rubber, and is likely to cause such as inadequate sealing.

Leakage of oil from the fuel pump to the internal part of the lubricating oil sump tank may have the following effects:

- Drop in fuel pump pressure,
- Reduction in the fuel injection quantity,
- Effects on fuel atomisation,
- Various ignition delays on engines complying with emission regulations such as *NOx* regulations.

2.3. Combustion problems when using low sulphur fuel oil

Although abnormal wear of piston rings and cylinder liners (*scuffing*) as well as combustion problems such as high temperature corrosion and the use of low sulphur heavy fuel oil (*LSHFO*) have been pointed out for a long time, comprehensive solutions related to the effects of sulphur content in fuel on the combustion process have not yet been found, according to [1], [8].
Combustion problems may occur because of each of the below factors independently, but in most cases, they occur because of a combination of several of these factors:

- Low sulphur level,
- Matching of low-sulphur content of fuel oil and the cylinder oil base number (*BN*),
- *FCC* catalytic fines,
- Defective combustibility of fuel oil,
- Contamination of used lubricating oil (*ULO*),
- Design of engine,
- Maintenance and operation of engine.

The assumption that low-sulphur content of fuel oil is by itself the cause of combustion problems is neither sound nor certain. The main causes of combustion problems may be the fact that a large amount of *FCC* catalytic fines is sometimes included in *LSHFO*, or that the fuel causing defective combustibility is sometimes used. Regarding the low sulphur itself, there is a concept that moderate corrosion of cylinder corrosion improves the run-in of cylinder oil and suppresses abnormal wear due to low-sulphur content. This is likely to occur owing to the fact that sulphur in the fuel burns and converts to a moderate amount of sulphuric acid which, when meeting the contact surface, minutely corrodes the piston rings and the liner (*micro-corrosion*), so that the contact surface becomes smooth. Consequently, the lubricating oil film can be easily retained, and the contact during a long period of operation is enhanced, according to [1].
When using fuel oil with the sulphur content that generates moderate corrosiveness, the edges of sharp grooves of the scratches on the cylinder liner made by *FCC* catalyst particles become rounded due to micro-corrosion and the oil film does not get broken. On the contrary, if *LSHFO* is used in a cylinder liner containing a number of tiny longitudinal scratches that have occurred because of *FCC* particles, the edges of grooves remain sharp when there is no corrosion, and this may eventually result in the destruction of the oil film, according to [1], [2], [9].
Today, the prevailing view is that the main causes of combustion problems are primarily related to

the defective combustibility or to the methods of manufacturing marine fuel oil wherein *FCC* catalyst residue is mixed. It is generally considered that the low level of sulphur itself is not the main cause of problems, according to [1], [2], [9].

Calcium compounds, which are the main components of the base number *BN* of cylinder oil, react with sulphur compounds such as SO_2 in combustion gases, and form calcium sulphate $CaSO_4$. This reaction suppresses the corrosion of the cylinder liner initiated by sulphur compound. However, if *LSHFO* is used and the use of cylinder oil of the normal high *BN* 70 to 80 continues, calcium oxide *CaO* is formed due to excessive *BN*.

Abnormal deposits stick to the piston rings, shrink and harden. As *CaO* is harder than $CaSO_4$, excessive deposits of *CaO* may result in abnormal wear of the piston and cylinder liner. In order to prevent excessive deposits when using *LSFO*, it is necessary to carefully observe the condition of the cylinder liner and piston rings, according to [1], [6], [7].

The components of *FCC* catalytic fines are aluminium oxide Al_2O_3 and silicon oxide SiO_2, forming a very hard ceramic. The diameter of *FCC* fines included in fuel oil ranges between several microns to 100 microns, but the size frequently observed on the cylinder liner surface with abnormal wear is in the range of 10 to 15 microns. As the thickness of the cylinder oil film is smaller, issues of oil film retention arise. Very hard *FCC* catalyst residue enters the contact surface of the cylinder liner and piston rings, causing scratches on both the liner and the rings. These are longitudinal scratches that are perpendicular to the piston ring that serves as a seal. The scratches easily allow high pressure and high temperature combustion gas to blow by between the piston and the liner. A large number of scratches are likely to cause scuffing, according to [1].

When using low sulphur gas oil (*LSGO*), whose kinematic viscosity is very low, there are increased chances of problems such as fuel pump sticking because of poor lubrication. In engines where the fuel oil is switched from *HFO* to *LSGO*, fuel oil cooler is sometimes fitted to mitigate the temperature rise of *LSGO* due to residual heat. Its flash point is also low and the risk of fire is increased, according to [1], [2], [5].

2.4. Problems in the crankcase oil and cylinder oil systems in two-stroke engines

Crankcase system oil in two-stroke engines does not directly affect the fuel combustion, so that the sulphur content has no direct effects in the process. The impact of *LSFO* includes the effects arising due to contaminants from the scavenging space, such as leakage from the stuffing box and recovery and re-use of the leaked oil from the stuffing box.

The contaminants from the scavenging space include cylinder oil drain and combustion products. Their features affect the sulphur content of the fuel oil in use. When normal cylinder oil having *BN* 70-80 is used, compared to *LSFO* of the sulphur content of 1-1.5%, the residual *BN* in the cylinder oil drain becomes higher than that used in high-sulphur fuels. As a result, the *BN* of the crankcase system oil increases, depending on the *LSFO* usage time, according to [1], [5], [7].

Low sulphur fuel oil (*LSFO*) is considered most suitable for use in the lubrication of cylinders and pistons in slow-speed two-stroke diesel engines. When the normal sulphur content in fuel is 1-1.5% m/m, the use of *BN* 70-80 can be resumed and operating conditions should be carefully monitored. When the normal sulphur content in fuel is lower than 1.0 % m/m and resulting in certain difficulties in engine operation, changing over to the cylinder oil with lower *BN* should be considered. In the engines with the cylinder liner temperature set to a high level, *BN* 50 cylinder oil can be used for the fuel having the sulphur content of 2-2.5%, according to [1],[5].

If normal *BN* 70-80 cylinder oil is continuously used when using *LSFO*, serious problems in cylinder lubrication may occur. Excess *BN* is generated for low sulphur content. Consequently, excess *BN* generates calcium oxide deposits which shrink and harden. These hardened deposits rub against the cylinder liner surface which gets abraded and, at the same time, the oil film is broken. In severe cases, scuffing occurs when the deposits on the piston crown grow enough to cause liner polishing. Figure 2, according to [1], shows the piston in a two-stroke diesel engine and the deposits on the piston crown.

Several oil manufacturers offer *BN* 40 or 60 cylinder oil suitable for *LSFO*. If the additive amount is merely reduced in low *BN* cylinder oil, it is likely to cause problems. Therefore, its manufacturing method is not simple. *BN* also has detergent performance.

So, if *BN* is reduced, the detergent performance reduces accordingly. This increases fouling of the piston due to the processes of combustion and oxidation, according to [1].

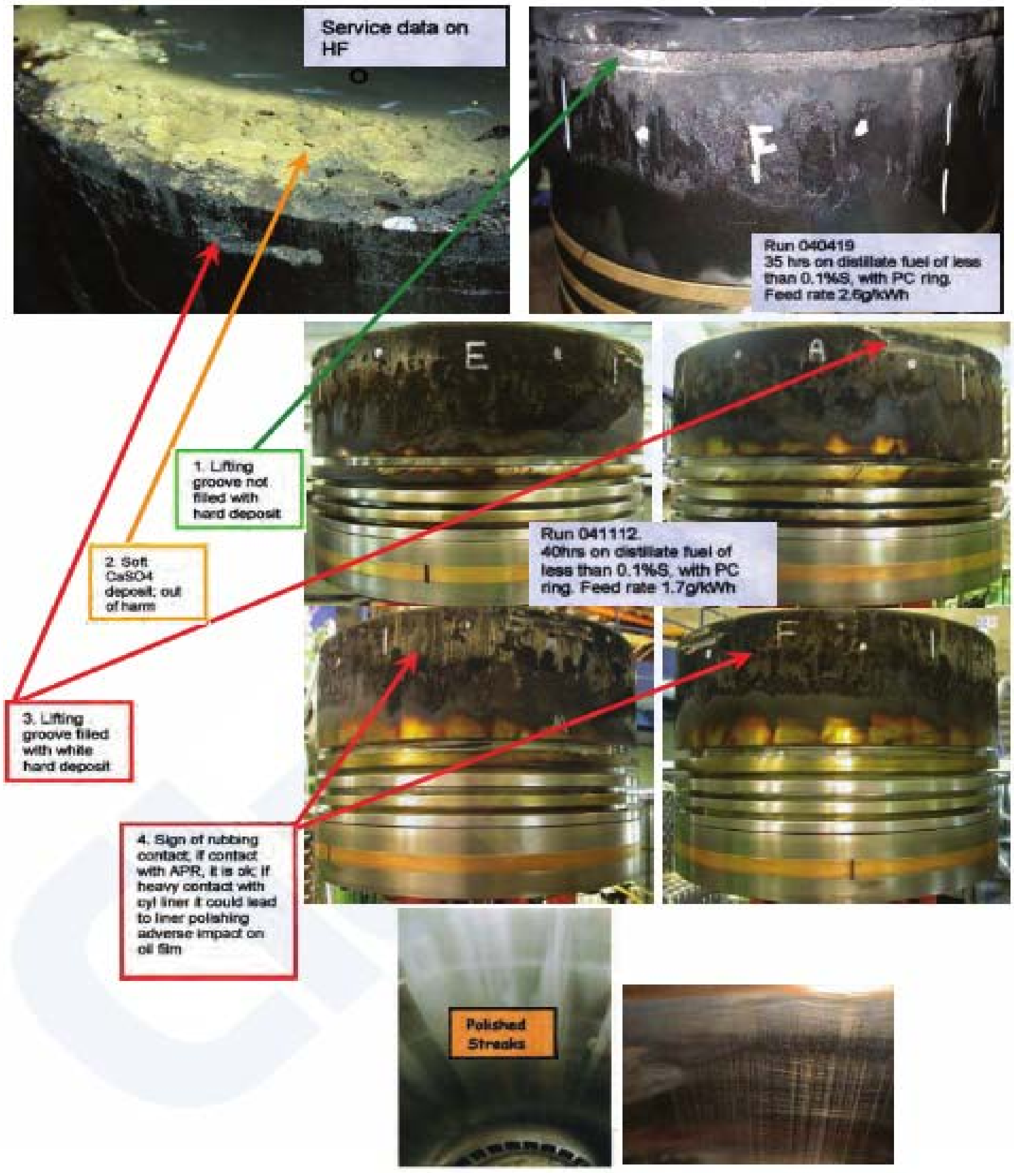

Figure 2. Deposits on the piston crown of a two-stroke diesel engine

3. MEASURES WHEN USING LOW-SULPHUR FUEL OIL

Reducing the operating load of the engine is the most effective measure. By reducing the load, both temperature and pressure within the combustion chamber are decreased, the penetrating force of sprayed fuel also decreases, and the oil film retention ability improves significantly. Mixing with good fuel oil is another effective measure.

Low grade fuel and good fuel should be mixed. The mixing ratio is determined by the values of properties that are known owing to fuel analysis or the ratio can be determined by increasing the percentage of low grade fuel, while checking the operating conditions of the engine, according to [1], [2].

In order to maintain stable operation, each engine manufacturer sets the recommended values of the concentration *Al+Si*, *FCC* catalytic fines, at the engine entry point. The recommended value of *Al+Si* for two-stroke engines ranges from 7 to 15 ppm and below. Even within the recommended range of *Al+Si*, under the influence of other factors, *FCC* catalytic fines may sometimes trigger abnormal wear of the cylinder liner and piston rings. Hence it is necessary to reduce *FCC* particles as far as possible and install fuel oil filters with mesh size below 10 microns, and thoroughly clean the fuel oil, according to [1], [2], [4].

Increasing the feed rate of cylinder oil and lowering the temperature of the cylinder liner cooling water are the measures resulting in strengthening the lubricating oil film. The temperature of the jacket cooling water (*JCW*) at the cylinder outlet is usually set at about 85-90°C, so that cooling is efficient at a small flow rate. In a normal engine room plan, the *JCW* outlet temperature can be made around 75°C. In this way, the cylinder lubricating oil temperature on the cylinder liner wall surface is slightly reduced and the viscosity increases. Consequently, the strength of the lubricating oil film increases and the film becomes difficult to tear. A decrease in engine load and an increase in lubricating oil quantity also represent the measures for reducing heat in the lubricating oil film, which leads to enhanced strength of the lubricating oil film, according to [1].

New cylinder oil feed systems have been developed and adapted in two-stroke diesel engines:
Electronically Controlled Lubricating – *ECL* System, Swirl Injection Principle – *SIP*, developed by Mitsubishi Heavy Industries Ltd., Pulse Lubricating System – *PLS* Wärtsilä and Alpha Lubricator System *MAN*. These systems directly and effectively supply lubricating oil to a wide area of the cylinder liner surface. The cylinder oil is supplied effectively in adequate quantity to the required parts, the reliability of the oil film has improved noticeably, and the margin until scuffing is reached has increased considerably, i.e. the occurrence of scuffing has been delayed. Again, process resulting in scuffing can be prevented by emergency measures such as the engine load reduction or increase in lubricating oil quantity. Compared to conventional cylinder oil feed systems, the above systems require considerably smaller amount of lubricating oil.

By introducing these systems, most of the problems related to the cylinder liner and piston rings due to *LSFO* are likely to be resolved in the near future, according to [1].

4. CONCLUSIONS

Inversed public interest in exhaust gas emissions and the protection of the environment against overall adverse effects of exhaust fumes including diesel engine combustion gases, as well as the associated technological innovations, have contributed to the development of systems aimed at controlling the emissions of exhaust fumes. Changing the main engine fuel type may affect the safety of navigation due to malfunction of the engine or interruption of its operation. In the emission control areas the fuel switching has to be carried out not only in main engines, but in auxiliary engines and steam generators as well, according to [2], [3].

When fuel oil is used after changing the type, large amount of sludge is generated if the mixing stability of *LSGO* and *HFO* is poor.

Consequently, if a mixture of *HFO* and *LSGO* oils remains in fuel oil pipes, clogging of strainers, sticking of fuel oil pump and other sludge

problems are likely to occur. Careful monitoring is therefore necessary, according to [1].
LSGO has low kinematic viscosity so it is likely to diffuse easily when it leaks. Moreover, as its flash point is also low, there is an increased risk of fire. The flash point of fuel oil used on board ships is regulated to a value above 60°C, in compliance with the *SOLAS* Convention of *IMO*, but the flash point of a part of *LSGO* may be less than 60°C. Although this does not lead to problems in engine operation directly, the issue requires the design and the arrangement of the engine room to be reviewed and reconsidered, according to [1].
Analyses of possible causes of the encountered problems have indicated that these issues have been mainly considered from the perspective of technology and engine room plant requirements when changing the fuel type on board ships. However, the causes have to include operators' errors and have to be also studied from the viewpoint of both onboard and corporate organisation, according to [3].

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MARITIME CYBER DEFENSE

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ABSTRACT

The purpose of this paper is to inform about the current state of cyber security in the maritime industry. Maritime security commonly addresses physical security, but now it should include cyber security. Cyber attacks on ships and crew are deliberate disruptions of critical automation systems that cause problems for computer networks. Future attacks are inevitable and the shipping industry may be vulnerable of collateral damage if sensitive information, as business confidential information, company proprietary data, details of vessel schedules and personnel data is picked up by malicious adversaries. Many activities in the maritime industry depend on electronic and communication systems, and that makes them susceptible to cyber attacks. It will be wise to establish and maintain a maritime cyber defense system that includes cyber security in all major maritime information and communication technology (ICT) components. Recently, IMO has created the position of an Electro Technical Officer (ETO) designation with core ICT skills and Certificate of Competency (COC). Though there is no specific IMO requirement for carrying an ETO crewmember, it would be wise to integrate this higher version of an electrical officer position into their crew. The maritime community would benefit from forming a maritime cyber defense team that would design a strategy and define policies in assisting standardization of cyber security guidelines in the maritime industry. The time is right to make this preventive move using the latest cyber defense methods to guard against future cyber threats.

KEY WORDS

cyber security, cyber defense, cyber threats, Electro Technical Officer, ETO, IMO, ICT, COC

1. INTRODUCTION

Cyber vulnerabilities exist at all Shipping Port Facilities. Domestic and International port facilities rely as much upon networked computers and control systems as they do on the manpower to ensure the flow of maritime commerce that the economy, the homeland, and the national security depend on. Unlike other sectors of the maritime infrastructure, little attention was paid to networked systems that support maritime port operations[1].

It would benefit the maritime community to agree to form maritime cyber security teams that would establish strategy, policy and guidelines that would be beneficial in securing and protecting the maritime sector from cyber threats.

2. THE ENISA REPORT

The European Network and Information Security Agency (ENISA) is a center of expertise for the European Union (EU), its Member States (MS), the private sector and Europe's citizens.
As an EU agency, ENISA works with these groups to develop advice and recommendations on good practice in information security. ENISA assists Member States in implementing relevant EU legislation, and works to improve the hardiness of Europe's critical information infrastructure and network systems.

Executing its work program, ENISA seeks to improve existing expertise in Member States by supporting the development of cross-border communities committed to improving network and information security throughout the EU.

2.1 Cyber Security aspects in the maritime sector

ENISA published this first EU report on cyber security challenges in the Maritime Sector[2] "Analysis of Cyber Security Aspects in the Maritime Sector". This milestone report highlighted essential key insights, as well as existing initiatives, as a baseline for cyber security, and finally high-level recommendations are given for addressing cyber security risks.
This report positions Maritime Cyber Security as a logical and crucial next step in the global protection efforts of ICT infrastructure.

2.2 Cyber Security awareness

Cyber threats are a growing menace, spreading to all industry sectors that are relying on Information and Communication Technology (ICT) systems. These deliberate disruptions of critical automation systems prove that cyber-attacks have a significant impact on critical infrastructures.
Disruption of ICT security capabilities may have dire consequences for the EU Member States' governments and social wellbeing. There's a need to ensure ICT robustness against cyber-attacks is thus a key challenge at national and pan-European level.
Maritime figures show that 90% of the EU's external trade and more than 40% of the internal trade take place via maritime routes. Therefore, securing the maritime sector's critical infrastructure and the movement of vital goods, such as foodstuffs and health supplies, is a priority area for European nations.
Some key findings of the report are that maritime cyber security awareness is currently low, to non-existent. Member States are thus highly recommended to undertake targeted maritime sector awareness raising campaigns and cyber security training of shipping companies, port authorities, national cyber security offices, etc.

Due to the high ICT complexity, it would be a challenge to ensure sufficient maritime cyber security, but following a common strategy and developing good practices in technology and the implementation of ICT systems would bring "security by design" for critical maritime ICT components.
Current maritime regulations and policies basically considers the physical aspect of security and safety, but policies should add the cyber security aspect to them also, therefore the ENISA report strongly recommends a holistic, risk-based approach and an assessment of maritime specific cyber risks, as well as identification of all critical assets within this sector.
As maritime laws and regulations are fragmented between different levels, as international, European, and national, the International Maritime Organization (IMO) together with the EU Commission and the Member States could align international and EU policies in this sector.
Better information exchange and statistics on cyber security can help insurers to improve their actuarial models, reduce their own risks, and thereby offer better contractual insurance conditions for the maritime sector.

3. CYBER SECURITY AT US PORTS

A recent study contends that the US's largest maritime ports have failed to implement sufficient defenses against potential cyber attacks, raising concerns about the vulnerability of computer networks that help move energy, foodstuffs and other goods to market[3].

3.1 Insufficient Cyber Defense at US ports

Some of the US's most heavily used ports are vulnerable to cyber attacks that could destabilize the economy, that include Los Angeles and Long Beach in California; Baltimore, Maryland; Houston and Beaumont in Texas; and Vicksburg, Mississippi, on the Mississippi River.
The ports of Los Angeles and Long Beach, the US's largest and second largest maritime ports, respectively, have taken some defensive steps. Los Angeles used a $1.6-million grant to protect its computer networks from hackers; Long Beach

spent $35 million to build a secure communications infrastructure, but both have done it haphazardly.
The Port of Los Angeles leases 27 terminals, warehouses and facilities to more than 300 private entities, and has overlooked the security of the networked systems that ensure the constant flow of more than 8 million containers it handles annually.
The Port of Los Angeles has not conducted a cyber security vulnerability assessment, and it does not have a cyber incident response plan, but a vulnerability assessment is currently underway and the authorities have taken the possibility of cyber threats seriously.
The Port of Long Beach has no written cyber security directive or response plan, but its spokesman states that they have the latest cyber security technologies and they patch all of our systems on a regular basis. They continuously train their users on cyber security best practices.

3.2 The dangers of Insufficient Cyber Defense

The danger of cyber attacks targeting US shipping ports is realistic and a disruption to any major US port could quickly affect the domestic economy. The flow of commerce would grind to a halt in a few days; shelves at grocery stores and gasoline storage tanks at fueling stations would run empty. The halt in energy supplies would likely send not just a ripple but a shockwave through the US and, in turn, the global economy.
More organization is needed to implementing and enforcing cyber security standards for US shipping ports, therefore, the US Department of Homeland Security would need to direct more resources to support cyber security at large US maritime ports.

4. CYBER THREATS

With the continuing growth in relying on information systems onboard vessels, there is a threat that terrorists may hack into maritime information systems and cause at least chaos and at worst a real disaster. It is „entirely feasible" that pirates could employ hacking a ships' system and re-direct it or tamper with its navigational data, as ECDIS maps[4].

4.1 Threat Statistics

In 2013, Mandiant reports that 63% of breaches are reported by third parties; 243 median days advanced attackers are on the network before being detected; 100% of breaches involve stolen credentials[5]. Verizon 2013 DBIR reports 47,000 breaches; 69% of breaches are reported by third Party; 29% use Social Tactics; 76% involve weak or stolen credentials; >70% of IP theft by internal people within 30 days of separation of employment[6].

4.2 Targeted Attacks and Data Breaches

The "Watering Hole Attack" has been used to breach numerous high tech organizations. These are browser exploits injected on websites which frequented by the targeted employees. These exploits lead to Trojan malware installations where SQL injection remains the most common breach 1st half of 2013 have surpassed all of 2011 and 2012 by year's end.
Social Media Account Takeovers are the ability for single attack to influence millions of people by "trusted" such as Twitter users with large number of followers sends link to malicious sites; and black market trade of compromised/fabricated accounts.
With the growing popularity of Android, malware authors hope to cash in with sophisticated attacks with strong intent for specific organizations.

4.3 Vulnerability Disclosures

Over 4,100 new publicly reported security vulnerabilities registered w/X-force database is on track to equal last year's total of 8,200. Over 50% of all web application vulnerabilities reported were victims of cross-site scripting (XSS); mobile application/OS vulnerabilities have increased considerably since 2009.
Exploitations are increasingly focusing on High Rate of Return exploits (cross-browser/cross-OS platform) with Adobe Flash and JAVA plug-ins.

4.4 Zero Day Attacks

Several Zero-Day vulnerabilities in the first half of 2013 were targeted attacks. This promoted significant investment in development of Internet

Explorer, Oracle, Java, Adobe Reader, and Adobe Flash. For instance, on Sep. 17th, 2013, all versions of Internet Explorer were affected. An estimated 70% of all Windows computers were vulnerable.

4.5 Malware Statistics

Malware Hosting is where a user is unknowingly redirected from an infected website to a malicious server website.

Table 1. Top 5 "Malware Hosting" Countries

Country	Percent
United States	42.3%
Germany	9.8 %
China	5.0%
Russia	4.5%
Netherlands	4.0%

Command and Control (or Botnet) is a series of computers that unknowing to the user communicate with each other to spread malware.

Table 2. Top 5 "Command and Control" Server Hosting Countries

Country	Percent
United States	31.6%
Russia	9.8 %
Germany	7.0%
South Korea	6.6%
China	6.2%

5. CYBERSECURITY MANAGEMENT

Effective cybersecurity management is essential to protecting a nation's technology infrastructure. The professionals accountable for this protection constitute a critical workforce. Until now, there has been little consistency in terms of how cybersecurity work is defined and categorized, who is responsible for the work, and what skill sets are needed to perform successfully. Even within organizations, individuals performing cybersecurity work are difficult to identify, locate, and quantify. As individual nations, we must establish consistency in how the cybersecurity workforce is defined and classified and handled.

5.1 The Anatomy of a Cyber Attack

1. A cyber attacker establishes a relay to obfuscate attribution.
2. The attacker sends a phishing email.
3. The victim clicks on the attachment.
4. The attacker establishes "Command and Control".
5. The attacker establishes a remote ***cmd*** shell on the victim's computer.
6. The attacker conducts reconnaissance – the attack.
7. Data is probably exfiltrated to a pivot computer/relay or data is moved directly to the attacker's computer.
8. Cleanup evidence, in RAM memory only or establishes persistence on the hard disk.

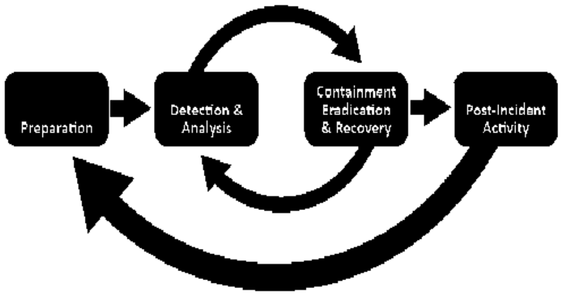

Figure 1. Incident Response Life Cycle

5.2 NICE Framework

With the direct engagement of over US federal departments and agencies, and numerous public and private organizations, the National Initiative for Cybersecurity Education[7] (NICE) developed the National Cybersecurity Workforce Framework, or the Framework, to define cybersecurity work and lay a foundation for cybersecurity workforce efforts. The **Framework** provides a common language and taxonomy and defines specialty areas, knowledge, skills, and abilities (KSAs), and codifies talent.

The National Initiative for Cybersecurity Education (NICE) developed the National Cybersecurity

Workforce Framework (the Framework) to define the cybersecurity workforce and provide a common taxonomy and lexicon by which to classify and categorize workers.
The Framework benefits organizations, the workforce, and even the nation, by defining cybersecurity functions and creating a common taxonomy which can be used when referring to cybersecurity work. The purpose of the Framework is to describe cybersecurity work irrespective of organizational structures, job titles, or other potentially individual conventions.

5.3 Information Assurance (IA) Compliance

Information Assurance (IA) Compliance oversees, evaluates, and supports the documentation, validation, and accreditation processes necessary to assure that new information technology (IT) systems meet the organization's information assurance (IA) and security requirements[8].
Information Assurance ensures appropriate treatment of risk, compliance, and assurance from internal and external perspectives.

6. CYBER DEFENSE PERSONNEL

Since current maritime security principally deals with physical security, it should be expanded to encompass cyber security and defense. How?

6.1 The Electro Technical Officer – ETO

Much of the cruise industry currently has IT onboard vessels and the new changes in the 2010 STCW Manila Amendments have even introduced an Electro Technical Officer[9] (ETO) designation with approved training and Certificate of Competency (COC). The 2010 STCW Manila Amendments have now been in force since 1st January 2012 and although there is no specific requirement for the carrying of an ETO, IMO has created the ETO position which requires core competencies and minimum mandatory requirements.

6.1.1 The ETO's IT responsibilities

On board cruise and passenger vessels an ETO is important as they have electrical requirements and unmanned technology handling them. An Electro Technical Officer (ETO) can be seen as a higher version of an electrical officer. Some areas of an ETO responsibility include: radio communications, electronic navigation equipment, telephone and satellite communications and engine room electrical equipment.
At sea some simple items that can be done to increase cyber security and vigilance that can include whenever updating ECDIS charts to verify the source, request encrypted data and digital electronic signatures. These are simple steps that the ETO can help alleviate a hacker maliciously sending you incorrect *navigational data* that could easily put your ship in jeopardy or peril for example by moving one buoy out of position in a channel.
Much of this can be framed around proper training for all crew members as well as implementing the ETO position and ensuring and performing systems audits on all equipment and systems to verify they have the latest security and software updates.

6.1.2 Implementing the ETO for cyber security

It is time to make this preventive measure move and on an individual basis. All shipping companies should be self-evaluating their operations and infrastructure to ensure they are fully compliant with the latest security and protection systems to avoid future cyber threats. It is plausible to believe that future requirements may make this a mandatory position on certain type and size vessels.
Vessel owners and operators would be wise to fully embrace this position and commence integrating it into their crew complement. The position of an Electro Technical Officer (ETO) would most likely be filled by candidates who have professional core skills training, such as Microsoft Academy, CISCO Systems, or other compatible certified training; information systems and/or modern communications technology work experience (5+ years); IMO approved Certificate of Competency, and who had not only looked for employment elsewhere but have the desire to work in the maritime community. The ETO could cooperate with Computer Network Defense Teams (CND-T), who can cooperate in implementing cyber defense measures based on ship's needs and in cooperation with other maritime community ETO's.

6.2 A Maritime Cyber Network Defense Team

A good model of a cyber defense team can be found in the US Armed forces who organized Computer Network Defense Teams (CND-T), who will implement Internal Defensive Measures based on US Department of Defense Information Networks (DoDIN) and when directed to do so, support the security of non-DOD networks (with proper authority).[10] Their primary function is to rapidly deliver operational cyber capabilities and trained operators to defend networks when called upon[11]. Cyber security training and certifications are based on civilian institutions as SANS Institute and Mandiant. This concept can be modified to cater to the cyber security measures needed by the maritime community.

6.2.1 Team Composition

A cyber security team may be composed of a Team Chief, a Deputy Team Chief, Information Protection Technicians, Information Systems Technicians on land and shipboard as ETO's.

6.2.2 Core Skills of team members

Each CND-T member is designated a specific function and must become proficient in this function through continued training: core skills (Windows, networks, servers, databases, etc.) and cross training is conducted to better understand each skill used on the team that builds team cohesion, continuity and provides a backup for each specialty role.

6.2.3 Training methodology.

CND-T training consists of the following: baseline standards that all members must meet; continuing education tracks that can be conducted by e-learning on the ship or from home; classes, workshops and resident courses at commercial training locations; collective training conducted at home station utilizing virtual/simulation equipment, and/or participation in exercises, skill evaluation, and validation from IMO sponsored events.

6.2.4 Staffing Considerations.

CND-T positions represent an advanced skill set within the Information Assurance community, who seek skilled System Admins or Information Security experience.

6.2.5 Recommended Training and Certifications

Recommended civilian training courses and certification is offered at SANS Instituite[12]. For managerial training is Certified Information System Security Professional (CISSP). Training and certifications for engineers and technicians are:
- SEC401: Security Essentials Bootcamp Style,
- SEC503: Intrusion Detection In-Depth,
- SEC504: Hacker Techniques, Exploits & Incident Handling,
- FOR508: Advanced Computer Forensic Analysis and Incident Response
- FOR610: Reverse-Engineering Malware: Malware Analysis Tools and Techniques

7. CONCLUSIONS

Maritime security commonly addresses physical security, but should include cyber security. Cyber attacks on ships and crew can deliberately disrupt critical automation systems that can cause problems for maritime computer networks and future attacks are inevitable. The maritime community would benefit from forming maritime cyber defense teams that would design a strategy and define policies in assisting standardization of cyber security guidelines in the maritime industry. Integrating maritime cyber defense teams who implement defensive measures based on civilian training and certification can provide cyber defense capabilities with trained operators to defend maritime networks. As part of a maritime cyber network defense team, integrating the position of an Electro Technical Officer (ETO) designation with core ICT skills into the crew would help maintain a maritime cyber defense system to include cyber security in all major maritime information and communication technology components.

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THE OBLIGATIONS AND LIABILITY OF THE SHIPPER UNDER THE ROTTERDAM RULES

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ABSTRACT

This paper presents and analyses provisions of the Rotterdam Rules in respect of the shipper's obligations and liabilities. Also these provisions are compared with the solutions of the current conventions that regulate the carriage of goods by sea. Three main obligations of the shipper - duty to delivery for carriage, duty to cooperate with the carrier in providing information and instructions and shipper's obligation to provide information, instructions and documents are examined in detail. The article also deals with the liability of the shipper and liability of shipper for other persons. Special attention is devoted to the provisions deal with the basis of shipper's liability to the carrier. The objects of the examination are also recent solutions in respect of defining and prescribing the liability of documentary shipper. Assumption of shipper's rights and obligations by the documentary shipper is also analysed. Other important innovations are pointed out, like special rules on dangerous goods and shipper's liability for failure to provide information for compilation of contract particulars. Rotterdam Rules attempts to regulate in a comprehensive and contemporary manner the obligations and liability of the shipper. The overall assessment is that the shipper's obligations and liability are not substantially increased under the Rotterdam Rules.

KEY WORDS

Carriage of goods by sea, Rotterdam Rules, shipper, documentary shipper, obligations, liability

1. INTRODUCTION

Under the contract of carriage of goods by sea the shipper has duties and liabilities. Over the different Conventions, these duties and liabilities have become ever more visible. The first convention – the Hague Rules[1] was in fact created as a reaction to the excesses of absolute freedom of contract and was precisely mean to impose minimum obligations and liabilities on the carriers. The HVR contain only a few provisions on the shipper's duties and liabilities, intermixed with the other provisions. According to Article 4 (3) the shipper is liable for

[1] The International Convention for the Unification of Certain Rules of Law relating to Bills of Lading, signed in Brussels on 25 August 1924. The Convention is known as "the Hague Rules". Protocol to Amend the International Convention for the Unification of Certain Rules of Law relating to Bills of Lading, signed in Brussels on 23 February 1968. The Protocol is known as "the Hague-Visby Rules" (HVR). The Hague-Visby Rules have been further amended by the Protocol to amend the International Convention for the Unification of Certain Rules of Law relating to Bills of Lading 1924, as amended by Protocol of 1968, signed in Brussels on 21. December 1979. The Protocol is known as "Special Drawing Rights Protocol or SDR Protocol.

loss or damage sustained by the carrier or the ship as a result of any fault or neglect by the shipper or his agents or servants. The Hamburg Rules[2] already contain a separate Part III on the liability of the shippers, consisting of two articles, one addressing the basic of the shipper's liability and one providing special rules for dangerous goods.

Today, the role of the shipper in transport had gradually become more important. In general shippers have become bigger and sometimes more powerful than many carriers. Large amounts of goods are today shipped between large company groups. The features of the goods vary a lot and often the shipper appears as the expert on how the goods should be handled. National authorities require a lot more documentation for safety and security reasons [5]. During the negotiations on the Rotterdam Rules is was felt that it was time to regulate also the shipper's obligations and liability to the carrier in a more detailed way.

The United Nations adopted on December 11, 2008, the United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea – The Rotterdam Rules (RR). On September 23, 2009 the Rotterdam Rules was signed in Rotterdam. So far, twenty-five countries signed new Convention. The Convention has not entered into force. So far, it has been ratified only by two states (Spain and Togo).[3]

The overt objective of the RR is to replace the existing disjointed international regime, composed of the two versions of the HVR, the HbR and a potential panoply of national laws, with a single universal regime; and also to lay down a firm foundation for the expansion of electronic maritime commerce [6].

The RR contains in chapter 7 (Articles 27-34) a comprehensive regulation of the responsibilities and liabilities of the shipper. Detailed provisions, gives more certainty to the regulation, for the benefit of the market and the parties involved.

This paper examines the shipper's obligations and liabilities under the chapter 7 of the RR.

2. THE DEFINITION OF THE «SHIPPER» AND «DOCUMENTARY SHIPPER»

"Shipper" is defined in the RR, Article 1.8 as "a person that enters into a contract of carriage with a carrier". Reference to the same notion of «shipper» can be found, although indirectly in HVR, Art. I (a), where "carrier" is defined as the owner or the charterer who enters into a contract of carriage with a shipper". HbR, Art. 1.3. introduced definition of shipper. "Shipper" means any person by whom or in whose name or on whose behalf a contract of carriage by sea has been concluded with a carrier, or any person by whom or in whose name or on whose behalf the goods are actually delivered to the carrier in relation to the contract of carriage by sea". The use of the word "or" as a conjunction indicates a certain degree of incertitude about which of the person mentioned in Art. 1.3. is entitled to exercise the rights or is subject to the obligations which the HbR attribute simply to the "shipper" [8].

There is, in fact, in addition to the shipper, another person whose possible direct involvement in the liabilities deriving from the contract of carriage. The RR qualifies the person, other then the shipper, that enters into a contract of carriage with a carrier, that accepts to be named as "shipper" in the transport document or electronic transport record as the "documentary shipper".

If such person "accepts" the transport document, he is then subject to the responsibilities and liabilities imposed on the shipper and is entitled to the shipper's rights and immunities.

The text of the RR does not clarify what "acceptance" means with reference to non-negotiable and electronic transport documents, or transport documents having a function purely as evidence of the terms of the contract of carriage and, in any case, if such acceptance must be express or can be implied from the behaviour of the person [8].

Article 33.2 of the RR provides that the liability of the documentary shipper does not affect the obligations, liabilities, rights or defences of the actual shipper, which is a somewhat indirect way of saying that the liability of the documentary shipper comes in addition to the liability of the actual shipper, and does not replace the latter's liability.

[2] The United Nation Convention on the Carriage of Goods by Sea, signed in Hamburg on 31 March 1978. The Convention is known as "the Hamburg Rules" (HbR).

[3] Source www.imo.org (February, 3, 2014).

Shipper and documentary shipper are, however, not jointly and severally liable [6].

3. OBLIGATIONS OF THE SHIPPER TO THE CARRIER

3.1. Delivery for carriage

The basic obligation of the shipper under RR is to deliver the goods for carriage, and even more importantly to deliver them in such condition that they are able to withstand the intended carriage without being damaged and without causing damage to the ship or other cargo, or persons or property.

During the later work of UNCITRAL's Working Group III, most of the discussion, centred on the question whether the shipper's duty to deliver the goods ready for carriage should be mandatory, or whether parties should be allowed to agree otherwise [6]. Based on the text of article 27.1. of the RR, the conclusion does seem to be that the shipper's duty to deliver the goods in a "safe" condition is indeed a mandatory obligation that cannot be modified in the contract of carriage.[4]

Article 13.2 of the RR, establishes that the carrier and the shipper may agree that the loading, handling, stowing or unloading of the goods is to be performed by the shipper, the documentary shipper or the consignee. This is common in the bulk trade, in which for economic and practical reasons the parties agree that the shipper shall load and perhaps also stow the goods. These clauses are usually named free in and out (FIO) or free in and out stowed (FIOS). Article 27.2 of the RR applies in the situation in which parties have agreed that the shipper, instead of the carrier, assumes responsibility for loading and other activities under a FIO clause. Article 27.2 of the RR prescribes that the shipper shall properly and carefully perform any obligation assumed under an agreement made pursuant to article 13.2. If the shipper during the loading of the cargo acts with fault and damages the ship, it will be liable for that.

The shipper performs not all activities under the FIO clause. For instance, the consignee may perform unloading of the goods form the ship. Article 27.2 does not regulate such activities performed by a person other than the shipper. If the consignee damaged the ship during the unloading process agreed in the FIO clause contained in a non-negotiable transport document the shipper has not breached the obligation under article 27.2 because it did not perform the discharge under FIO clause unless the consignee is not the person referred to in article 34 of the RR. The consignee might be liable under applicable national law but not under the RR. The chapter 7 of the RR provide only for the shipper's obligation and liability [2].

Article 27.3 of the RR extends this obligation of the shipper, when a container is packed or shipper loads a vehicle. Article 27.3 of the RR provides a special rule for containerised cargo. The shipper is than obliged to properly and carefully stows, lash and secure the contents in or on the container or vehicle, in such way that they will no cause harm to persons or property.

3.2. Cooperation for the shipper and the carrier in providing information and instructions

Performing the contract of carriage effectively requires that the parties properly communicate. To ensure the success of the transaction, the parties should in any event provide the information that they possess and the instructions that they can reasonably give. The reasonability requirement ensures that the obligation – by definition – does not impose an unreasonable burden on the parties [2].

Article 28 sets out the principle that the carrier and the shipper shall cooperate so that the shipper is able to deliver the goods ready for carriage and to submit correct documentation of the cargo. With regard to the carrier there is no direct sanction for not cooperating, but if the carrier does not respond to the request from the shipper and the ship is later damaged by the cargo, it runs the risk that the shipper might anyway not be considered to have with fault [7].

[4] Article 27.1 of the RR provides that the shipper shall deliver the goods «ready for carriage», *unless otherwise agreed in the contract of carriage*. The next sentence of subparagraph 1, however, provides that *in any event* the shipper shall deliver the goods in such condition that they will withstand the intended carriage and will not cause harm to persons or property.

3.3. Shipper's obligation to provide information, instructions and documents

In Article 29.1 the RR refers to the shipper's obligation to provide information, instruction and documents. The shipper shall provide to the carrier in a timely manner such information, instruction and documents relating to the goods that are not otherwise reasonably available to the carrier, and that are reasonably necessary:

a) for the proper handling and carriage of the goods, including precautions to be taken by the carrier or a performing party; and
b) for the carrier to comply with law, regulations or other requirements of public authorities in connection with the intended carriage, provided that the carrier notifies the shipper in a timely manner of the information, instructions and documents requires.

Under article 29.2 RP, even if the carrier does not notify the shipper about the information, instructions or documents required for the carriage, the shipper is still obliged to comply with any law requiring to provide such information, instructions or documents. Therefore, this specific obligation of the shipper does not depend, according to the RR, on any particular requirement from the carrier [3].

The first draft of the RR imposed strict liability for a breach of the shipper's obligation to furnish information. During the UNCITRAL negotiations, however, the nature of the shipper's liability for the failure to furnish proper information changed substantially. Under the final text, the breach of an article 29. of the RR obligation triggers ordinary fault-based liability under article 30.2 of the RR Only the failure to furnish certain kinds of information triggers the shipper's strict liability [2].

The new provisions of the RR do not, in fact, modify the existing law as stated in the international conventions in force. Pursuant to the article 4.2.i) HVR the carrier is not liable for the loss or damage to the goods caused by "act or omission of the shipper or owner of the goods". Under article 4.3 HVR the shipper shall not be responsible for loss or damage sustained by the carrier or the ship arising or resulting from any cause without the act, fault or neglect of the shipper, his agents or his servants. The same rule is derived from article 12. of the HbR.[5] In this case, the burden of proving the act or omission of the shipper remains on the carrier.

3.4. Information for compilation of contact particulars

The shipper shall provide to the carrier, in a timely manner, accurate information required for the compilation of the contract particulars and the issuance transport documents or electronic transport records, including the following information:

a) A description of the goods as appropriate for the transport;
b) The leading marks necessary for identification of the goods;
c) The number of packages or pieces, or the quantity of goods;
d) The weight of the goods, if furnisher by the shipper;
e) The name of the party to be identified as the shipper in the contract particulars;
f) The name of the consignee, if any;
g) The name of the person to whose order the transport document or electronic transport record is to be issued, if any.

The shipper is deemed to have guaranteed the accuracy at the time of receipt by the carrier of the information that is provided. The shipper shall indemnify the carrier against loss or damage resulting for the inaccuracy of such information.

Failure to provide the information in time is a fault-based liability, not a strict liability. Unlike previous international conventions under which the shipper guarantees the accuracy of information provided for the transport document, the first draft's strict liability applied to any kind of information. UNCITRAL Working Group expressed its concerns about the shipper's strict liability regarding the accuracy of information and decides early in the process that the shipper's liability for furnishing information should, except in limited cases, be basted on fault [2].

The RR makes no significant changes to the existing law and do not increase the shipper's obligations in this regard.[6]

[5] The shipper is not liable for loss sustained by the carrier or the actual carrier, or for damage sustained by the ship, unless such loss or damage was caused by the fault or neglect of the shipper, his servants or agents.

3.5. Inform of the dangerous nature or character of the goods

Special provision is made by article 32 about the shipper's obligation to inform the carrier about the dangerous nature or character of the goods. When goods by their nature or character are, or reasonably appear to become, a danger to persons, property or the environment the shipper shall:

a) Inform the carrier of the dangerous nature or character of the goods in a timely manner before they are delivered to the carrier or a performing party and
b) Mark or label dangerous goods in accordance with any law, regulations or other requirements of public authorities that apply during any stage of the intended carriage of the goods.

If the shipper fails to inform the carrier of the dangerous nature or character of the goods and the carrier or performing party does not otherwise have knowledge of their dangerous nature or character, the shipper is liable to the carrier for loss or damage resulting from such failure to inform. If the shipper fails to mark or label dangerous goods, it is liable to the carrier for loss or damage resulting form such failure.
The HR and HVR regulate dangerous goods in article 4(6). The shipper is liable for all damages and expenses directly or indirectly arising out of or resulting from the shipment if the carrier did not properly consent to the carriage of the goods.[7] The HbR have slightly more detailed regulations, including the shipper's obligation to inform the carrier of the dangerous nature of the cargo and to mark and label the dangerous goods, and the shipper's strict liability for the loss resulting from the shipment of dangerous goods when the carrier is not aware of their dangerous character [2].

4. LIABILITY OF THE SHIPPER

Article 30. provides for the basic of the shipper's liability for loss or damage under the RR.

In order for the action to be successful the carrier should provide a) the loss or damage it has suffered, b) a breach of the shipper's obligations under the Convention, c) a causative link between the breach and the loss.
The requirements differ significantly from the burden of proof for carrier's liability. A cargo claimant does not have to prove any breach of obligation by the carrier to establish a prima facie cause under article 17.1, but need prove only that the loss, damage, or delay occurred during the carrier's period of responsibility. In contrast, a breach of obligation is always a prerequisite for the shipper's liability. Prior conventions require only proof of the shipper's fault, not any specific breach of an obligation under the convention [2].
The liability of the shipper is based on fault, with relevant exceptions referred to in article 30.2 of the RR. The RR imposes strict liability on the shipper only in connection with information required for the compilation of the contract particulars or with respect to the dangerous nature of the goods.
Article 30.2. RR gives the shipper a defence to the carrier's action: if the shipper can prove that the cause or one of the causes of the loss or damage is not attributable to its fault or to the fault of any person to which it has entrusted the performance of any of its obligations, it will be relieved of all or part of its liability. However, this provision does not apply to two of the shipper's obligations: a) to indemnity the carrier against loss or damage resulting from the inaccuracy of the information required for the compilation of the contract particulars and the issuance of the transport document, and b) those relating to dangerous cargo [1].
The RR impose strict liability on the shipper in two exceptional cases:

1.) A breach of the obligation to provide accurate information for the compilation of the contract particulars and
2.) A loss or damage caused by improper information or inappropriate marking and labelling with respect to dangerous goods.

According to Article 30.3 RR the shipper is liable only for the part of the loss that is actually

[6] The same obligation exists in article 3.5 of the HVR and the article 17.1 of the HbR.
[7] The House of Lords have interpreted article 4 (6) as imposing strict liability (Effort Shipping Company v. Linden Management S.A. – The "Giannis NK"), Lloyd's Report [1998] 1, p. 337.

attributable to his fault or to the fault of any person referred to in Article 34.[8]

Parties cannot increase the shipper's obligation and liabilities by contract. The shipper is liable without limitation for loss or damage sustained by the carrier if the carrier proves that such loss or damage was caused by a breach of the shipper's obligations under the RR.

4.1. Liability of the documentary shipper

A documentary shipper is subject to the obligations and liabilities imposed on the actual shipper pursuant to chapter 7 RR and pursuant to article 55 RR. A documentary shipper is entitled to the rights and defences provided to the actual shipper by chapter 7 and 13 RR (article 33.1 RR). From the debates in Working Group III, it is clear that the delegates were primarily thinking about the position of an FOB seller [6].

In practice it is somewhat difficult to foresee what liability the shipper and the documentary shipper will have in relation to the carrier. Most likely Article 33.2 RR must be construed in a way that it indicates that the shipper will still keep some of his obligations and liabilities in addition to the documentary shipper, but that there is no joint liability between them [5].

4.2. Shipper's liability for other persons

Under the RR the shipper is not only liable for his own acts or omissions, but also for the acts or omissions of his employees, agents, subcontractors or any other person to which he entrusts the performance of any of his obligations (article 34), which is a simple application of the general principle of vicarious liability [6]. There is one exception to this principle, though: if the shipper entrusts the performance of some of his obligations to the carrier, then the shipper is not liable for the acts or omissions of the carrier or of a performing party acting on behalf of the carrier [6].

[8] Shipper is liable for the acts or omissions of any person, including employees, agents and subcontractors, to which it has entrusted the performance of any of its obligations.

5. CONCLUSIONS

Shipper's obligations under RR can be divided into the following:

a) to deliver the goods ready for carriage. In any event, the shipper shall deliver the goods in such condition that: they will withstand the intended carriage, including their loading, handling, stowing, lashing and securing, and unloading, and that they will not cause harm to persons or property;
b) to provide information, instructions and documents. Shipper shall provide to the carrier information, instructions and documents relating to the goods, that are reasonable necessary: i) for the proper handling and carriage of the goods, ii) for the carrier to comply with law, regulations or other requirements of public authorities, iii) for the compilation of the contract particulars and the issuance of the transport documents or electronic transport records;
c) to provide information for the compilation of contract particulars;
d) to inform of the dangerous nature or character of the goods.

Shipper's liabilities can be classified as follows:

a) general shipper's liability rule,
b) special liability regime regarding the information for the compilation of contract particulars,
c) special liability regime for dangerous goods.

The liability of the shipper is mostly based on fault. Shipper is relieved of all or part of its liability if the cause or one of the cause of the loss or damage is not attributable to its fault. There are two exceptions to the principle that the shipper's liability is fault-based: a) in the case of breach of the shipper's obligation to provide accurate information for the compilation of the contract particulars and the issuance of the transport documents, and b) the special rules on dangerous goods, the shipper cannot prove that the causes of the loss are not attributable to its fault.

Pursuant to the RR a documentary shipper is subject to the obligations and liabilities imposed on the actual shipper. A documentary shipper is entitled to the rights and defences provided to the actual shipper.

Under the RR the shipper is liable for the breach of its obligations under the Convention caused by the acts or omissions of any person, including employees, agents and subcontractors, to which it has entrusted the performance of any of its obligations.

The RR are the result of an ambitious project, which seeks to codify almost all aspects of maritime carriage. It is therefore considerably more complex than its predecessors HVR and HbR. If RR is not ratified, the status quo of the existing regimes most particularly the HVR will not remain and the likelihood is that the EU and the US would enact their own regional or domestic legislation. One should note that the European Parliament recently included in a recent Resolution a statement calling on all Member States to rapidly sing, ratify and implement the RR [4].

Compared to the HVR the shipper has through the RR suddenly become visible. However, neither of those rules significantly increases the shipper's liability when compared with previous conventions.

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CHALLENGES OF MARINE SPATIAL PLANNING IN EASTERN ADRIATIC

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ABSTRACT

Marine spatial planning (MPS), being a public process for analysing and planning the spatial and temporal distribution of human activities in sea areas to achieve economic, environmental and social objectives, is a mean for a rational and scientifically-based use of sea space. Its main purpose is to identify and manage spatial uses and conflicts in maritime areas and to provide a framework for arbitrating between competing human activities and managing their impact on the marine environment. MPS enables the recognition that the oceans are no longer free for all commons, but rather a space where human interests, responsibilities and ecosystems interact. There is no MSP in Croatia, or spatial planning with regard to the Adriatic Sea, but only a fragmented sectorial legislation. The paper identifies MPS as an important legal tool for the effective governance of marine areas. Any MSP should be developed in a transparent manner and should advocate public interest. Also, coherence between terrestrial and MSP should be achieved. Conducted properly, MSP should optimize the use of the sea, reduce the cost of information, regulation, planning and decision-making, it represents strategic planning, facilitates conflict resolution and sustainable resource use, helps to ensure that developing marine sectors are allocated space to develop, supports environmental economy, improves stakeholder involvement, and develops common approaches to the acquisition and dissemination of information. The authors are proposing that MSP in Eastern Adriatic should in particular take account of new land-based developmental hazards such as new construction and creation of impermeable surfaces.

KEY WORDS

marine spatial planning, governance of marine areas, integrated protection of marine environment, Adriatic Sea

1. INTRODUCTION

A significant part of population lives by the coast and depends on the sea in its activities. Ever more intense use of the sea, in combination of climate changes, place additional pressure on the marine environment. The list of hazards associated with the sea ranges from unsustainable fisheries, sea- and land-based marine pollution, eutrophication, noise pollution from maritime transport and port activities, drilling and underwater acoustic devices, invasive species, climate change impacts, ocean acidification, sand extraction, oil exploration, to land use, coastal development with sprawl of artificial areas and adverse impacts from tourism.

The knowledge necessary for pursuing the multiple challenges and the powers are distributed between numerous public and private entities at diverse administrative levels, from global level to small coastal communities. Owing to such inseparable interdependence, the best method of dealing with maritime affairs is the integral approach to maritime governance.

This paper evaluates the instrument of marine spatial planning (MSP), provides the comparison between land spatial planning and MSP, presents the review of relevant sources of law, and in focusing on special character of the Eastern Adriatic region lists the challenges in MSP development.

2. THE INSTRUMENT OF MSP

It should be noted that there is no universally accepted definition of MSP or what a marine spatial plan should consist of [1].

Spatial planning refers to the methods used largely by the public sector to influence the future distribution of activities in space. It is undertaken with the aim of creating a more rational territorial organisation of land (space) uses and the linkages between them, to balance demands for development with the need to protect the environment, and to achieve social economic objectives. Spatial planning embraces measures to coordinate the spatial impacts of other sector policies, to achieve a more even distribution of economic development between regions that would otherwise be created by market forces, and to regulate the conversion of land and property uses. However the existence of maritime spatial plans alone does not guarantee that sea areas are used sustainably [2].

MSP operates within three dimensions, addressing activities (a) on the sea bed; (b) in the water column; and (c) on the surface. This allows the same space to be used for different purposes. Time should also be taken into account as a fourth dimension, as the compatibility of uses and the "management need" of a particular maritime region might vary over time [3].

MSP is also innovative in the sense that it enables the recognition that the oceans are no longer being a free for all commons, but rather a space where human interests and responsibilities (established and emerging) and ecosystems interact [4].

3. COMPARISON BETWEEN LAND SPATIAL PLANNING AND MSP

Coastal zones are the "hinge" between maritime and terrestrial development. Drainage areas or land-based impacts from activities such as agriculture and urban growth are relevant in the context of MSP [3].

Since its inception in the 1960s, the concept and the approach to spatial planning on land has undergone some significant transformations. The first transformation was its development from a project- or permit-based approach to a more comprehensive approach to resource use planning based on distinct areas. The activity of spatial planning has also undergone a transformation, developing from a pure means of physically organising space to an increasingly communicative activity which needs to rely on co-operation between different scales of decision-making, sectors and stakeholders. More recently, spatial planning is also being linked to the concept of coastal governance, where the focus is as much on the process of planning as on its actual output [1].

Present planning in marine environment is much similar with land planning of the sixties. Much can be learned from the existing systems of land use planning, but at planning it is also necessary to take account of the differences. First, marine area is tri-dimensional and dynamic in its character, so that each site will have multiple uses, simultaneously or during various periods or seasons, as opposed to the constancy of use at land. Also, although there are some private ownership rights in coastal zone, the sea is generally a public and not private resource [5]. Furthermore, physical and ecological conditions vary significantly in marine systems, and that requires flexibility in the use of space [6].

4. SOURCES OF LAW REGARDING MSP

A review of basic sources of law related to MSP is provided hereinbelow.

The **United Nations Convention on the Law of the Sea (UNCLOS) 1982** [7] provides legal basis to allocate activities and duty to protect the marine environment without the expressly referring to the MSP. There are a number of marine areas in which coastal states can exercise jurisdiction regarding the MSP such as internal waters, territorial seas, archipelagic waters, contiguous zones, continental shelf's, exclusive economic zones and fishery zones.

The **Convention on Biological Diversity (CBD) 1992** [8] stipulates a commitment to introduce environmental impact assessments procedures for proposed activities that may have adverse effects on biological diversity, including public participation.

United Nations Conference on Environment & Development, Rio de Janeiro, Brazil, 3 to 14 June 1992 [9] in its Chapter 17 sets out framework program of action for achieving protection and sustainable development of the marine environment and its resources. The program areas include, among others, marine environmental protection and integrated management and sustainable development of coastal areas.

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, as amended [10] is requiring Member States to select, designate and protect sites that support certain natural habitats and species of plants or animals as Special Areas of Conservation (SACs).

The **European Union Recommendation on Integrated Coastal Zone (ICMZ) 2002** [11] although not making a reference to MSP, provides a basis for doing so, in particular as a part of requirements of Member States to develop national ICZM strategies.

The **European Union Marine Thematic Strategy (Marine Strategy) 2005** [12] introduces the principle of ecosystem based MSP and provides supportive framework for national initiatives toward spatial planning designed for achieving a good status of the marine environment.

The **European Union green Paper Towards a Future Marine Policy for The Union: A European Vision for the Oceans and Seas (Maritime Policy) 2006** [13] provides the basis for maritime policy including MSP as a key aspect to managing a growing and increasingly competing maritime economy, while at the same time safeguarding biodiversity.

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds [14] is providing a framework for the identification and classification of Special Protection Areas (SPAs) for rare, vulnerable and regulatory occurring migratory species.

The **EU Marine Strategy Framework Directive** [15] pursues the ecosystem-based approach in the sense that the adoption of decisions can no more be based on sectorial approach only, but must reflect major transboundary marine ecosystems that should be preserved in order to maintain the basic resource for all maritime activities.

Governance based on ecosystems constitutes an integrated approach and differs from approaches to date which are usually focused on particular species, sectors, activities or problems, and considers cumulative effect of various sectors [5]. Ecosystem services among others include provisioning services (food, raw materials, fresh water, medicinal resources), regulating services (local climate and air quality, carbon sequestration and storage, moderation of extreme events, waste-water treatment, erosion prevention and maintenance of soil fertility, pollination, biological control), habitat or supporting services (habitats for species, maintenance of genetic diversity, soil formation, photosynthesis, primary production, nutrient recycling, i.e. services needed to maintain other services), and cultural services (recreation and mental and physical health, tourism, aesthetic values, spiritual, religious values and the sense of place).

Human dimension of MSP can be simplified in most cases to listing and mapping activities (e.g. oil and gas, fisheries, shipping). These are of course vital to document, but they are complex processes across a variety of scales, parallel to biophysical processes. Ecosystem-based approaches have transformed both the way we view biophysical processes and, by association, the way we also now manage the biophysical environment by understanding processes, connections, space and scales. In the same way, human dimensions need to be examined through a similar understanding of processes (e.g. community and territory), connections (e.g. within and across communities, economies), space (e.g. territories, cultural perceptions) and scales (e.g. local, regional, national scales of society) [16].

Explanatory text of the **Proposal of Directive of the European Parliament and of the Council establishing a framework for maritime spatial planning and integrated coastal management**

[17] states that maritime spatial planning is commonly understood as a public process for analysing and planning the spatial and temporal distribution of human activities in sea areas to achieve economic, environmental and social objectives. The main purpose of maritime spatial planning is to identify and manage spatial uses and conflicts in maritime areas. In order to achieve that purpose, Member States need at least to ensure that the planning process or processes result in a comprehensive map identifying the different uses of maritime space, taking into consideration long term changes due to climate change. The aim of the action is for Member States to establish a process or processes that cover the full cycle of problem identification, information collection, planning, decision-making, management, monitoring of implementation, and stakeholder participation.

The most important feature of proposed new directive is the requirement for countries and groups of countries to prepare maritime spatial plans and integrated coastal management strategies. Five years after the adoption of the directive, the Commission will compile a follow-up report based on progress reports submitted by the Member States. Also, one of the most important improvements is the creation of geospatial data. Most of the information currently compiled by Members States about their coastal regions is socio-economic in nature and does not contain location data that would help pinpoint precisely where certain environmental changes are happening [6].

5. SPECIAL CHARACTER OF EASTERN ADRIATIC REGION

Croatia is located on the eastern side of the Adriatic Sea, bordering Slovenia in the north, Italy in the west and Bosnia and Herzegovina and Montenegro in the south. Croatia has a very long coastline with many inlets and islands. Croatia established an Ecological and Fishery Protection Zone (EFPZ), but this zone only applies to non-EU Member States. Croatia has an extensive spatial planning system, but an ICZM strategy has not yet been developed. There is no specific Maritime Spatial Planning regulation in Croatia, nor any spatial planning or coastal law which can also be applied to the sea. Interest in ICZM/MSP principles is emerging from specific sectors (e.g. mariculture and maritime transport) [18].

In Croatia, sectorial legislation is predominant. Important laws in this respect include the Maritime Code, the Maritime Demesne and Marine Ports Act which defines maritime demesne and marine ports, management thereof and the requirements for granting the concessions, the Marine Fisheries Act, the Environmental Protection Act and the Nature Protection Act which regulated the establishment of MPAs. The 300 m marine belt, which is protected under the Act on Physical Planning and Construction and the Regulation on Development and Protection of the Protected Coastal Area, could be considered an exception. This protected coastal area represents an area of special interest for Croatia [18, 19].

Physical planning documents in Croatia are as a rule filled with good and technically correct objectives, but that is evidently not sufficient, as Croatia is in a situation similar to other transition states endowed with precious coastal resources. Croatia requires the physical planning system that is based on the principles of sustainable development, as well as implementable, clear and precise (as quantified as possible) building regulations and control measures [20]. Simplified application of the Environmental impact assessment is being implemented in Croatia for years, but such an instrument was never coherently included in the physical planning system [21].

As regards specific features of the Adriatic Sea, its northern part lies at the continental shelf of 30 m average depth collects 1/3 of the total continental freshwater of the Mediterranean and 80% of all pollution in the Adriatic [22]. The shelf dense water formation in the area affects circulation and thus oxygen supply in the Eastern Mediterranean [23]. Western side is characterized by sandy coasts interrupted by lagunas, while eastern coast is karstic with numerous channels, small islands, submerged cliffs and abrupt depth variations. Dinaric karst, the greatest continuous karst area in Europe, encompasses north and eastern parts of the Adriatic, and half of Adriatic Sea bed. Thus there is pronounced biodiversity of habitats and benthic fauna located over a small area [22]. Direct exploitation (marine transport, offshore platforms, submarine cables, hydrocarbon exploration, fishing, fish farming, military drills, scientific research, tourism) as well as indirect exploitation (discharge of municipal and industrial wastewater, runoff drainage) make this part of the Adriatic an interesting example of an ever increasing economic importance of the sea, but also of one of the most imperilled ecosystems globally due to pollution and excessive exploitation of its natural resources [24].

Croatia is close to the European average of 4.9% increase in impervious areas in the 2006-2009 periods [6], which is substantial given the complex Eastern Adriatic karstic area with numerous rivers and karstic springs and insufficient knowledge of numerous submarine springs discharged in the area. Urbanism in particular has direct impact on the area of impervious surfaces, pollution and intensity of storm runoff, and pollution of the sea, meaning that land-based activities have particular relevance for MSP [25].

The rise in its geostrategic significance will lead to increased maritime transport. The indispensable declaring of the Adriatic as particularly sensitive sea area would also require appropriate management while harmonized vision at international strategic level together with Italy, Slovenia, Bosnia and Herzegovina and Montenegro could be elaborated within an integrated transboundary marine spatial plan.

The most recent spatial plan of one of the administrative units in the area, the Littoral-Mountain County [26] for instance, has done very little with regard to MSP, save for standard aspects such as berths, submarine cables and pipelines, ports, etc.). Comprehensive plan would require the availability of much more data, especially the knowledge of situation concerning marine ecosystems, and it is especially in Quarner area of the North Adriatic which constitutes marine part of said county that exceptionally little investigation has been done to date.

6. THE CHALLENGES IN MSP DEVELOPMENT

In many ways MSP is similar to integrated coastal zone management. For example, both are integrated, strategic, and participatory – and both aim to maximize compatibilities among human activities and reduce conflicts both among human uses and between human uses and nature. When coastal zone management was first conceived over 40 years ago, one definition of the coastal zone was the area of land affected by the sea and the area of the sea affected by the land. That definition was interpreted to cover the coastal plain to the edge of the continental shelf. However, the boundaries of coastal zone management have been limited in most countries to a narrow strip of coastline within a kilometre or two from the shoreline. Only rarely have the inland boundaries of coastal management included coastal watersheds or catchment areas. Even more rarely does coastal management extend into the territorial sea and beyond to the exclusive economic zone [8]. There are however few examples of how MSP has been applied in coastal waters which include bays, estuaries and near shore marine waters [27].

Furthermore, international and ecological perspectives are insufficient although oceans and the seas are physically connected to each other.

Ecosystem-based management is place-based and needs a more spatial and temporal approach. As no single, readily applicable best practice of marine spatial management exists there is a need for better-defined tools, procedures, and guidelines that support the implementation of ecosystem-based NSP [28]. Not all steps will apply to all regions, and a „one-size-fits-all„ approach is counterproductive [29]. Also, in the longer term there is nothing to guarantee that MSP will be able to fulfil its potential as a tool for ecosystem stewardship, but it is important that it continues to build on the idea that humans and nature as an integral whole within which a healthy planet is the premise for economic and social development [4].

It should also be noted that some see MSP as a way to gain influence and power through the reservation of space and exclusion of certain activities, possibly demoting economically less gainful sea uses, such as marine protected areas [6]. Therefore the management of ocean spaces outside the protected area becomes increasingly more important [30]

The value of MSP is not just in the development of the product but also in the process. Done well, the planning process can help to clarify management objectives, examine trade-offs among them, involve stakeholders and reduce conflicts among users. The process does not end with the plan, especially since many plans have specified dates for re-evaluation [29]. On the other hand, real outcomes, not the process, should be the goals of MSP [31].

7. CONCLUSIONS

Any MSP should be developed in a transparent manner and should advocate public interest. Also, coherence between terrestrial and MSP should be achieved.
Conducted properly, MSP should optimize the use of the sea, reduce the cost of information, regulation, planning and decision-making, it represents strategic planning, facilitates conflict resolution and sustainable resource use, helps to ensure that developing marine sectors are allocated space to develop, supports environmental economy, improves stakeholder involvement, and develops common approaches to the acquisition and dissemination of information.
Owing to the value of its marine natural resources and coastal karst, Croatia should in authors' opinion institutionalize and foster the MSP integrated with quality environmental impact assessment and active participation of local communities.
MSP in transboundary in character, so it is necessary for the states to set up the central coordination body that will act as a support in elaborating and implementing the integrated marine spatial plans at various levels. In the paper, the authors advocate that coordination body be independent with respect to the sectors in its role that is technical in character, and be subject to control of a democratically elected body or public authority, with clear rules for representation in such a coordination body, thus ensuring that relevant interests at land and the sea are considered.
The authors are proposing that MSP in Eastern Adriatic should in particular take account of new land-based developmental hazards such as construction and creation of impermeable surfaces.

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SOLUTION FOR EDUCATION OF SEAFARERS

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ABSTRACT

Education of seafarers is very complex process because it is regulated with the STCW convention and in the same time with the national rules in higher education. We compare the study programs in maritime faculties in Croatia, Montenegro and Slovenia. These countries changed their study programs in last year and there are several differences between them. The objective of all is to have qualified seafarers with high competence. International collaboration in maritime education and in training in accordance with METNET can be a solution. In this paper we propose o new way of education of seafarers where we build a team/group of expert with all necessary knowledge and experience in the field of maritime science and with appropriate title in high education. This team of expert will rotate between the faculties and ensure that the level of knowledge in all studies programs for maritime education is in accordance with STCW and scientific requirements.

KEY WORDS

Education of seafarers, STCW, METNET

1. INTRODUCTION

Sea is one of the most important resources for the European economy and in terms of volume, 90% of the freight exchanges of Europe with the rest of the world is done by sea. Shipping represents one of Europe's largest export industries, providing deep sea transport services between Europe and the rest of the world. In terms of added value, traditional maritime sectors represent a share of 1.09% in the total GDP of the EU-27 and Norway. Maritime transport activities' related employment in Europe amounts to 1.5 million people. Some 70% of shipping related jobs are onshore – in shipbuilding, naval architecture, science, engineering, electronics, cargo-handling and logistics (1). Transport of freight and passengers at sea generated € 24.7 billion in 2006 as a net contribution to the EU balance of payments (2).The volume of export and import goods is expected to increase during the coming decades and importance of shipping will therefore grow.

While demand is increasing, there has been an acute shortage of European seafarers – mainly officers. This is expected to rise considerably if no corrective measures are taken. The EU fleet have a shortfall of around 30 000 trained officers (1).

2. EDUCATION OF SEAFARERS

For Europe maritime transport with the off-shore activities are essential. It helps it to play an important role in global world. In the same time technical, technological and organisational changes in maritime transport require new concepts of transport, and the application of new technologies in the individual traffic branches are necessary. The development of science and information technology provides just-in-time supply. Ships are more and more automated and specialised. Ports, which are becoming the most important logistics link in the transport chain, are adapting to the changes in the sea transport market (5). Today choosing a career in maritime sector is a special decision.

Education and training of seamen in the European Union has certainly an important role, though not the only one, considering the decrease of interest in the maritime profession (3).
Maritime curricula require complete updating. The updating should be as follows:

- graduates must become interested in maritime and non-maritime economy on land;
- maritime curricula must provide mobility of students among European maritime schools;
- maritime curricula among European maritime schools must be harmonised so as to enable mobility;
- this harmonisation will ultimately require simulation based training;
- maritime profession should become a regulated profession in the EU.

Considering the statistical data regarding the employment of graduates with maritime orientation in the EU it is possible to deduct the following groups (6):
1. The group that after graduation continues with a maritime career on ships and remains there till retirement. The statistical trend in this group is decreasing.
2. The group that after graduation continues with a maritime career on ships but after approx. seven years of employment on a ship changes to an employment in maritime economics on land. The statistical trend in this group is steady.
3. The group that after graduation leaves the maritime career and enters other mostly maritime economic and non economic activities. The statistical trend in this group is rising.

2.1. STCW – *conditio sine qua non* for METNET and maritime science

Development of modern maritime technology demands the growth of comprehensive maritime knowledge and skills. Knowledge about the ship becomes the object of lifelong learning education from aspect of global and specialist knowledge. In accordance with that demands for obligatory and non-obligatory courses for professional sailors are in progress because the needs of upgrading their present knowledge. Higher level of professionalism in maritime business means better alternatives for developing the attitudes towards actual technology and optimises decision making process on management level. The main argument for that is comprehensive education. Modern European project of maritime education known as *Thematic Network on Maritime Education, Training and Mobility of Seafarers* – ***METNET*** *– World Maritime University, Malmo(7)* – is giving the classification the seafarers education thru the next levels and institutions:

- 1E MET level is institution which offer main (*Essential i.e.)* syllabuses and programs with minimum demands proposed by STCW 95. Convention.
- 2E MET level, relatively to institution which offers base plus additional programs (*Extensions*). Additional programs in this context mean offering the courses which enable boarding to ship at some capacity or rank. This programs are more detailed than base STCW courses and offers more than STCW Convention.
- 3E MET level, relatively to institution which offer along with base and additional programs also advanced programs (*Enrichment)*. Advanced programs refer to teaching syllabi and programs which are important for achieving the academic level. This academic level enables the future ship officers determined diapason of jobs on ashore, not only on board the ship.
- 4E MET level, relatively to institution which is the fact 3E institution and offer advancement thru the post diploma studies to reach the PhD level.

Taking in to the consideration all from above, the essential principle for successful education is to fulfil demands of STCW Convention. Starting from standards of STCW Convention is possible to develop all other,(*more than STCW Convention*), demands to achieve successful education on management level. For this purpose all institutions involved in maritime education need to ensure the presence of qualified teachers - instructors with proper STCW certificates and seagoing experience, for all teaching subjects related to STCW demands.

2.2 Education of seafarers in Croatia, Montenegro and Slovenia

In Croatia there are University of Rijeka with the Faculty of maritime studies and University of Split with the Faculty of maritime studies and University of Dubrovnik with Department of maritime studies and University of Zadar with Department of maritime studies in Montenegro at University of Montenegro is Faculty of maritime studies and in Slovenia is University of Ljubljana with the Faculty of maritime studies and transportation. In all faculties and department the programme comprises in two branches - nautical science and marine engineering, with the view of the modern trends and recommendations of the STCW Convention. The basic objective of the programme is to train deck and engineer officers for leading positions on the ships of national or international shipping companies. The programme fully complies with the international convention on standards of training of seafarers. Although the STCW Convention (International Convention on Standard of Training, Certification and Watchkeeping) specifies the minimum extent of knowledge, the qualifications provided are comprehensive (3). In fact, considering the provision of knowledge from the point that the candidate is only capable of implementing it, the minimum required by the convention is reached. If, on the other hand, knowledge is provided from the point that it also needs to be understood, thus enabling the candidates to follow, comprehend and apply the developing technology on ships in the next 10 to 20 years, the maximum is reached in terms of the STCW Convention. Upon a successful completion of the studies, the student is awarded the professional title of Bachelor of Science in Maritime Studies. In table 1 is shown a number of students in academic year 2013/14.

Table 1: Number of students in academic year 2013/14

Faculty /Department	Nautical science			Marine engineering		
	1.year	2.year	3.year	1.year	2.year	3.year
Rijeka	166	119	75	109	75	39
Split	111	137	77	47	48	22
Dubrovnik	37	27	27	21	9	3
Zadar	69	17	14	64	10	3
Kotor	204	82	44	119	43	24
Portorož	55	32	15	27	13	7
Total	**642**	**414**	**252**	**387**	**198**	**98**

From the Table 1 we can see that the number of student in nautical science in third year is less than 40 % of the number of students in first year, but even worse is with the students in marine engineering where the number of student in third year is around 25 %.
According to the rules of STCW Convention standard the professors at University must have qualification and training requirements, but the High education system requirements are different. In practice that mean that professor at University must fulfil both requirements. Therefore is very difficult to obtain the high qualified team of university professors. In table 2 is a number of professor that provide the STCW and HE standards.

Table 2: Number of professors with the STCW and HE conditions

Faculty/Department	Professors of Nautical science and Marine engineering		
	Full professor	Assoc. professor	Assistant professor
Rijeka	7	3	10
Split	/	/	5
Dubrovnik	1	1	1
Zadar	/	1	/
Kotor	2	/	/
Portorož	/	/	2
Total	**10**	**5**	**18**

3. MODEL OF EDUCATION OF SEAFARERS

The need for rapid and safe transport of people and goods and the effective functioning of the ship requires a high consistency of all systems and subsystems, technical and technological organization of ships, their management and crew. In the last twenty years the ships have changed significantly and require highly trained officers who must cope with an increasingly broader and more specialized knowledge. That means that education of seafarers is more complicated that it was years ago and required professors with academically knowledge and also with the practice in the sea. From the table 1 and 2 we can see that in Croatia, Montenegro and Slovenia there are 33 professors for 1991 students, that means than more than 60 students are for 1 professor.

How to obtain all requires? We propose a so call Pooling&Sharing model. The concept is similar in Nato, supplemented by the concept of the so-called Smart Defence project. The main purpose of the project is to reach appropriate capabilities, whereas the realization of projects can be achieved by association with countries that have similar goals within Nato, EU or regional initiatives (4).

In our case we can talk about “pooling and sharing” of professors and equipment at the national and international level. At the first step we create a group of professor from Croatia and Slovenia and in the second step we propose this model to other European maritime faculties that have the same problems with the STCW Convention and High education standards for professors. In this case we can achieve a good cooperation between faculties, the same level of knowledge of students in all faculties as well cost effectiveness (equitable distribution of financial burdens). On one side the model stimulates synergy of pooling and sharing, whereas on the other side it prevents a parallel, independent establishment of comparable capabilities. A key precondition to enforce such a model is readiness of all actors involved to take part in the process.

4. CONCLUSIONS

Education of future maritime employees must be in accordance with the planned economic policy of the country and European Union. Quality education is very important for the safety of the transport and depends on the need at maritime sector. This statement anticipates a need for a specialization of the educational process which is made by the agreements of Bologna, Lisbon and Manila. But for achieve a high quality of a seafarers the education must be supported with training. The modular form of the study plan enables specialization and optimal achievement of the goal of excellence in individual branches of the maritime education and training. That means that all professors must fulfil the requirements of STCW Convention regarding the training and in the same time the standards of national High education. The problem is that the number of such professor is very limited and as a solution we propose the model of “pooling and sharing” of professors. This model is also in accordance with Erasmus exchange of staff mobility.

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CALCULATION OF THE HYDRODYNAMIC LOADING ON A VERTICALLY SUBMERGED CYLINDER BY MEANS OF THE MORISON EQUATION

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ABSTRACT

Oil and natural gas are among the most important sources of energy. Price of these sources determines to a large extent all other branches of industry and global economy. The search for oil has resulted in the development of many technologies, primarily petroleum engineering and geosciences. Whereas land oil reserves are mainly exhausted, under oceans and seas there are vast deposits of oil and gas. This fact has influenced the development of marine engineering and extremely rapid progress of sea keeping. As a field of hydrodynamics, sea keeping theory researches the design and maintenance of offshore structures. Statistical analysis, wave models, force and energy calculations, structural analysis, etc. are various fields of research in sea keeping theory. In this paper the Morison equation, a semi-empirical equation for calculating the inline force on a body in oscillatory flow, has been used for calculating wave loads on submerged structures.

KEY WORDS

fluids, sea keeping, waves, Morison equation

1. INTRODUCTION

When designing a ship or a craft it is necessary to take into consideration the impact of waves exerting significant forces on the construction and affecting the construction's exploitation conditions. Analysis of wave loads is a field of research in sea keeping theory and, in a wider sense, fluid mechanics. Rough sea is considered as a random process as each wave has its own characteristics. Therefore it is hard to apply the laws of classical mechanics on a random process and it is necessary to simplify the problem, i.e. to transfer the different wave characteristics into a model. There are a number of theories and models attempting to reduce complex wave motions to two-dimensional or three-dimensional models. The simplest theory is known as small amplitude theory or linear wave theory, where wave action is described in the two-dimensional context. The most appropriate wave model that explains the flow and all other aspects of waves is called the Airy's wave or the model of a harmonic progressive wave. This method and the use of this model produce acceptable analytical results, given the constraints of the theory itself.

2. LINEAR WAVE THEORY

It is necessary to reduce the complex wave action to a two-dimensional context in order to explain physical occurrences in the wave environment. When doing so, it is assumed that the wave amplitude is small with regard to the wave length and the water depth. Another assumption is that the velocity of the wave particle has to be small in comparison with the velocity of the wave. The model of the wave which is studied is the model of a harmonic progressive wave, or Airy's wave [2].

The linear theory basically represents the solution of Laplace's equation [3], considering that the flow is defined, i.e. determined by boundary conditions, whether we deal with the vertical free surface or the bottom. In order to describe complex wave motion, it is necessary to define essential elements such as the potential of the flow velocity, pressure and forces on the wetted surface.

2.1. Potential of the flow velocity

The scalar function describing the flow of fluid where the rotation of particles does not exist: $\Phi(x, y, z; t)$. The value of the flow velocity is achieved through derivation of the flow velocity potentials along three translation directions at time t (u, v, w).

2.2. Continuity equation

The continuity equation defines the law of conservation of mass. A fluid entering an elementary volume has to correspond to the displaced fluid [2]:

$$\frac{\partial v_x}{\partial x} + \frac{\partial v_y}{\partial y} + \frac{\partial v_z}{\partial z} = 0 \qquad (1)$$

$$\frac{\partial^2 \Phi}{\partial x^2} + \frac{\partial^2 \Phi}{\partial y^2} + \frac{\partial^2 \Phi}{\partial z^2} = 0 \qquad (2)$$

This rule is defined by Laplace's equation:

$$\nabla \vec{v} = \Delta \Phi = 0 \qquad (3)$$

2.3. Euler's equation of motion in a non-viscous liquid

Euler's equation represents the balance of forces acting on a moving fluid particle. The function's value varies with changes in time and position.

$$\begin{aligned} \frac{Dv_x}{Dt} &= -\frac{1}{\rho}\frac{\partial p}{\partial x} \\ \frac{Dv_y}{Dt} &= -\frac{1}{\rho}\frac{\partial p}{\partial y} \\ \frac{Dv_z}{Dt} &= -\frac{1}{\rho}\frac{\partial p}{\partial z} \end{aligned} \qquad (4)$$

2.4. Forces on the wetted surface

An expression for hydrodynamic pressure has been produced by means of modifying Bernoulli's equation in potential streaming:

$$p(x, y, z; t) = \rho g z +$$

$$+Re\left\{-i\omega\rho\left[\begin{matrix}\zeta_a\begin{pmatrix}\phi_0(x,y,z)+\\+\phi_7(x,y,z)\end{pmatrix}+\\ \sum_{j=1}^{6}\delta_j\,\phi_j(x,y,z)\end{matrix}\right]e^{-i\omega t}\right\} \qquad (5)$$

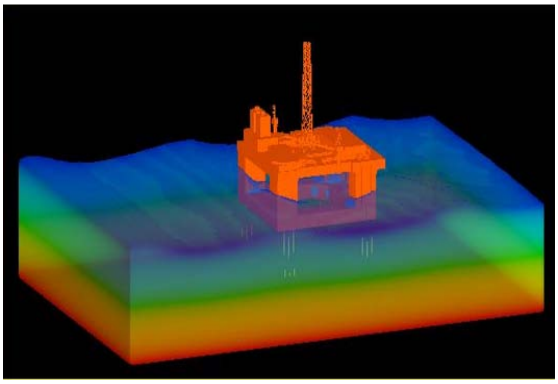

Figure 1. Simulation of oil rig loads resulting from wave action, *CFD Model*

An expression for force and momentum is obtained through the integration of pressure along the wetted surface:

$$\vec{F} = -\iint_S \vec{n}pds \tag{6}$$

$$\vec{M} = -\iint_S \vec{r}x\vec{n}pds \tag{7}$$

The force on the wetted surface is divided into three components:

- Excitation force:

$$\overrightarrow{F_U} = Re\left\{i\omega\rho\zeta_a \iint_S \left(\phi_0(x,y,z) + \phi_7(x,y,z)\right)\vec{n}dS\, e^{-i\omega t}\right\} \tag{8}$$

- Hydrodynamic reaction:

$$\overrightarrow{F_H} = Re\left\{i\omega\rho \sum_{j=1}^{6} \eta_j \iint_S \phi_j(x,y,z)\vec{n}dSe^{-i\omega t}\right\} \tag{9}$$

- Return force:

$$\overrightarrow{F_K} = -\rho g \iint_S z\vec{n}dS \tag{10}$$

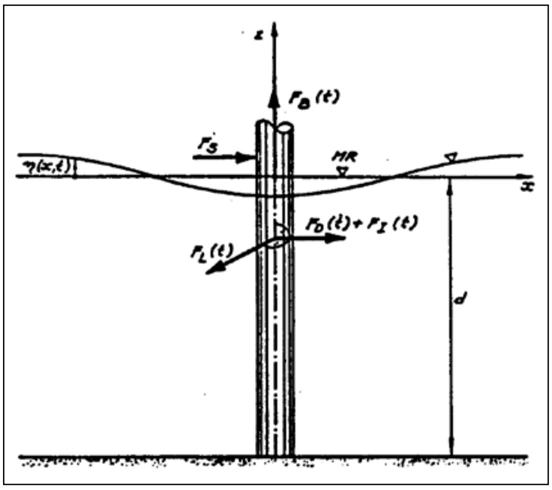

Figure 2. Main components of wave loading on the oil platform leg [3]

2.5. Morison equation

The forces acting on a submerged, fixed vertical leg of an oil platform can be divided in two groups [3]:

- Horizontal forces: drag force, inertia, and force of wave impact;
- Vertical forces: static and dynamic lift forces.

The forces having the most significant effect are the drag force and inertia, i.e. horizontal forces (Figure 2).

The overall horizontal force exerted on the oil platform leg can be expressed as superposition of the drag force and inertia, assuming that the velocity and acceleration remain unchanged regarding the water depth.

According to Morison's equation:

$$dF = dF_D + dF_t = \frac{1}{2}C_D\rho A_u|u| + C_M\rho V\frac{Du}{Dt} \tag{11}$$

the overall wave force acting on a leg at time t through a wave period T, is calculated through the integration of the drag force and inertia along the elementary length of the leg.

$$F=\int_{-h}^{n} dF=\int_{-h}^{n}\frac{1}{2}C_D\rho Du|u|dz + \int_{-h}^{n}\rho C_M\frac{\pi D^2}{4}\frac{Du}{Dt}dz \quad (12)$$

Coefficients C_D and C_M depend on the leg's length. For the purpose of integration, they should be assumed as constant. This results in [3]:

$$F=C_D DnEcos(kx_1-\sigma t)|cos(kx_1-\sigma t)| + C_M\pi DE\frac{D}{H}tanhkhsin(kx_1-\sigma t) \quad (13)$$

3. CALCULATION OF THE LOAD ON AN OIL PLATFORM LEG

The following example shows the application of the hydromechanics postulates.

3.1. Analytical solution

A vertical, submerged cylinder is exposed to wave action. By applying Morison's equation it is possible to obtain an analytical solution for the values of forces and momentum that are dependent on time (Figure 3).

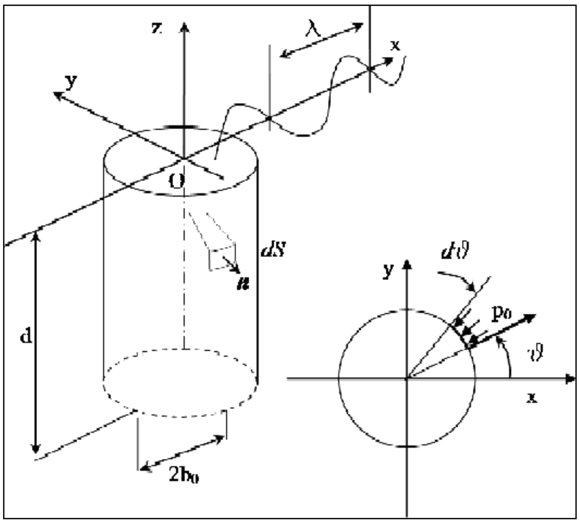

Figure 3. Loading on a vertical cylinder due to wave action [4]

Calculation has been performed for the leg having the following dimensions [4]:

$$D_c=2{,}5\ m;\ L=28{,}0\ m;\ \lambda=40{,}0$$

and considering the wave characteristics:

$$M_{max}=30;\ \rho=1025{,}0\frac{kg}{m^3};\ \zeta_a=1{,}0\ m;$$

$$b_0=b;b=\frac{D_c}{2};k=\frac{2\pi}{\lambda};kb_0=kb;$$

$$\omega=1{,}24116\frac{rad}{s};T=5{,}06234\ s^{-1}$$

The function of the flow velocity potential in polar coordinates:

$$\phi_0[k,r,\vartheta,z,t]=-\bar{\imath}\frac{g\zeta_a}{\omega}\frac{\cos h[k(d+z)]}{\cos h[kd]}\left(\sum_{m=0}^{M_{max}}(\vec{\imath}^m\delta[m]cos[m\vartheta]Bessel\,J[m,kr])\right)e^{-\bar{\imath}\omega t} \quad (14)$$

consists of the real and imaginary parts.

The normal velocity component has been calculated by means of the expression (15):

$$v_{no}[kr,\vartheta,z,t]= = Re\left[\partial_{kr}\phi_0[kr,\vartheta,z,t]\right]\partial_r(kr) \quad (15)$$

Hydrodynamic pressure in the head sea is, in terms of mathematics, a very complex issue that is calculated by using Bessel's functions:

$$p_{FK}(kr,\vartheta,z,t)=\rho g\zeta_a\frac{\cos h[k(d+z)]}{\cos h[dk]}\left(Bessel\,J[0,kr] + 2\sum_{m=1}^{M_{max}}i^m\,Bessel\,J[m,kr]cos[m\vartheta]\right)e^{-it\omega} \quad (16)$$

In this case, the Morison equation is:

$$dF_{x=} = \rho\frac{D^2\pi}{4}C_M a_x(x,y,z;t)dz + \frac{1}{2}\rho DC_D v_x(x,y,z;t)|v(x,y,z;t)| \quad (17)$$

The expression of forces on the cross-section of the cylinder:

$$dF_{FKx}[z,t] = -2\rho g\pi\zeta_a b_o$$

$$\frac{\cos h[k(d+z)]}{\cos h[dk]} Bessel\, J[1, kb_0] sin(\omega t) \quad (18)$$

It is necessary to clarify the coefficient of the Froude – Krylov force in order to define the above expression.

The Froude – Krylov force belongs to the group of inertia forces and the definition stems from the linear wave theory. If it is assumed that the length of the submerged body is considerably smaller than the wavelength, it may be deemed that the wave field is not changed due to the existing body, hence the diffraction and radial components can be ignored. Therefore it can be concluded that the F-K force represents just an inertia force depending on the submerged body's geometry.

$$F_{FK}(t) = -\rho \iint \frac{\partial \phi_I}{\partial t} n dS \quad (19)$$

By using the mathematical program Wolfram Mathematic and Bessel's functions of the first kind, the overall force and momentum on the vertical cylinder affected by wave impact can be calculated:

$$F_{FKx}[kb_0, t] == 2\zeta_a \frac{g\rho\pi b_0^2}{kb_0} tanh[kd]$$
$$Bessel\, J[1, kb_0] sin[\omega t] \quad (20)$$

$$F_{FKx}[kb_0, t] = 47{,}9085 \sin[1{,}24116t]$$

$$M_{FKx}[kb_0, t] =$$
$$= -2g\rho\pi\zeta_a {b_0}^2 b_0 \frac{-1 + Sech[dk] + dktanh[dk]}{{kb_0}^2}$$

$$Bessel\, J[1, kb_0] sin[\omega\iota] \quad (21)$$

$$M_{FKx}[kb_0, t] = -1043{,}85 sin[1{,}24116t]$$

The calculation has produced the maximum value of the force and momentum (Figures 4 and 5) for $t = 1{,}4\ s$:

$F_x = 47{,}24\ kN$

$M_y = -1029{,}35\ kN$

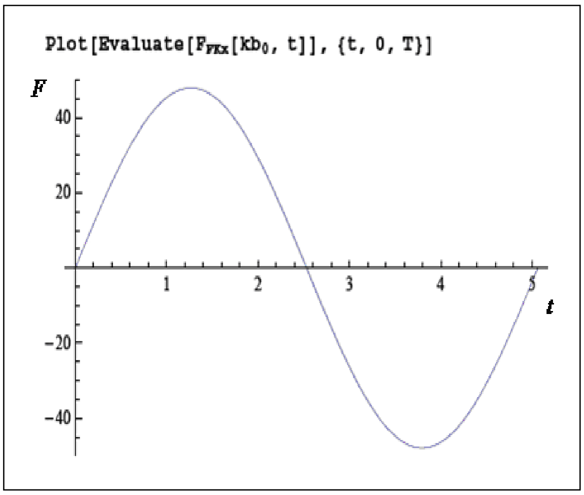

Figure 4. Diagram of force depending on time, *N*, [4]

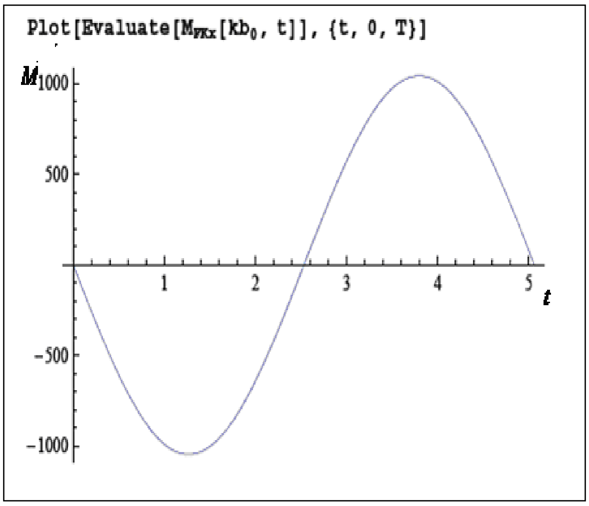

Figure 5. Diagram of momentum depending on time, *Nm*, [4]

Taking into consideration the coefficient value of the Froude – Krylov force in the diagram (Figure 6) amounting to: $C_{MD} = 2$, the force achieves its final value: $F_x = 94{,}48\ kN$.

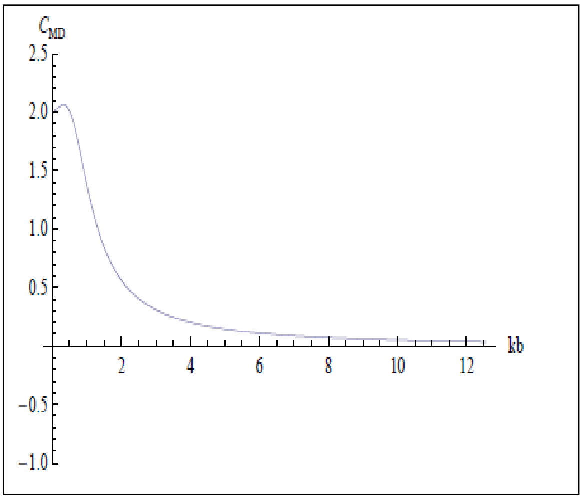

Figure 6. Diagram of the coefficient of the Froude – Krylov force, [4]

3.2. Calculation performed in SESAM

Morison's model for calculating hydrodynamic load has been used to design the oil platform legs having the identical dimensions. The calculation has been carried out with the aid of the SESAM software package and the following sub-packages [5]:

- *Prefem* (model design),
- *Prewad* (data entering),
- *Wadam* (calculation of hydrodynamic load),
- *Postrespons* (interpretation of the results).

3.2.1. Model design

The leg has been modelled as an elastic post consisting of 41 nodes and 40 elements (Figure 7). The model has been designed in the *Prefem* sub-package. The girder model has been defined as the first-level super-element having the determined physical features.

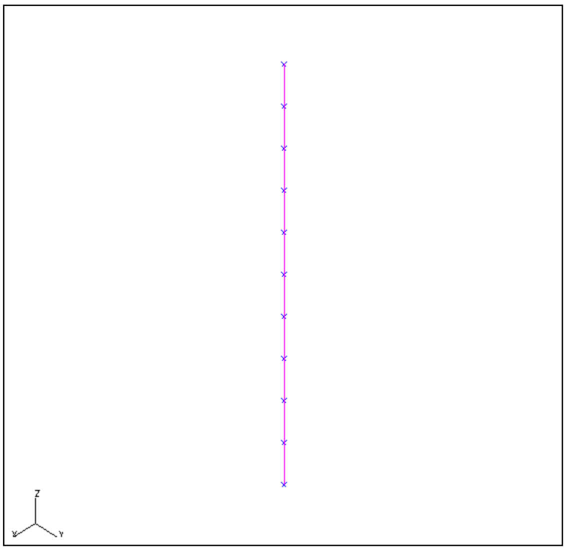

Figure 7. Model of the leg created in SESAM, [4]

3.2.2. Creating an input data-base

The files serving as the basis for hydrodynamic calculation have been created in the *Prewad* sub-package. The following physical attributes have been added to the girder model:

Table 1. Model's characteristics

Material	Steel
Young's modulus	$2{,}1 \cdot 10^{11}$
Poisson's coefficient	0,3
Density	7850,0
Cross section	PIPE
Diameter	2,5
Wall thickness	0,025
MEASUREMENT UNITS	m, N, kg

In addition to the model's physical characteristics, it is necessary to define the ambient conditions, as shown in Table 2.

Table 2. Ambient conditions

Sea depth	28,0
Wave direction	0,0
Wavelength	8
Wave amplitude	1
MEASUREMENT UNITS	m, °

Using a post-shaped girder model featuring two nodes, calculation has been performed for eight wave lengths having 10-meter steps. As the model is still not fully defined, hydrodynamic characteristics of its cross-section, representing the Morison's 2D element, should be added.

Table 3. Model's characteristics

Total number of sub-elements	Stot=1
Diameter of the elements (tube)	Dia=2,5
Mass per length unit	Dm=0,5
Coefficient of flow resistance around the axis y	Cksi=0,0
Coefficient of flow resistance around the axis z	Czeta=0,0
Added mass coefficient for the axis y	Aski=2,0
Added mass coefficient for the axis z	Azeta=2,0

Gravitation and density of the seawater are constant, amounting to $9{,}81 m/s^2$ and $1025\ kg/m^3$ respectively.

The only remaining task is to define the model's geometric characteristics (Table 4).

Table 4. Model's geometric features

Typical length	L=28
Vertical coordinates of the calm sea surface	ZLOC=0
Number of nodes in the Morison model	NMNOD=76

3.2.3. Calculation of hydraulic load

Calculation of the hydrodynamic response on the girder element has been performed using *Wadam* sub-package software, with the aid of the Morison equation taking into account the relative motion effect:

$$F = \omega^2(M + \rho V_M C_a)\xi - \omega^2 \rho V_M (C_a + I)x + i\omega B(x - \xi) + f_c + f_g + f_b \qquad (22)$$

The Morison equation elements are defined in Table 5:

Table 5. Elements of the Morison equation

Wave frequency	ω
Mass matrix (3x3)	M
Matrix of added mass coefficients (3x3)	C_a
Matrix unit (3x3)	I
Water density	ρ
Displacement volume of the Morison model	V_M
Matrix of the linearised viscosity attenuation	B
Matrix of drag coefficient	C_D
Projected surface of the Morison element	σ
Complex amplitude of the wave input field	x
Complex amplitude of motion	ξ
Pulsating hydrostatic reverse force	f_c
Pulsating gravitational force	f_g
Pulsating buoyancy force	f_b

Considering that the oil platform leg is observed as a fixed structure, the Morison equation assumes the following form:

$$F = \rho V_M(1 + C_a)\dot{v} + \frac{1}{2}\rho\sigma C_D v|v| \qquad (23)$$

The impact of the Morison elements (23) is calculated in the local coordinate system, while the obtained values are transferred to the global coordinate system. As the calculation results produced by *Wadam* are non-dimensional values, it is necessary to multiply them by dimensional coefficients in order to obtain a valid interpretation; hence the values of the force and moment are (Figures 8 and 9):

$F_x = 116{,}09\ kN$

$M_y = 956{,}91\ kNm$

$y = 8{,}24\ m$

The interpretation of the results has been obtained in *Postrespons*, as follows:

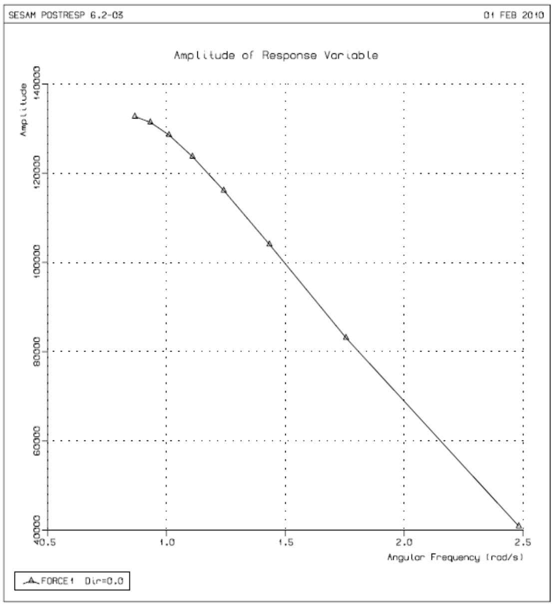

Figure 8. Diagram of the force towards the axis x, *N* [4]

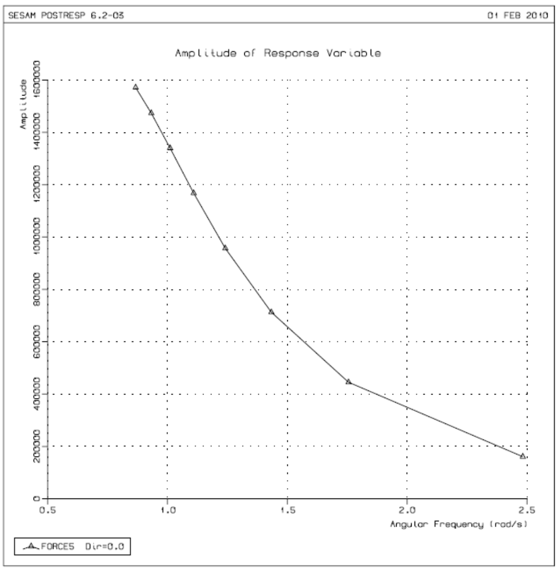

Figure 9. Diagram of the momentum around the axis y, *Nm* [4]

3.3. Comparison of the results

Table 6. Comparison of the results

	Analytical calculation	Morison's model	*Measurement units*
F_x	94,48	116,09	*kN*
M_y	-1029,35	956,91	*kNm*

Table 6 compares the results of the analytical calculation and the Morison's model in SESAM. For a selected wavelength $(\lambda = 40{,}0\ m)$the two methods produce values that vary by 18%. This variation is caused by a number of factors, primarily by the selection of coefficients. It can be noticed that the loading force value is smaller in the analytical calculation, which is logical, given the fact that the calculation can not take into consideration all conditions of the hydrodynamic load. On the other hand, SESAM is able to accurately define the drag and added mass coefficients, i.e. the impact of inertia and drag forces, which results in a more precise, that is, a more realistic calculation. The analytical calculation assumes that the value of the added mass coefficient is 2. This value may not be optimal. It is likely that an added mass coefficient ranging from 0.7 to 0.8 would produce more realistic results.

5. CONCLUSIONS

This paper discusses the calculation of the hydrodynamic loading on a vertically submerged cylinder. The latter is assumed as a slender post-shaped structure that does not affect the wave field as the length of the cylinder is considerably less than the wavelength.

Hydrodynamic loading has been calculated in an analytical way and by means of the Morison's 2D model in SESAM, and the obtained results have been compared. It can be concluded that the Morison model produces the results which indicate greater hydrodynamic loads due to inclusion of the drag and the added mass coefficients that can be accurately interpreted within the Morison's model.

The simple example of a slender submerged structure has served for applying the Morison equation in the hydrodynamic loading calculation. The same approach can be used in designing and constructing much more complex offshore structures.

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CHANGE MANAGEMENT AND POSSIBILITIES OF ITS APPLICATION IN SEAMENSHIP

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ABSTRACT

At a time when changes have become a constant in business, and the economic crisis has affected even the strongest economies and societies in the world, one has to agree that good management, i.e., management adaptable to changes is necessary in all countries, economies, as it is the case with seafaring and all its segments. In a turbulent surroundings it is difficult to recognize real threats, but also real chances for further development of maritime companies. All maritime companies, even those with a leading position on the maritime market, must comply with the changes in surroundings, enabling them to survive as leading competitors.
This paper aims at exploring the way the changes affect the business performance of the maritime companies and by virtue of the chronologic sequence determine how and at which pace they develop. Company management has a difficult task to fulfill, and the task of a researcher is at the same time to develop a constructive, pragmatic debate on the ways and mechanisms enabling adjusting to changes, their acceptance and working atmosphere in which the change is a normal occurrence, but not the unexpected or unwanted one.

KEY WORDS

maritime market, maritime companies, change management

1. INTRODUCTION

Nowadays change is something to be constantly reckoned with, that is to say an integral part of any organization's management, whether it is a matter of change in terms of improvement or otherwise. Seamanship, as a service providing branch of economy is constantly subject to impacts generated by global changes and that being the case, the need arises for developing mechanisms in seamanship in order to constantly initiate constructive changes. These changes entail forecasting of future events, creating the necessary climate for changes in the organization itself, as well as a suitable environment in which changes would develop in the desired direction.
This document deals with maritime companies and currently the three largest companies in the container transport business are: Maersk Line, MSC and CMA CGM [10]. It is these companies exactly the ones which dictate the way business is done, since in addition to the fact that they own the largest fleet for container transport, they are also companies which successfully keep up with changes. As we are about to see in the example of CMA CGM these companies have gone through different stages of their life cycle [2] and with time they faced many problems and went through numerous transformations. In addition to numerous events in the business environment which require quick reacting, several restructurings took place within the companies. We shall see that several months ago three of the largest companies for transport of containers merged[12]. Every company management needs to be aware of the fact that in addition to innovations regarding ship storing space and the constant battle with the competition, it also

primarily needs to overcome internal problems such as settling differences within the company in order to upgrade their business to an as high as possible level, hence facilitating adaptation to the business environment. The establishing of new lines and emergence of ships with enormous transport capacities should be regarded not only as a threat but also as potential opportunities. On the other hand, each organization has its internal strengths and weaknesses, which should be constantly taken into consideration and be used in the best possible way (e.g. staff).

This paper presents through actual examples the ways in which maritime companies adapt to changes. These may not necessarily be the best ways, but are ways which certainly should be studied keeping in mind the continual opportunity for introduction of improvements.

2. CHANGE ANALYSIS IN THE MODERN MARITIME ECONOMY

In today's business world, the tempo at which changes occur gets faster and faster with each day and it seems that it is going to stay that way in the near future. New technologies and new ways of doing business enable fast development and growth of companies which are able to keep up with changes, while other companies which do not adapt in time become inactive, gradually weaker and fall behind with time. Today not even the greatest companies in the world are immune to change and cannot on any condition give way to lethargy, due to the fact that whatever today seems a good business move in the ever changing business environment is not necessarily a model pattern for business in the future. On the contrary, in a short time period a business move which yesterday generated profit and success, tomorrow can be fatal should the new circumstances not be taken into consideration.

Seafaring is a specific branch of economy where one has to consider a great variety of cargo structures, disproportionate capacities of ships compared to cargo, regions in which to operate, as well as frequent fluctuations of freight rates and other charges. The afore mentioned leads to the creation of an unbalanced business environment, so that management in maritime companies needs to provide for steady business operations and to initiate changes within the company itself, in order to be competitive on the maritime market.

Due to the nature of the business maritime companies are forced to adapt to all the changes on the global market maybe even more so than companies in other branches of economy. Considering the fact that the largest maritime companies do business in all parts of the world (maritime companies connecting all the continents) and that they deal with all kinds of cargo, it is evident that there is a myriad of factors influencing their performance success. The question is how to harvest all those changes in the business environment and make them work to the benefit of the organization.

If change has become a constant part of doing business today, one can even claim that seafaring business inevitably includes change. This is the way things have been not only today but since always. Picture 1 shows chronology of the most important events influencing the growth and development of the world container market.

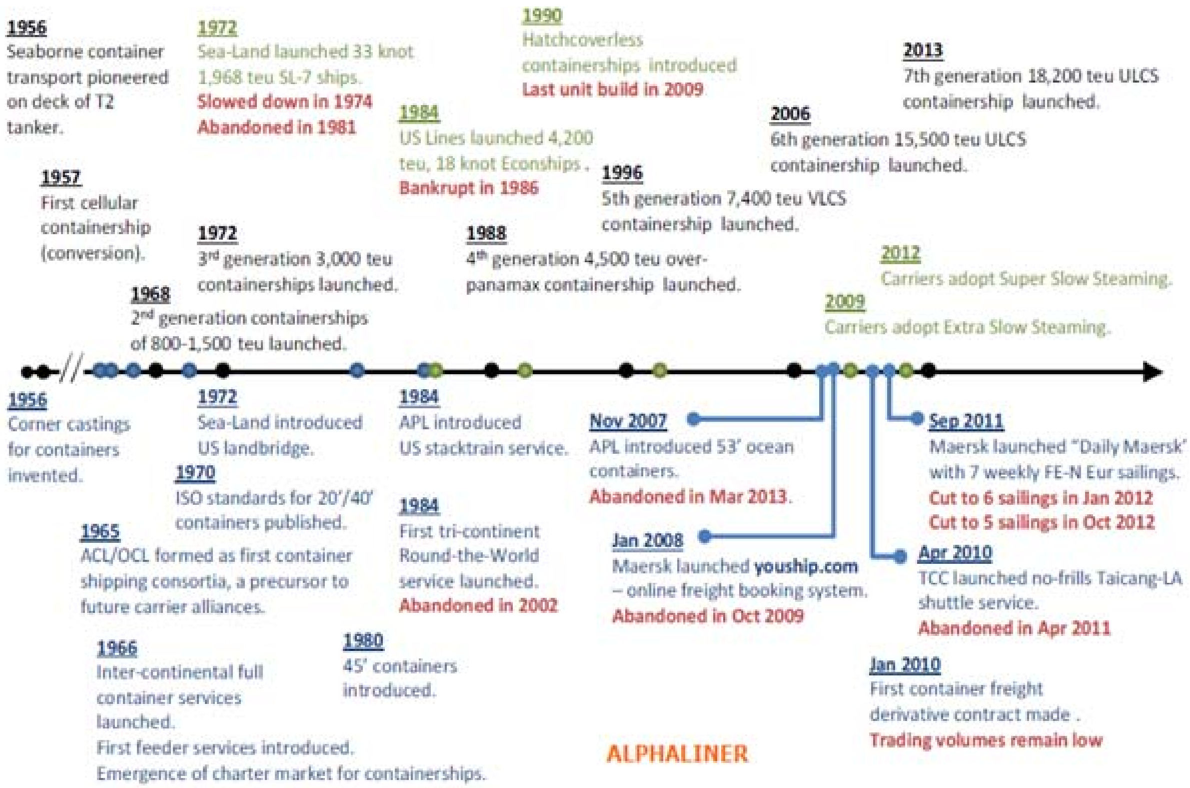

Figure 1: Innovation in Container Shipping 1956 - 2013 [11]

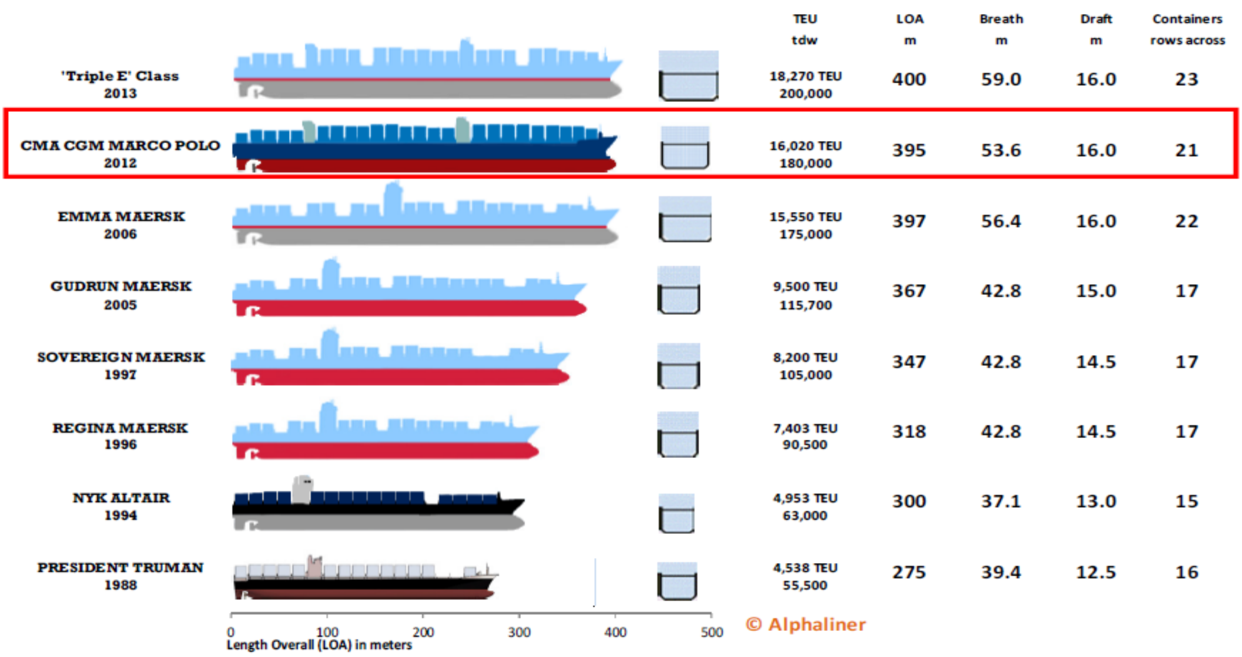

Figure 2: Evolution of the largest containerships 1988 - 2013 [11]

All the above mentioned changes influenced also the development of shipbuilding industry, i.e. the size of ships for transport of containers, since at the beginning these ships were less than 1000 TEU. As it was very soon clear that transport of goods in containers is the most cost effective way to transport large amounts of goods over great distances, ships of greater cargo capacity began to be built. An expansion of container ships building was soon to happen (Picture 2) on the global maritime market, hence ships used today are of cargo capacity of more than 16000 TEU. Picture 1 shows that for instance in 1968. second generation container ships emerged (of cargo capacity from 800 to 1500 TEU), and twenty years later ships are of cargo capacity of over 4500 TEU, while in 2013. seventh generation container ships are of cargo capacity of even up to 18200 TEU. Along with increases in cargo capacity for container ships, also the dimensions of those ships grew (Picture 2), so the length of some ships today is up to 400 m.

Nowadays for the most part the major maritime companies in the world are at the same time the owners of the largest container ships. Changes occurring on the maritime market for container transport, as well as changes in the size of container ships influence the way maritime companies do their business. When it comes to the kind and degree of the occurred changes within the biggest companies dealing with transport of containers, it is best to look into the data relating to these companies. Companies such as MSC and CMA CGM were established rather recently (1970. and 1978.), company ZIM in 1945. and company Compania Sud Americana de Vapores (CSAV) in 1872., still it is very informative to see today the difference in capacities of their fleets (Picture 3).

Rnk	Operator	Teu	Share
1	APM-Maersk	2,579,847	14.5%
2	Mediterranean Shg Co	2,371,752	13.4%
3	CMA CGM Group	1,498,786	8.4%
4	Evergreen Line	846,699	4.8%
5	COSCO Container L.	778,990	4.4%
6	Hapag-Lloyd	729,604	4.1%
7	APL	641,214	3.6%
8	Hanjin Shipping	627,027	3.5%
9	CSCL	600,757	3.4%
10	MOL	547,464	3.1%
11	OOCL	458,360	2.6%
12	NYK Line	457,529	2.6%
13	Hamburg Süd Group	454,930	2.6%
14	Yang Ming Marine Transport Corp.	381,502	2.1%
15	PIL (Pacific Int. Line)	373,859	2.1%
16	K Line	347,803	2.0%
17	Hyundai M.M.	336,017	1.9%
18	Zim	332,249	1.9%
19	UASC	274,044	1.5%
20	CSAV Group	273,008	1.5%

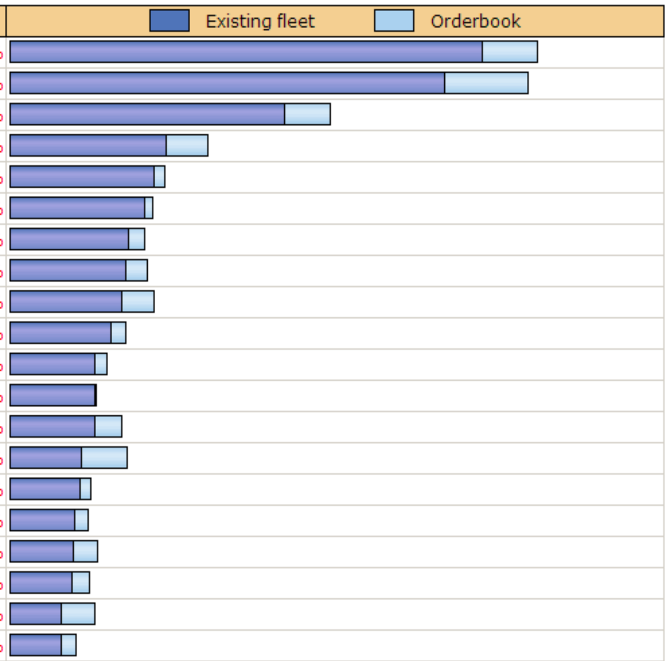

Figure 3: The biggest companies in january 2014. [10]

The above picture shows that the three leading companies together have more than 35% share of the world maritime market. The difference between companies from the fourth to the tenth place is slight and it is obvious that even small fluctuations in the container ships market could shift positions in this ranking list.

Considering the tendency of the maritime container market today, forecast is that the list of top 20 maritime companies in a few years from now is going to be the one shown in Picture 4.

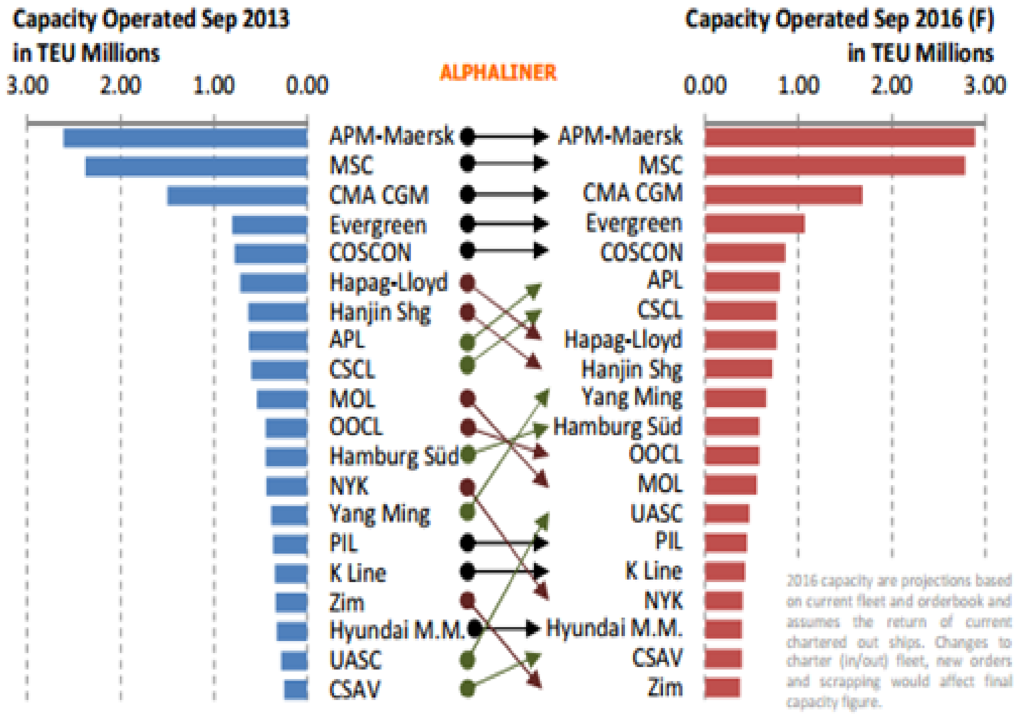

Figure 4: Top 20 Carriers: Potential Change in Rankings [11]

2.1. The model of companies CMA CGM and MSC

The best illustration as to the kind and magnitude of the occurred changes and as to the extent to which they influenced maritime companies is the actual data relating to their development and business activities in previous years. Companies CMA CGM and MSC today represent the leading maritime companies in the world; hence data relating to their business activities is of key importance. Chronological development of company CMA CGM [12], for instance, occurred as follows:

1978.	On September 13, Jacques Saadé creates the CMA (COMPAGNIE MARITIME D`AFFRETEMENT, a shipping company, to trade between the Levant and the Western Mediterranean)
1980.	CMA buys its first two vessels: Ville d`Orient and Ville du Levant
1981.	Delivered from the other end of the world to your door - the multimodal
1983.	The first crossing of the Suez Canal (The CMA decided to "Go East", crossing the Suez Canal and launching the "Red Sea Express" Service)
1986.	Asia or "the great jump toward East" - CMA pushed further east, opening its first Far East Europe Serviceand that the future of CMA was in Asia
1989.	China was firmly on the economic liberalization tracks and was soon to become the "factory of the world"
1990.	Gaining experience in the North-South trades, Jacques R. Saadé promptly realized the importance of reefer markets when CMA CGM carried reefers from Europe to the Middle East Gulf and back from Indian Subcontinent. Massive investments in latest generation state-of-the-art reefer containers were decided and the reefer department became a Business Unit in its own right in the 2000's.
1992.	The first CMA office is opened in China (CMA opened its first office in Shanghai and the management of the local organization was entrusted to John Wang, and today he still leads the China organization which has grown to 64 offices manned by over 1500 staff)
1994.	Creation of the French Asia Line Service (FAL) which to this date remains, together with its seven siblings, the back bone of the Company
1996.	The French government privatized the Compagnie Générale Maritime (CGM), one of France oldest shipping company. CMA decided to purchase CGM
1997.	CMA CGM Holding Company was created
1999.	A giant is born: CMA and CGM merge (the merging of CMA and CGM the new company becoming CMA CGM). At that time, CMA CGM becomes the world`s nº 12 with 78 vessels and 260000 TEU per year
2004.	Container Terminals - a key asset CMA CGM becomes the world`s nº5
2005.	Hope for children: CMA CGM creates its own Corporate Foundation
2006.	Becoming an expert of Africa CMA CGM buys DELMAS, CMA CGM becomes World`s nº 3
2008.	CMA CGM is awarded "Maritime Company of the Year"
2009.	The first 13800 TEU vessel is delivered
2011.	A new Head Office: the CMA CGM Tower
2012.	The first 16000 TEU vessel is delivered
2013.	CMA CGM Group celebrates 35 years Signing; The CMA CGM Jules Verne is inaugurated in the presence of François Hollande (the President of the French Republic)

Today, CMA CGM has built Alliances with the two major operators, MAERSK and MSC, on key trades such as the Asia Europe Trades, the Asia Mediterranean trade and the Transpacific.

Company MSC (Mediterranean Shipping Company) is the second biggest seafaring company dealing with transport of containers. Mediterranean Shipping Company S. A. [13] (MSC), of Geneva, Switzerland is a privately owned shipping line, founded in 1970, which has rapidly grown from a small conventional ship operator to become one of the leading global shipping lines of the world. During recent years MSC`s maritime fleet has expanded substantially to consolidate its position as the 2nd largest carrier in respect of container slot capacity and of the number of container vessels operated. Such spectacular growth has been achieved internally through organic growth rather than through acquisition or merger.

Pictures 5 and 6 are graphs presenting the growth and development of this company according to the number of ships and their cargo capacity broken down to years.

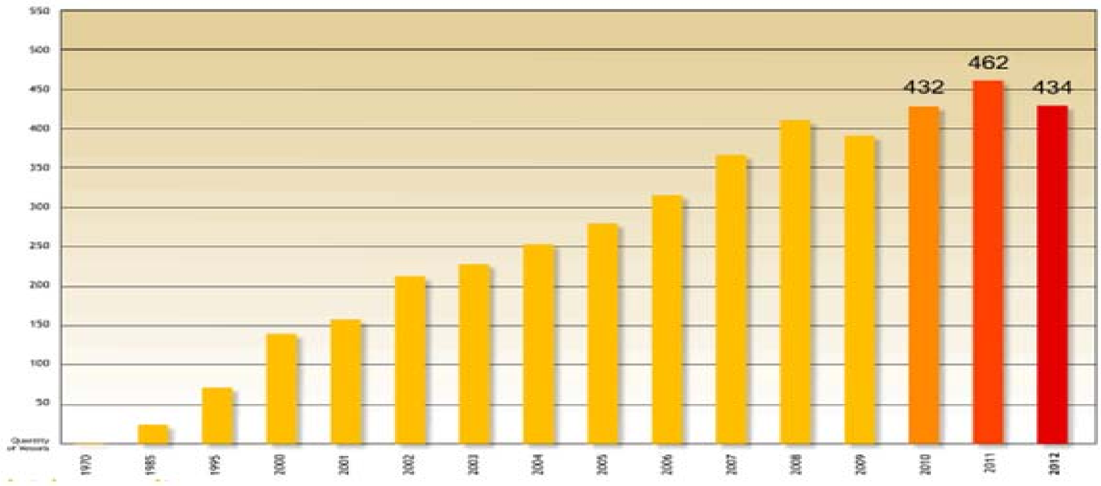

Figure 5: Quantity of vessels from 1970. to 2012. [13]

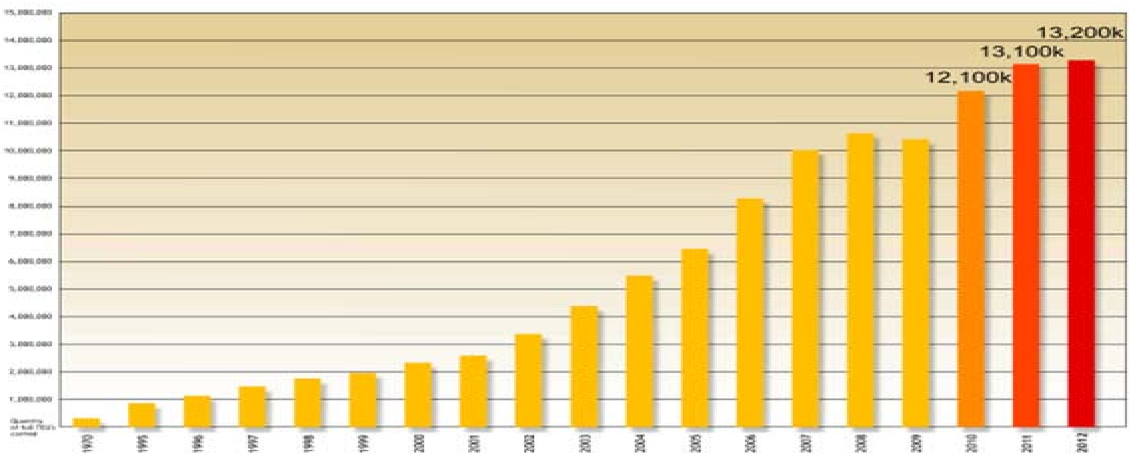

Figure 6: Quantity of TEU`s carried from 1970. to 2012. [13]

The graphic display of the number of ships and amounts of transported cargo in the period from 1970. to 2012. speaks volumes on how this company evolved gradually from phase to phase and became stronger, more stable and eventually not only survived but has also managed to be the main competitor on the world seafaring market for years.

3. MODELS OF CHANGE MANAGEMENT IN MARITIME COMPANIES

Fact is changes are a constant occurrence in seafaring companies. Whether these changes are caused by the companies themselves or whether they are a consequence of global affairs in the surroundings, they have to be managed companies need to make the most advantage off them. Many concepts and theories have been written on how to manage change, of which one is presented in this paper. ABS (American Bureau of Shipping) [1] presented a process for change management with a basic classification of changes likely to occur in shipping company. A Management of change (MoC) system is a combination of polices and procedures used to evaluate the potential impacts of a proposed change so that it does not result in unacceptable risks. Developing an effective MoC strategy requires establishing, documenting, and successfully implementing formal polices to evaluate and manage both temporary and permanent modifications in a facility or ship including equipment, materials, operating procedures and conditions, and personnel. Successful organizations are dynamic and constantly undergoing change in striving for innovative and cost effective solutions to achieve sustainability in a robust and competitive business environment. Most changes controlled by an MoC program fall into one of the following categories: [1]

- equipment - this category addresses equipment or technological changes (new equipment, replacement or modification of equipment, replacement or modification of computer hardware, modification to software, modification or removal of safety equipment, etc.)
- operational changes - changes in administrative controls or management system that define the way processes are conducted throughout the organization (deviation from preventive maintenance or mechanical integrity programs, deviation from inspection program or testing frequency, deviation from operational procedures and safe work practices, deviation from repair requirements, change to a controlled document, implementation of a new procedures, etc)
- organizational changes - this category includes personnel and staffing modifications, such as changes to crew, personnel, management structure, shift manning, company-wide policies, regulations, etc. Examples of organizational changes may include: changes to onboard management, new crew on board, new contractors, flag change or new flag into fleet, crew new to company or new full crew nationality, etc.

Despite numerous and frequent changes happening in shipping as consequences primarily of development of containerization, some companies have managed to remain on top of the world seafaring market. There are two probably most important factors generating numerous changes are. The first is the fact that more and more seafaring lines started gravitating towards China, by looking at the map of lines of one of the leading companies in the world (Picture 7) it is obvious that the market of goods has shifted to the East and that today China is the region towards which gravitate all the biggest and most important seafaring companies (especially from Europe). These companies with the Trans-Pacific and Trans-Atlantic lines make the backbone of container transport.

The second important factor is the emergence of VLCS ships. Several biggest and strongest world seafaring container companies dictate the market conditions for ships and storage space on board ships. In the last few years the trend of increase of VLCS (Very Large Container Ships) on the seafaring market is clearly evident. This entails numerous changes of the seafaring transport market as well as of the structures of fleets belonging to seafaring companies. The VLCSs (Very Large Container Ship) are ships of considerable cargo capacity but considerable is also their price of several hundreds of millions of dollars. It is clear that smaller seafaring companies cannot match the VLCSs with their significantly smaller ships. Fact is that the three leading world operators (Maersk Line, MSC and CMA CGM) according to data from 2008. [15] own around 40% of all VLCS in the world.

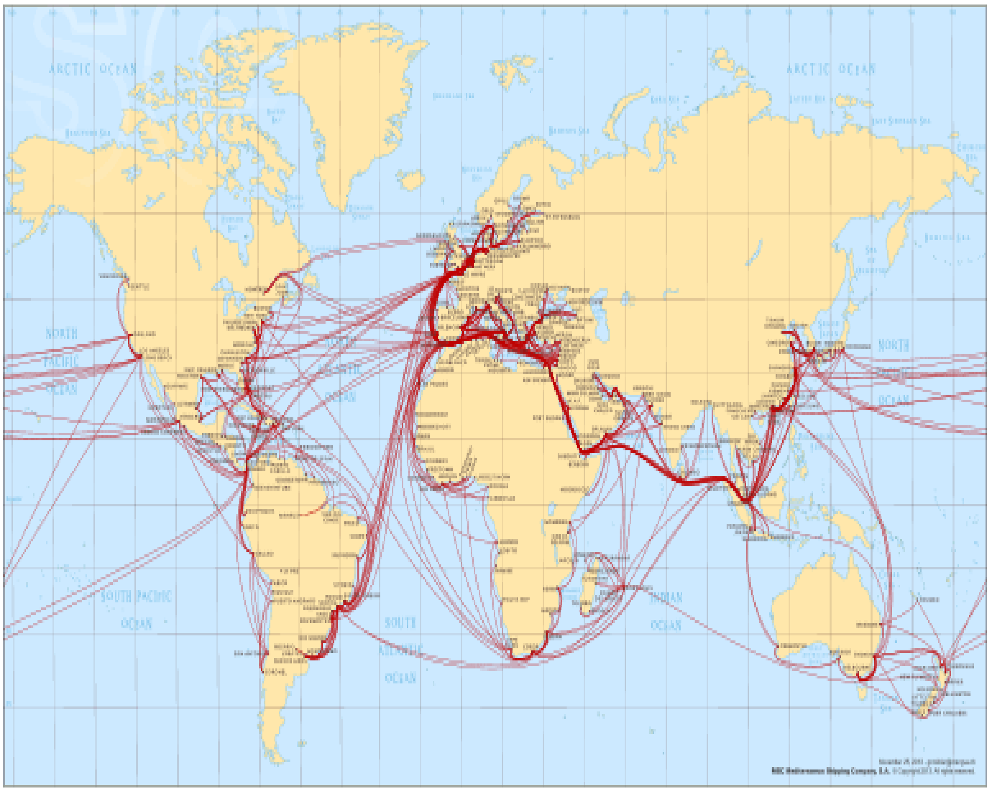

Figure 7: Worldwide routes [13]

This fact alone speaks of the unbalance on the market and goes to prove that the construction of VLCS divided the market of seafaring container companies to those which took advantage of the changes in sizes and capacities in the best possible way, enhanced their offers in terms of cargo space and made their fleet more modern and competitive, and to those which are hardly keeping up with the trend and are in a constant battle for survival. The question is how do the strongest seafaring giants manage to survive on a turbulent market, and what are the strategies to be applied in business planning. In the summer of 2013. major changes took place regarding management at the three of the world's biggest container transport companies i.e. their restructuring (merger).

Maersk Line, MSC (Mediterranean Shipping Company) and CMA CGM have agreed to establish a long-term operational alliance on East-West trades, called the P3 Network. The aim is to improve and optimize operations and service offerings. The P3 Network will operate a capacity of 2.6 million TEU (initially 255 vessels on 29 loops) on threetrade lanes: Asia-Europe, Trans-Pacific and Trans-Atlantic. While the P3 Network vessels will be operated independent sales, marketing and customer service functions. The P3 Network will provide customers with more stable, frequent and flexible services. Each of the lines will offer more weekly sailings in their combined Network than they do individually. As an example, the P3 Network plans to offer 8 weekly sailings between Asia and Northern Europe. In addition the P3 Network will offer more direct ports of call. The improved P3 Network is expected to reduce the disruptions for customers caused by cancelled sailings. In order to provide customers with a consistent service offering across the Network, the lines will establish an independent joint vessel operating center. The lines intend to start operations in the 2nd quarter of 2014., but starting date will be subject to obtaining the approval of relevant competition and other regulatory authorities. The P3 Network will based on existing capacities of each member, initially operate a capacity of 2.6 million TEU. Maersk Line will contribute with approximately 42% of the capacity (of about 1.1 million TEU), MSC will contribute with approximately 34% of the capacity (of about 0.9 million TEU) and CMA CGM will contribute with approximately 24% of the capacity (of about 0.6 million TEU). Vessels contributed to the P3 Network will continue to be owned and/or chartered by the lines. [12]

4. BUSINESS ENVIRONMENT FACTORS AND STRENGHTENING OF INTERNAL CAPACITIES

The two important factors of maritime business environment: (a) creation of new transport lines and (b) increase in demand for ships of greater cargo capacity can be considered as opportunities in the business environment to take advantage of, but also as eventual threats for some companies. Furthermore when companies are viewed as separate systems, one can easily individualize its weaknesses and strengths.[9] Since there are as many opportunities and threats in the business environment as there are internal strengths and weaknesses in a company it would be hard to name them all. This paper however deals with the employees and leaders since they represent the major strength of a company. At the same time these two factors can represent a weakness if employees are not prepared to take part in the process of implementation of changes or if the leader is not prepared to influence or induce employees to adjust to new circumstances - changes.

More and more attention is being given to employees since staff quality is essential in order for maritime companies to be able to function and for them to keep up with changes. Awareness has been raised in companies in terms of the fact that employees have to be invested in both in on shore offices and on board ships. For instance the CMA CGM company introduced many innovations in their business conduct when it comes to staff training.

FIRST University (French Institute for Research, Studies and Training) [12] exists within the company. It was founded in 2000 on request by company chairman with the aim of developing individual and team skills for each employee. This University offers training to employees in the following fields: development of maritime skills, increase of efficiency in the work place (techniques aimed at helping employees optimize their work day and increase their performance), improvement of language skills (English, Spanish, French), computer skills (short courses for mastering basic computer skills) etc. The company offers employees the opportunity to obtain the degree "Masters in International Maritime Management"; this program is designed for young students who intend to work for renowned maritime companies such as this one. The example of this maritime company seems to be an excellent way of training staff for own purposes.

Employees can be thought of as the major strength of a company, however in order to function well a company also needs good leadership and a sense of belonging.

A good leader is indispensable, not only to run the company but also to make changes acceptable to employees. Some changes may be hard to implement, regardless of their origin – from the business environment or from within the company itself, however in order to make a change a successful one, all employees have to contribute in spite of the many fears that change might cause.

Employees at large companies often find it difficult to initiate transformation processes due to lack of leadership combined with arrogance, narrow-mindedness and bureaucracy. Transformation asks for sacrifice, loyalty and creativity, and usually not one of the mentioned requirements gets done under pressure. Only leadership can fight off the many sources of inertia within a company. Only leadership can motivate necessary actions towards changes in behavior. Only leadership can manage changes by incorporating them in the very principles of the organization. The driving force behind every process is leadership, leadership and again more leadership. [7] Leadership is a series of processes which foster first of all organization and fine-tunes the organization to ever changing circumstances. Leadership defines what the future should be like, guides people in the direction of that vision and inspires them to live up to the vision in spite of obstacles. [7]

The fact is that constant need for changes demands leadership.[14] Not one key player in the shipping business can afford to close its eyes for "change demands"; and so, every player employs a competent leader who can steer the company towards the right direction, walk the talk, improve work culture for productivity's sake, deliver tangible results, and assure stricter compliance with statutory requirements. Indeed, change requires a kind of leadership that can address the persisting forces of change in the shipping business environment (clients, legislators, insurance companies, non-government organizations) and ensure strong change management system in order to boost the shipping companies' staying power. Hence, the companies' change management system must be strengthened for them to competently manage change.

Finally, here is what a leader at CMA CGM said in reply to the question: What difference have you noticed between shipping in 1978 and how it is today, in 2013? Farid T. Salem, Executive Officer: [12] "Container shipping today is not that different from what it was in 1978. The industry remains open to all but only some happy few will be able to turn a profit; they will need an in-depth knowledge of all shipping activities, and they will need courage, imagination though remaining hands-on as well as the ability to take prompt decisions. Like in 1978, freight rates remain subject to market supply and demand without befiting any more from the protective umbrella of conferences suppressed since some years now. However, our environment has changed: From a "regional" start, we are now "global". We have successfully implemented the netting of various liner services connecting all continents with the assistance of performing IT systems and afinely tuned operation management. To our initial liner operations, we have added land based activities generating welcomed additional revenues such as port terminals, dry ports, intermodal, logistics, all services completing and improving service to customers. Last but not least, we have very early pioneered the implementation of measures and technologies aimed at protecting the environment, our responsibility towards our children and grandchildren."

5. CONCLUSIONS

In addition to presenting some of the most important and most common changes on the world maritime market, this paper, through analysis of actual success models, also deals with guidelines for accepting changes in the best possible way. What is more it also tackles methods for confronting problems, methods employed by some of the greatest maritime companies. The companies in question are the ones which react promptly to all newly arisen situations on the market and develop strategies for paving a path of success. One of those strategies is the creation of P3 network for transport of containers for which it is yet to be seen whether it was a good business move or not for the three mentioned companies. The results of some decisions can be seen only after some time elapses and that is precisely the reason why change management has to be continuously developed and upgraded in order to achieve positive results. Today conditions of business conduct on the global market are unstable, and the responsibility of all managers dealing with change is solely and exclusively to achieve the greatest profit possible. It requires great skill to be able to react well in a turbulent business environment without making mistakes. The key is to embrace change as a challenge, which seems to be the success case of companies today such as: Maersk Line, MSC and CMA CGM, hence these companies were models for analysis in this paper.

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EU MARITIME POLICY AND THE NEW PROVISIONS OF CROATIAN MARITIME CODE ON COMPULSORY PILOTAGE

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ABSTRACT

Pilotage is guiding a water craft through the water by trained crew (a pilot) and giving expert advice to its master for the sake of safe navigation in ports, straits and other areas of internal waters and territorial sea in the coastal states. The compulsory pilotage is determined for vessels of certain types and sizes if required for the safety of navigation. In Croatia, the pilotage services are regulated by *the Maritime Code of the Republic of Croatia* and *Marine Pilotage Code*. In an attempt to achieve more liberalisation in port services within the European Union, maritime pilotage regulations remained separate from those pertaining to other port services due to their importance for navigational safety. The reason for this is to allow various pilotage regulations depending on specific requirements of an individual port, primarily having in mind the safety of navigation. The coastal states may decide to carry out the pilotage operations themselves, or to directly entrust them to specific operators. In Croatia, these operations are conducted by domestic legal entities based on the approval of the Ministry of Maritime Affairs. Each state regulates compulsory pilotage for vessels, taking into account their dimensions, type of cargo and the density of traffic in a specific fairway, or within a certain area. The flag of the vessel is not a decisive criterion for the exemption of vessels from the obligation of pilotage. The new provision, included in 2013 Amendments of Maritime Code, which regulates compulsory pilotage (Article 70, Paragraph 2, Subparagraph a) excludes from compulsory pilotage not only the Croatian passenger vessels that ply on regular routes (as before), but also the passenger vessels flying the flags of other EU member states. European states do not recognize the system of vessel exemption according to their flag, so it was not necessary to change the existing provision in order to harmonize the Maritime Code with the EU acquis communautaire. Moreover, due to the fact that the new provision on exemption from compulsory pilotage causes much more danger to the safety of navigation inside the internal waters and territorial sea of the Republic of Croatia. In addition, the provision is not in accordance with the *1923 Convention and Statute of the International Regime of Maritime Ports* whose party is the Republic of Croatia based on the Notification of succession. The provision fails to provide equal treatment to the vessels that do not fly the European Union flag, which is contrary to the provisions of *the Convention and the Statute*.

KEY WORDS

pilotage, *1923 Convention and Statute of the International Regime of Maritime Ports,* the principle of equal treatment, Pilotage Exemption Certificates - PEC, Amendments to the 2013 Maritime Code

1. INTRODUCTION

Pilotage is conducting the vessel by professionals (pilots) and giving expert advice to the master of the vessel, in order to ensure safe navigation in ports, straits and other areas of internal waters and territorial sea of the Republic of Croatia. [1]

[1] Maritime Code, Official Gazette No. 181/04, 76/07, 146/08, 61/11 and 56/13, Article 68, paragraph 1.

Pilotage has a long and rich history as an important instrument of navigation safety. During the passage through areas dangerous to navigation, seafarers have long been using the services of people familiar with local conditions to help them safely conduct their vessels through these areas, and thus prevent maritime accidents. The provisions on pilotage in this region date back to the Middle Ages. In medieval town statutes, pilots were referred to as *pedotae* and pilotage fees as *pedotia*[2]. At some places, this fee became a kind of a levy that the vessel had to pay, regardless of whether pilotage services[3] were actually provided or not. In the late nineteenth and early twentieth centuries, when the vessels, cargo, and ports become objects of great value, the coastal states started introducing compulsory pilotage in order to protect their ports and waterways.

In Croatia, the pilotage services are regulated by *The Maritime Code of the Republic of Croatia* and *Marine Pilotage Code*.[4] From the very definition of maritime pilotage it is clear that the main goal of pilotage is to ensure the safety of navigation. That is why compulsory pilotage was introduced for certain vessel types and sizes, and the Maritime Code expressly exempts vessels (ships and yachts) that are not required to use pilotage services.[5] These vessels may also use pilotage, but they are not bound by applicable regulations to do so (non-compulsory or optional pilotage).[6]

The Marine Pilotage Code determines compulsory pilotage in certain areas of internal waters and territorial sea of the Republic of Croatia, lays down the conditions to be met by a company that renders pilotage services, qualifications, authorizations and other conditions and obligations to be met by a marine pilot, the conditions for exemption from compulsory pilotage, the procedure of acquiring the certificate of exemption from pilotage (pilot exemption certificate - PEC)[7], designation and certification of marine pilots, a way of marking the pilot tenders/boats and pilotage call signs.[8]

Maritime pilotage is classified according to two criteria: the criterion of the area where it is conducted and the criterion of whether it is compulsory or not. Pilotage, according to the area where it is conducted, may be *port* or *coastal*, and according to the criterion of whether it is compulsory or not, it may be *compulsory* or *non-compulsory* (optional). Port pilotage is the pilotage of craft in the port area to a certain border[9], while the coastal pilotage is piloting in a part of the internal waters and territorial sea of the Republic of Croatia to the borders of the area of port pilotage[10]. In terms of legal consequences, there is no difference between the port and coastal pilotage.

Compulsory pilotage, its borders, time and place of pilot embarkation and disembarkation is determined by Harbour Master's Office for port pilotage, and by the Ministry of Maritime Affairs for

[2] The Statute of Dubrovnik, Volume VII, Article 56; The Statute of Hvar, Volume V, Article 10

[3] Pilotage fees were also calculated in general average.

[4] Marine Pilotage Code, Official Gazette No. 116/10

[5] Maritime Code, Article 70, paragraph 2, subparagraph a). The following are not subject to compulsory pilotage: a) Croatian warships, Croatian public vessels, vessels that serve to maintain the fairways and aids to navigation on these routes, water carriers, Croatian passenger vessels and passenger vessels flying the flags of EU Member States which operate on regular routes, b) vessels of gross tonnage less than 500, c) yachts of gross tonnage of less than 1000.

[6] Optional pilotage lasts until cancelled by the craft engaged in pilotage or until it enters the area of compulsory pilotage (and the pilot is not authorized to perform such pilotage).

[7] A person obtains Pilot Exemption Certificate under the conditions in Article 20 of Marine Pilotage Code. The person must pass a specific exam, under supervision of the pilot, perform at least 10 entrances and 10 departures from the port, on a vessel and port basin for which the certificate is requested and should embark the vessel as the master of the vessel seeking port pilot exemption certificate. For details, refer to 5.

[8] Marine Pilotage Code, Article 1

[9] The Harbour Master's Office decides on the borders of the compulsory port pilotage, and the time and place of embarkation and disembarkation of the pilot.

[10] Maritime Code, Article 68, paragraph (3); Marine Pilotage Code, Article 10. The port pilotage is compulsory for the vessels that carry dangerous liquid chemicals, i.e. liquefied gases, during the entrance into the territorial waters and internal waters of the Republic of Croatia in order to enter the ports that are open for international transport a) for the port of Rijeka: - from the position 45° 11.8′ N i 14° 29.4′ E to the borders of the pilotage port b) for the port of Zadar: - from the position 44° 23.3′ N i 14° 34.6′ E to the borders of the pilotage port c) for the port of Šibenik: - from the position 43° 38.7′ N i 15° 52.3′ E to the borders of the pilotage port d) for the port of Split: - from the position 43° 28.2′ N i 16° 01.0′ E to the borders of the pilotage port and e) for the port of Ploče: - from the position of 43° 05.0′ N i 17° 00.0′ E to the borders of the pilotage port. Such vessels are subject to compulsory pilotage when they sail between the ports open to the international transport from the position of pilot disembarkation in the port of departure to the position of his embarkation in the port of arrival.

coastal pilotage. Compulsory port pilotage applies to all vessels and yachts, except those expressly excluded by the Maritime Code. Compulsory coastal pilotage applies only to vessels carrying dangerous liquid chemicals and liquefied petroleum gas[11]. The master of the vessel must request pilotage services if they are compulsory.

In port in which the port pilotage is compulsory, the vessel must take a pilot even if it is only moving from one coast another, if it moves along the coast using a propulsion engine or using a tug, or if the vessel is turning on the same berth with or without a tug[12]. The master of the vessel has to request port pilotage service at least two hours before the vessel's departure, relocation, moving or turning[13]. Pilotage begins or ends at the borders of pilotage areas from the moment when the pilot starts giving instructions for the commencement or for completion of pilotage. If the vessel has to be moored or anchored, the pilotage ends at the moment when it is finished with anchoring or berthing[14].

During the compulsory pilotage, pilot must not cease to perform pilotage duties before he completes the pilotage of the vessel, regardless of whether or not the master of the vessel engaged in pilotage accepts his instructions in relation to advice on navigation, manoeuvring, mooring and anchoring of the vessel. If the pilotage is not compulsory, the pilot is obliged to terminate it upon the request of the master of the vessel that is using the services of marine pilotage.[15] This means that optional pilotage lasts until terminated by the vessel engaged in pilotage, or until it enters the area of compulsory pilotage, and the pilot is not authorized to conduct such pilotage.[16]

Piloting the vessel, regardless of whether it is compulsory or not, does not relieve the master of the vessel that uses the services of pilotage, of obligations and responsibilities to be in charge of navigation and manoeuvring operations of his vessel. The shipowner using pilotage services is responsible for the actions and omissions of the pilot, as well as for the actions and omissions of the crew members of his vessel. As an expert on maritime-nautical local conditions, the pilot is the master's advisor. The master's decision is always final regarding the manoeuvre that should be performed and he retains full command of the vessel. Therefore, our law recognizes the principle according to which the vessel, i.e. the shipowner is always liable for the damage caused to third parties by a pilot, regardless of whether the pilotage is compulsory or optional.[17]

2. PILOT COMPANIES AND PILOTS

There are different organizations of pilot companies in different countries. In most countries, pilots are employed by their own private companies, in others they are port employees, while in a number of states they are employed by state companies. Regardless of the structure of pilot organizations, because of their great importance for the safety of navigation, they are always under the control of the coastal state.[18]

The current organization of the maritime pilot service in the Republic of Croatia has existed since 1997. Port and coastal pilotage in Croatia may be conducted by a pilot company[19] if they have a valid authorization from the Ministry of Maritime Affairs,

[11] Marine Pilotage Code, Article 10, paragraph 1
[12] Ibid, Article 7, paragraph 1
[13] Ibid, Article 7, paragraph 2
[14] Ibid, Article 2
[15] Ivo Grabovac – Ranka Petrinović, Pomorsko pravo, Pomorsko javno, upravno i radno pravo, Split, 2006, p. 55
[16] Maritime Code, Article 71

[17] For details, refer to Axel Luttenberger, *Peljarenje s posebnim osvrtom na odgovornost za štetu uzrokovanu peljarenjem*, Pomorski zbornik 42 (2004)1, pp. 149 – 158; Ivo Grabovac – Ranka Petrinović, *Pomorsko pravo*, *Pomorsko javno, upravno i radno pravo*, p. 55; Mladen Russo, *Pomorsko peljarenje i odgovornost za štetu tijekom peljarenja*, (Master's thesis), 1995

[18] As an example, in France the general rules on pilotage are made at national level. The pilots are organised as private legal companies, so called Pilot stations, established for the area of an individual port, and they are employed through the job vacancies by the Ministry authorised for ports. In Germany, various bodies are authorised for different regions. In Hamburg and Bremen it is the pilot company under the authority of designated Harbour Master. In Italy, port pilotage (Article 88 of the Pilotage Code) is carried out by pilot companies under the authority of the Harbour Master's Office. In Poland the conditions under which the pilotage services are performed are decided by the Maritime Offices, and these services are generally carried out by the private companies in which port authorities may appear as shareholders. For more details on pilotage organisation in EU member States see Božena Bulum, *Usluge pomorskog prijevoza i lučke djelatnosti u pravu tržišnog natjecanja Europske zajednice*, Zagreb, 2010, pp. 233 – 256.

[19] Pilot association is a company registered for the pilotage activities.

which may be issued only to one pilot company in the area of one Harbour Master's Office[20]. The authorization is issued for a period of five years to a pilot company that must have: the required number of pilot boats or tenders, the required number of VHF radio stations, the required number of pilots with valid ID cards for maritime pilots, as many portable VHF radio stations as there are pilots. They must also have a pilot company liability insurance contract while piloting the vessel, at least up to the amount of basic compensation provided by the pilotage fee for the rendered pilotage services multiplied by a factor of 300[21]. At the moment, in Croatia there are seven pilot companies (in the area of each Harbour Master's Office there is one company except for Harbour Master's Offices in Rijeka and Senj, where there is only one company). All seven companies are privately owned by the pilots themselves.

A pilot company is obliged to keep a pilot logbook that has to be submitted to the Harbour Master's Office for inspection every week, directly or by electronic mail. The pilot's logbook includes: serial number; name of the vessel engaged in pilotage; IMO number; flag state; port of registry; GRT; type of vessel; length overall; beam; draft; day, month and year of pilotage; place of berthing/unberthing; type of manoeuvre (arrival, departure, relocation of the vessel); pilotage commencement and completion time: the name of the pilot, tug number and comments (port, coastal, PEC[22]).

If it is determined that a company engaged in pilotage based upon the approval of the Ministry of Maritime Affairs, does not fulfil the conditions under which it was granted, or if some other irregularity in the operation of the company is established, the Ministry may withdraw their approval.

Maritime pilots as members of pilotage companies are the persons that contribute to the safety of navigation in areas of increased risk to navigation. Pilots are familiar with the relevant data for pilotage in the local area, the technical characteristics of vessels, as well as with weather conditions in the local area. They must also be skilled in communication, both with the crew they are in direct contact with, and also with other participants in the maritime transport. Since the pilot's job is very important for the safety of navigation, pilotage can be conducted only by professional, competent staff with appropriate management skills and valid pilot ID cards. In order to safely conduct the pilotage, a pilot becomes ready for his job after receiving the required education, completing internship and advanced training as required by IMO Resolution A 485 (XII), and Marine Pilotage Code[23] in Croatia.

Pilotage duties in internal waters and territorial sea of the Republic of Croatia may not be performed by foreign legal entities without the specific approval of the Ministry of Maritime Affairs. A foreign legal entity will be granted the approval only if the local legal entity is unable or unwilling to render pilotage services[24]. The pilotage of the vessel may be performed only by those holding a valid identity card of maritime pilots.[25] During the pilotage, the pilot is bound to guide the vessel and give expert advice to the master of the guided vessel in relation to navigation, mooring/unmooring,

[20] In the area of Split Harbour Master's Office, there is a company Marine Pilot Ltd. In the Republic of Croatia, the pilots are organised as the Association of Marine Pilots which was founded and registered in 1990 for the reasons of development of pilotage on the Adriatic Sea. The association is an equal member of EMPA, European trade association of marine pilots. The association includes both, active and retired pilots that operate in the areas of the Harbour Master Offices in Pula, Rijeka and Senj, Zadar, Šibenik, Split, Ploče and Dubrovnik.

[21] Marine Pilotage Code, Article 12. The Ministry decides on the requirements regarding the number of boats, tenders, VHF radio stations and pilots, in accordance with traffic density in a port. They also determine whether a pilot company satisfies required conditions.

[22] Ibid, Article 15. PEC (*Pilotage exemption certificate*) is a certificate that allows the holder to be exempted from the obligation of using the services of compulsory port pilotage in a specified port, basin and for vessels as designated in the certificate.

[23] The Marine Pilotage Code prescribes the conditions that have to be satisfied by a person sitting for a pilotage exam (a master's certificate for vessels of 3000 GRT and more, other certificates for basic and additional training, specified sailing experience, health requirements, as well as, a specified number of port coastal pilotage assignments under the supervision of the pilot.)

[24] Maritime Code, Article 69 pilotage licence, conditions

[25] The Marine Pilotage Code prescribes the conditions for the issuance of the pilotage license, conditions and method of license revocation, proficiency, authorisations and other terms and conditions that must be fulfilled by a pilot, the procedure of the license issuance, the conditions that must be fulfilled by the trade association engaged in pilotage, the method of markings of pilot boats and tenders, and pilotage call signs, as well as the conditions and the procedure of the pilotage and the pilot rights and obligations.

anchoring, and give warnings regarding sailing conditions and regulations that apply to the vessel in the area in which the pilotage is conducted.
Immediately upon embarking or just before disembarking the vessel, the pilot is bound to make contact with VTMIS service using a VHF radio station, and to inform them about the time of embarkation or disembarkation, and to exchange information about the time of pilotage commencement and completion, the position/place of the pilotage commencement and completion, the way of sailing in and out, and vessel relocation, specified tug number and conditions along the fairway. He must, without any delay, report to VTMIS service by VHF radio station on any observed deficiencies that may affect the safety of the vessel, the safety of navigation or pose a threat to the environment.
A pilot is required to reject the pilotage if the draft of the vessel does not correspond to the depth of the sea at the place designated for mooring or anchoring, or if at the place of berth the conditions are not ensured for the vessel to be always safely berthed when afloat or disabled, or if the Harbour Master's Office has not granted the inwards or outwards clearance.[26] In the event of such grounds for refusal of pilotage, the pilot is required to notify VTMIS service, without any delay, and to make the respective entry in the logbook.[27]
The pilot is also required to promptly inform VTMIS service by VHF radio station or by phone, and to inform the Harbour Master's Office in writing or by electronic mail no later than within 24 hours in the following cases: infringements of regulations by the vessel engaged in pilotage or some other vessel pertaining to the safety of the vessel, crew, passengers and cargo, and environmental protection; maritime accidents caused or suffered by the vessel engaged in pilotage and any action on the vessel engaged in pilotage or some other vessel that has endangered or may have endangered any of these vessels, floating and other craft in the fairway, or cause them damage or action that led to the pollution of the environment. The pilot is also required to inform the same service if the master of the vessel that requires pilotage does not accept the instructions regarding forthcoming pilotage and if he suspects the master of the vessel of being under the influence of alcohol or other intoxicants.[28]
During the compulsory pilotage, the pilot must not leave the bridge of the vessel engaged in pilotage before its completion no matter whether or not the master of the vessel accepts his advice on navigation, manoeuvring, mooring and anchoring of his vessel. If the pilotage is not compulsory, the pilot is obliged to terminate it upon the request of the master of the vessel that is using the pilotage services. The pilot is bound to promptly notify VTMIS service on the termination of non-compulsory pilotage[29]. Also the pilot is not allowed to leave the vessel engaged in pilotage that arrived from abroad before the vessel obtains a Free Pratique by the Harbour Master's Office.

3. THE DUTY OF EQUAL TREATMENT OF VESSELS IN PORTS

It has been a long established principle that the coastal state has a duty to treat equally both national and foreign vessels, and that does not only apply to the freedom of foreign vessels entering national ports open to international trade, but also to the actions of port authorities, as well as to providing various allowances (use of ports, payment of port dues, etc.).[30] This also applies to pilotage services. Thus, as regards the use of pilotage services and payment for those services, foreign vessels are to be treated the same as Croatian vessels, subject to reciprocity.[31]
The principle of equal treatment of all vessels in ports open to international trade is regulated at the international level by the *Convention and Statute of the International Regime of Maritime Ports*, Geneva, 9 December 1923[32], whose party is the

[26] The Marine Pilotage Code, Article 17, paragraph 4
[27] Ibid, paragraph 5
[28] Ibid, paragraph 6
[29] Ibid, Article 18
[30] Branko Jakaša, Udžbenik plovidbenog prava, Zagreb 1983, p. 41
[31] Maritime Code, Article 72, paragraph 2
[32] Convention and Statute on the International Regime of Maritime ports, Geneva, 9 December 1923, Official Gazette of the Kingdom of Yugoslavia, No. 280-LXXXIX of 30 November 1931 (The decision of the Croatian Government to publish the multilateral international treaties to which the Republic of Croatia is a party based on the notification of succession - Official Gazette - MU 1/1992). The said Convention was published in the Official Gazette of the Kingdom of Yugoslavia 280-LXXXIX of 30 November (or September, according to the

Republic of Croatia on the basis of notifications of succession of 8 October 1991. In Article 2, the Statute obliges states parties to ensure that foreign vessels are equally treated, subject to reciprocity, as their own vessels or vessels of any other country in the ports under their sovereignty. This equal treatment is related to open berthing in the port, the use of ports and all the amenities at disposal to shipping and commercial operations of vessels, their cargoes and passengers[33]. Equal treatment applies to various allowances such as: provision of coastal space, loading and unloading, and for various dues and fees to be paid to the state or other authority in the port[34].

The principle of equality of treatment, as defined by the Statute, does not mean restricting the freedom of competent authorities to implement the best measures for good governance of ports, if such measures are in accordance with the principle of equal treatment of national and foreign vessels in ports.[35] The provisions of the Statute do not apply to maritime cabotage.[36]

Compulsory pilotage is regulated by Article 11 of the Statute of the Convention on International Regime of Maritime Ports: *Each Contracting State reserves the right to organise and administer pilotage services as it thinks fit. Where pilotage is compulsory, the dues and facilities offered shall be subject to the provisions of Articles 2 and 4, but each Contracting State may exempt from the obligation of compulsory pilotage such as its nationals as possess the necessary technical qualifications.* [37] According to this provision, the principle of equal treatment is applied to vessels of all flags. The exceptions from this obligation are national vessels that meet certain technical requirements.

4. FREEDOM TO PROVIDE PORT SERVICES AND PILOTAGE IN THE EUROPEAN UNION

Liberalization of port services in the European Union began after the 1990s, when a number of decisions of the European Court and Commission were brought in connection with the freedom to provide services and market competition in European seaports. The European Commission published Green Paper on Seaports and Maritime Infrastructure in 1997. In a Communication to the European Parliament and the Council in 2001, the Commission, among other things, put forward their views on the liberalization of market access to port activities and submitted a proposal for a Directive on market access to port services - Proposal I. However, this proposal failed because the different nature of port activities and the diversity of European ports were not adequately distinguished. In that respect, it is necessary to differentiate between the port services that ports provide to vessels with regard to navigation, the so-called technical-nautical port activities[38] including pilotage, port services provided to passengers and cargo and other commercial activities that contribute to the development of maritime transport, and other basic port activities.[39] A common feature in all technical and nautical activities (pilotage, towage and berthing and unberthing of vessels) is to achieve safety of vessels, cargo, passengers and the port community as a whole, as well as environmental protection. These activities differ from other port activities as they are carried out for the benefit of vessels calling at the port, while other activities are mostly related to cargo and have commercial aspect, so they can be organized according to competitive principles; technical-nautical services are focused mainly on maintaining safe navigation in the port, and are subject to the specific rules when it comes

ZOPUP-in with commentary, 1981., p 23) 1931, on the basis of the Decision on publication of multilateral international treaties to which the Republic of Croatia is a party based on the notification of succession (Official Gazette, International Agreements 1/1992). Texts of the enumerated treaties, including the Convention and Statute under No.22, published in the official gazettes of the predecessor State, shall be valid and applicable as official texts until they are published in the Official Gazette.

[33] The statute of the Convention on the International Regime of Maritime Ports, Article 2, paragraph 1

[34] Ibid, paragraph 2

[35] The Statute, Article 3

[36] The maritime cabotage refers to the carriage of goods and passengers by sea between points that are located in the same country.

[37] The Statute, Article 11.

[38] Technical-nautical port activities are those activities that are carried out in the port for safety of navigation and protection of the marine environment.

[39] Božena Bulum, *Zajednička Europska lučka politika - prošlost i recentne mjere u njezinom uspostavljanju*, Zbornik radova Pravnog fakulteta u Splitu, vol. 46, 2/2009, pp. 337-358.

to their organization and performance, as well as market access of these activities.[40]

The Proposal I, the Directive on market access to port services, was followed by Proposal II that regulates market access to pilotage services. The pilotage jobs are considered a commercial port service, but a service that due to its specificity is of great importance to the safety of navigation in the port, and is separated from the other port services, as well as other technical-nautical services. According to the Proposal II, the Member States may make the granting of authorizations for pilotage dependent on the fulfilment of particularly strict criteria relating to the achievement of maritime safety and rendering of public services. The competent authorities may prescribe the obligation of using the services of pilots, and in some cases, if demanded by special circumstances in the port keep rendering of such services for themselves or entrust them directly to particular operators. The aim of these provisions is to allow the various pilotage regulations depending on the specific needs of individual ports, primarily taking into account the safety of navigation[41].

In pilotage, there is an additional circumstance that makes the service stand out from the other port activities, and there must be a special organization and management in a specific port, particularly in order to coordinate the relocation of vessels in the port. The relocation of vessels in port and their pilotage by pilots (pilotage in a narrow sense) may represent two separate markets of services, whereby the *pilotage in a narrow sense* may be organized in accordance with the principles of market economy. However, the separation of these two services would lead to inefficiencies in rendering of port pilotage services, and there is a danger that competing operators, under the pressure to relocate vessels as quickly and as efficiently as possible, could endanger the safety of navigation in the port and cause problems in the coordination of vessel relocation. Therefore, the monopolistic market structure of pilotage services seems to be the most efficient and the most appropriate solution, provided that the competent authorities of the coastal state perform inspections so that pilots do not abuse their position and that additional, unnecessary services and excessive fees are not be imposed on the pilotage service users.[42]

The Proposal II enables the authorities of Member States to grant exemption from compulsory pilotage to all, or certain types of vessels by issuing certificates of exemption from compulsory pilotage. That document issued by the competent authority, grants in whole or in part, exemption from compulsory pilotage to certain types of vessels. Such solutions were adopted in many EU member states such as Belgium, France, Germany, Ireland, the Netherlands, Portugal and the United Kingdom, which, under certain conditions, allow vessels to be exempted from compulsory pilotage, i.e. their masters are allowed to independently perform pilotage for their own needs by means of a certificate of exemption from compulsory pilotage - PEC. In Italy and Spain, PEC is not issued, but under certain conditions, some vessels (ferries and vessels with limited capacity) may be allowed to move through the port without the presence of a pilot on board.[43]

5. CERTIFICATE OF VESSEL EXEMPTION FROM COMPULSORY PORT PILOTAGE – PEC

The study on certificates of exemption from compulsory pilotage (Pilotage Exemption Certificates - PEC) which was carried out and submitted to the European Union, Directorate-General for Mobility and Transport on 18 September 2012[44] showed that the criteria for exemption from pilotage vary from state to state and that, in general, the pilotage is compulsory

[40] Božena Bulum, *Usluge pomorskog prijevoza i lučke djelatnosti u pravu tržišnog natjecanja Europske zajednice*, Zagreb, 2010, p. 211.

[41] Nikoleta Radionov, Tamara Čapeta, Jasenko Marin, Božena Bulum, Ana Kumpan, Nikola Popović, Iva Savić, *Europsko prometno pravo*, Zagreb, 2011. (Božena Bulum, VI. Pomorski promet, pp. 258 – 269).

[42] Božena Bulum, *Usluge pomorskog prijevoza i lučke djelatnosti u pravu tržišnog natjecanja Europske zajednice*, p. 215; Sergio Carbone, Francesko Munari, *Port services ancillary to navigation between market and safety requirements,* Lloyd's Maritime and Commercial Law Quarterly, 1996., p. 67-92

[43] Ibid

[44] The study on certificates of exemption from pilotage (Pilotage Exemption Certificates-PEC), which was submitted to the European Commission, Directorate-General for Mobility and Transport on the 18 September 2012 on p. 116 and further gives a comparative overview of the requirements for compulsory pilotage, exemption from compulsory pilotage and PEC by EU countries.

when entering or leaving the port, or port manoeuvring, taking into account its size, type of cargo, in the context of the channel indentedness, tides and currents, as well as the density of traffic in a particular fairway or within an area. The study clearly states that the flag of the vessel is not a decisive criterion in terms of exemption of pilotage[45].

Since 2004, Croatia has recognized the exemption from compulsory pilotage of vessels of a certain size, whose master has a certificate of exemption from compulsory pilotage - PEC. Thus, the Maritime Code of 2004 (Official Gazette 181/04) stipulates that any vessel with gross tonnage of less than 2000, may exceptionally be exempted from pilotage, provided that the master meets the requirements that were subsequently defined in the Marine Pilotage Code, i.e., to possess a valid certificate of exemption from compulsory pilotage. Thus, the vessel with gross tonnage of less than 2000, except for tankers and vessels carrying dangerous or toxic cargo, can be relieved from port pilotage for a specified period of time and in a particular port area, under the conditions that it is ready, in all respects, to perform the entering/leaving procedure and that the master has a certificate of exemption from compulsory pilotage – PEC.[46]

If these two conditions are fulfilled at the request of the shipowner, charterer or companies, subject to approval of the port authority, the Minister of Maritime Affairs shall issue a decision to exempt the vessel from compulsory port pilotage[47]. The master of such vessel shall not later than two hours before arriving at a pilot embarkation position inform the boarding station of his intent to enter the port. He is also required to inform the pilot station of his intention to depart two hours before leaving the port. The pilot station is bound to provide pilotage services to such vessels at all times, as required.[48]

Legal provisions on vessel exemption from the obligation of pilotage, if the master possesses a valid certificate of exemption for compulsory pilotage, does not violate the principle of equal treatment and equal treatment with respect to vessels of all states, as the criteria for exemption from pilotage are exclusively for technical and safety reasons. This meets the additional criteria of Article 11 of the 1923 Convention and Statute on the International Regime of Seaports, which provides that only national entities on an exceptional basis may be exempted from the obligations of pilotage if they meet certain technical requirements. Those requirements are the gross tonnage of the vessel, a master's certification of exemption from compulsory pilotage, and the ability to perform entering/leaving the port procedures in a particular port area.

6. ISSUES ON CONFORMITY OF THE LATEST PROVISIONS OF THE MARITIME CODE ON COMPULSORY PILOTAGE WITH INTERNATIONAL TREATIES

6.1. Amendments to the 2013 Maritime Code

Constant improvements of navigation safety standards often lead to the adoption of new international agreements or amendments, which are reflected in national legislation. In addition, Croatia was obliged to harmonize its regulations with the EU legislation. Because of this, there have been five amendments to the Maritime Code since its adoption in 2004. The latest intervention adopted by the 2013Law on Amendments to the Maritime Code[49], contains two amendments to provisions on compulsory pilotage. The first refers to the vessels exempted from compulsory pilotage (Article 70, paragraph 2, subparagraph a), while the second provides for pilot boarding position as

[45] Four EU countries for exemption from pilotage prescribe enrolment in a national registry or national flag, and besides Croatia there are also Bulgaria, Greece, Poland and Portugal. Of these only Greece does not limit this exemption to cabotage, while others that are mentioned apply exemption only to cabotage navigation, which is in line with the Convention and Statute on the International Regime of Maritime ports. Namely, the flag only indirectly becomes a *criterion* because the mentioned coastal States reserve the cabotage operations for the vessels flying their own flag.

[46] Marine Pilotage Code, Articles 8 and 38

[47] The Minister may, on the proposal of the Harbour Master's Office annul that decision if the vessel is not fully prepared to carry out the arrival/departure procedures, or if any irregularities are found in that procedure.

Exceptionally, the Harbour Master's Office may order the vessel to use a pilot until they rectify the deficiencies for which he ordered the use of pilots, as well as for reasons of safety.

[48] Marine Pilotage Code, article 9

[49] The Law on Amendments to the Maritime Code, Official Gazette 56/13

plotted and described in the official navigational charts and publications *Notices to Mariners I* (Article 70, paragraph 10). The second provision is formal in nature and is not controversial in any way.

As regards the EU acquis communautaire, in an attempt to liberalize the port services market, the Proposal II of the Directive on market access to port services excluded pilotage jobs and allowed Member States to prescribe the compulsory pilotage requirements and make them dependent on the fulfilment of particularly strict criteria relating to maritime safety and to reserve these jobs for themselves or entrust them directly to a particular operator.

Each state exempts certain categories of vessels from compulsory pilotage, especially taking into account that the vessels which do not use pilotage services should not endanger the safety of navigation. The criteria for exemption of vessels from compulsory pilotage are the size of vessels or yachts and masters' being familiar with the fairways where the vessel sails. Thus, public vessels, vessels for maintenance of fairways, water carriers, vessels engaged in cabotage navigation, and the vessels of less than 500 gross tonnage and yachts less than 1000 are exempted from compulsory pilotage. Exceptionally, the Minister of Maritime Affairs man relieve of compulsory pilotage a vessel or a yacht (except for vessels carrying dangerous or toxic cargo), of gross tonnage of less than 2000 for a fixed time period and at a specified port area, provided that the master has passed a special exam[50]. Conversely, the Harbour Master's Office may determine certain types of vessels whose gross tonnage is less than 500, to be subject to compulsory port pilotage.[51]

Before the entry into force of the last amendment to the Maritime Code, the provision on exemption from compulsory pilotage was as follows: *not subject to compulsory pilotage: a) Croatian warships, Croatian public vessels, vessels which serve to maintain the fairways and aids to navigation on these routes, water carriers, Croatian passenger liners operating on fixed routes, b) vessels of gross tonnage less than 500, c) yachts whose gross tonnage is less than 1000.* Article 29, paragraph 1 of the Law on Amendments to the Maritime Code (Official Gazette 56/13) provides*: Article 70, paragraph 2, subparagraph a), after the words "Croatian passenger vessels", the following words shall be added "and passenger vessels flying the flag of a Member State of the European Union".*

After the amendment was adopted, Article 70, paragraph (2), subparagraph a), now states that: *the following are not subject to compulsory pilotage: a) Croatian warships, Croatian public vessels, vessels which serve to maintain the fairways and aids to navigation on these routes, water carriers, Croatian passenger vessels and passenger vessels flying the flags of EU Member States which operate on fixed routes, b) vessels of gross tonnage less than 500, c) yachts of gross tonnage of less than 1000*.

6.2. Historical overview of the provision of the Maritime Code on exemption of Croatian liners from compulsory pilotage

The provision on the exemption of national liners from compulsory pilotage has existed for forty years in our legislation. The 1974 Law on Maritime Pilotage[52] prescribed the exemption of compulsory pilotage to the Yugoslav merchant marine vessels used for administrative purposes, vessels rendering safety navigation service, vessels engaged in the maintenance of maritime fairways and aids for navigation safety on these routes, *passenger liners and ferries on fixed routes*, and water carriers. As it was not explicitly stated that the provision on passenger liners and ferries on fixed routes refers only to the cabotage navigation (which is in accordance with the provision of Article 9 of the Convention and Statute on the International Regime of Seaports), the prevailing interpretation was that this provision should apply to international navigation (routes Rijeka-Dubrovnik-Bari, and later Zadar-Ancona and Split-Ancona) that were operated by *Jadrolinija* vessels.

Exemption of liners in cabotage navigation from pilotage is a general practice known throughout

[50] The master must have a certificate of exemption from compulsory pilotage (*Pilotage exemption certificate*) - PEC. The Marine Pilotage Code prescribes the requirements for obtaining a Certificate of Exemption from compulsory pilotage. The Code differentiates the requirements for vessels longer than 50 meters LOA and those below 50 meters.

[51] Maritime Code, Article 70, paragraph 3 and 4

[52] The Law on Maritime Pilotage, Official Gazette of the Socialist Republic of Croatia, 15/74, Article 5

the world (and it is in accordance with the Convention and Statute on the International Regime of Seaports), because it is usually applied to smaller vessels which often call at the same ports, so it is implied that their masters meet technical requirements in order to fulfil the requirements for exemption of such vessels engaged in cabotage navigation from the obligation of pilotage.

The 1994 Maritime Code took over the provision from the 1974 Code and only applied it to Croatian vessels. Article 104, paragraph (2), subparagraph 2, of the 1994 Maritime Code[53] provided *that the compulsory pilotage does not apply to: a) Croatian warships, Croatian public vessels, vessels that serve to maintain the fairways and aids to navigation in these fairways, Croatian passenger vessels and ferries that sail on fixed routes ...* In that way, the Croatian legal system kept the provision which from the beginning was not in conformity with the Convention and Statute on the International Regime of Seaports, because the benefits of exemptions from compulsory pilotage were unconditionally enjoyed only by national passenger vessels and ferries. It is known that Articles 2 and 3 of the Convention and Statute on the 1923 International Regime of Maritime Ports explicitly provide the equality of treatment with its own vessels for all member states.

Instead of finally correcting the omission in the Codes of 1974 and 1994, the current Maritime Code took over this provision in an almost identical content, and Article 29, paragraph 1 (i.e. Article 70, paragraph 2, subparagraph a), of the latest Law on Amendments to the Maritime Code the privileged position has been extended, in addition to national, also to the cruise ships and ferries on fixed routes, flying the flag of Member States of the European Union, although EU law does not contain such a requirement by the Member States. From the study of Pilotage Exemption Certificates - PEC filed with the European Union, Directorate-General for Mobility and Transport in 2012, it is clear that the flag of the vessel is not a decisive criterion in terms of exemption from pilotage.

This provision established the inequality and discrimination against vessels flying the flag of other State Parties to the Convention, which are not members of the European Union, and which are engaged on regular routes, in relation to the vessels of the Member States of the European Union, which operate on regular routes without the condition to satisfy technical requirements, and thus the principles and provisions of the Convention and Statute on the International Regime of Maritime Ports are violated. It is a violation of the requirement of reciprocity in dealing with other governments' vessels in ports of other countries (whether or not parties to the Convention), and finally it is the basic requirement of safety of navigation, which is the main reason why the pilotage services were introduced and why they exist.

This change and broadened effect of discriminatory provisions were not specifically explained by the proponent of the Law on Amendments to the Maritime Code. In the explanation of the proposal, Articles 29 and 30 explain only the provision contained in Article 30, which refers to the obligation of plotting the pilot boarding position into the charts, as well as the obligation of the vessels in terms of update of nautical charts and publications.

Due to the afore said, a group of pilots submitted a proposal to the Constitutional Court to institute proceedings to review the Maritime Code with international treaties proposing a temporary suspension of the application of the provisions of Article 70, paragraph (2), subparagraph a) of the Maritime Code, and Article 29, paragraph (1) of the Law on Amendments to the Maritime Code.

7. CONCLUSIONS

Pilotage is technical-nautical and also commercial port service which, because of its great importance for the safety of navigation, is considered the service of general and public interest; thus the government keeps the provision of pilotage services for themselves or directly entrusts them to a national entrepreneur. The compulsory pilotage is determined for vessels of certain types and sizes if required for the safety of navigation. In an attempt to liberalize port services in the EU, due to its great importance for the safety of navigation marine pilotage remained apart from other port services. The reason for this is to allow for different pilotage regulations depending on the specific needs of

[53] Maritime Code of the Republic of Croatia, Official Gazette 17/94, 74/94 and 43/96

individual ports, primarily taking into account the safety of navigation. Member States may require that the issuance of pilotage licences depends on the fulfilment of particularly stringent criteria relating to the provision of maritime safety and performance of public service.
Pilotage can be used by any vessel under equal conditions. As regards the use of pilotage services and payment of fees for these services, foreign vessels have equal treatment as Croatian, subject to reciprocity. The maximum permitted fee for pilotage services is established by the Minister via a special regulation. The principle of equal treatment for all vessels in the ports open to international trade, including pilotage services, is provided in Articles 2, 3 and 11 of the 1923 Convention and Statute on the International Regime of Seaports.
In the Republic of Croatia, the pilotage services are regulated by the Maritime Code and Marine Pilotage Code. The latest amendment that was adopted by the Law on Amendments to the 2013 Maritime Code contains two provisions on compulsory pilotage. The former concerns vessels that are exempted from compulsory pilotage (Article 70, paragraph 2, subparagraph a), while the latter provides for the position of pilot embarkation to be plotted and described in the official navigational charts and the publication *Notices to Mariners I* (Article 70, paragraph 10). This second provision is formal in nature and there is nothing controversial about it. The provision of Article 70, paragraph 2, subparagraph a), excludes from compulsory pilotage , not only Croatian passenger vessels operating on regular routes (as it was by then) , but also passenger vessels flying the flag of a Member State of the European Union.
The existing provision on exemption from compulsory pilotage *Croatian passenger vessels and ferries that sail on regular routes*, although inconsistent with the Convention and the Statute, has not endangered the safety of navigation since the masters of Croatian vessels that ply the same routes are familiar with the conditions of navigation in our ports.
Article 70, paragraph (2) (a), is not in conformity with the Convention and Statute on the International Regime of Seaports. It established inequality and discrimination against vessels flying the flag of another State Party to the Convention which are not members of the European Union, and engaged on regular routes, in relation to the vessels of the Member States of the European Union, which ply on regular routes without having to satisfy technical requirements, whereby the principles and provisions of the said Convention and Statute are violated. It also violates the requirement of reciprocity in dealing with other government vessels in ports of other countries (whether or not parties to the Convention), and finally, the basic requirement of safety of navigation, and that is the main reason why pilotage services were introduced and why they exist.
There is no regulation of the European Union that in any way requires from their member states to exempt from compulsory pilotage vessels flying the flags of EU states. Member States may require that the issuance of pilotage licences depends on the fulfilment of particularly stringent criteria relating to the provision of maritime safety and performance of public service. The study on the certificates of exemption from pilotage (Pilotage Exemption Certificates - PEC), which was submitted to the European Commission, Directorate General for Mobility and Transport in 2012, provides a comparative review of the conditions for compulsory pilotage, exemption from compulsory pilotage and PEC by EU countries. The Study shows that the flag of an EU Member State vessel is not a decisive criterion for the exemption of vessels from the obligation of pilotage.
Therefore, Article 29, paragraph 1, (i.e. Article 70, paragraph 2, subparagraph a) of the 2013 Law on Amendments to the Maritime Code is not the provision that harmonizes national legislation with the EU acquis, nor does it allow vessels of other EU member states to enjoy in Croatian ports the same treatment the Croatian vessels enjoy in their respective ports. As an example, we can mention a Croatian or Italian passenger vessel on a regular route Split-Ancona that will be exempted from pilotage obligations in Split in accordance with applicable Croatian regulations, regardless of whether the master has the PEC or not, while in Ancona the same vessel shall be subject to the obligation of pilotage, irrespective of its flag.
Exemption from pilotage obligation of the vessel whose captain might be entering a Croatian port the first time just because it is a passenger vessel on a regular route and because it flies a certain flag

is not only contrary to the provisions of the Convention and Statute and does not comply with the requirement of reciprocity, but it is dangerous in terms of safety of navigation (it is the case of large passenger vessels), the protection of human life and nature and the marine environment. This works against the very purpose and need for pilotage, as an element of safety of navigation and the protection of nature and the environment, being the highest values protected even by the Constitution of the Republic of Croatia.

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ASSESSMENT OF THE CURRENT SITUATION AND THE SUPPOSITIONS FOR THE EFFICIENT WORK OF THE REGIONAL PORT AUTHORITIES IN THE REGION OF ISTRIA

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ABSTRACT

Several port authorities have been established for the purpose of management, construction and operation of ports open to public traffic of regional and local significance within the Adriatic regions in Croatia. In legal terms, the Region independently decides on the appropriate, best model of management of ports of regional and local significance. The management of ports plays a special role because the ports the primary benchmarks of development of the maritime economy.
In the paper the authors analyse the status of the port authorities from the institutional and economic aspects and explain their technical-technological and organizational-economic structure. The paper also researches and analyses the port authorities' level of development, level of integration, project opportunities and the compliance of all the factors in the structure of the port and its surroundings.
The operating result of a regional port authority is the indicator of its success, the role and importance it has for the port, traffic and economic system both at the national level and within the scope of the competitive transport market.
The authors analyze the operations of port authorities of the Region of Istria and determine the significance of the administrative capacity and the effects on the improvement and development of port infrastructure. Measures are proposed for the improvement of knowledge and of the effects of the operating process.

KEY WORDS

ports, regional port authorities, administrative capacity, operating results, Region of Istria

1. INTRODUCTION

The port system is a vital segment in the process of valorising the sea and the marine orientations of any country and, together with shipbuilding, it is a fundamental link in the chain of the shipping industry. A strong shipping industry is created by developing all its segments which are interdependent and systematically joined to form a unique whole. Ports are especially important because they are the primary starting points in developing a shipping industry.

A Port Authority managing a seaport and its entire port area is a business entity (legal person) and it should operate according to the principles of economics. Hence, a financial analysis is the most important part of the overall analysis of the performance of a Port Authority and it is a precondition to the rational management of a port's operations and development. Although a Port Authority is a non-profit organization, maximizing earnings is a crucial factor in generating as much revenue as possible which is to be invested in maintaining or building port infrastructure. To ensure the efficiency of business operations it is important that these operations are well organized. In this respect, some Port Authorities are still searching for the right model and the right personnel who are a vital component of this very important segment of the Croatian economy.

2. BASIC DETERMINANTS OF CROATIA'S PORT SYSTEM

In this chapter the authors examine legal regulations governing the port system and describe the features of managing Port Authorities of county and local significance.

2.1 Legislation and legal framework

Port management is defined by legal regulations that establish the ownership and management of ports. In the field of maritime affairs the Maritime Code (MC) [1] was adopted in 1994 and the Seaports Act (SPA) [2] in 1995. Since then both acts have been superseded by:

- the Maritime Domain and Seaports Act adopted in 2003[3]
- the Maritime Code of 2004[4]
- the Decree on the Classification of Ports Open to Public Traffic and Special Purpose Ports[5] adopted in 2004
- the amendments to the Maritime Domain and Seaports Act adopted in 2006 and 2009.[6]

Compared with the old SPA, the new Maritime Domain and Seaports Act – that is, the part of the Act that refers to seaports open to public traffic – has not brought about any significant changes. Its greatest novelty is that it has joined the maritime domain and seaports within a common document. The new Maritime Code brings together all charters and regulations referring to maritime sailing. With the adoption of the Maritime Domain and Seaports Acts, a part of the provisions of the Maritime Code have ceased to be valid. Hence, as far as analysing the legal determinants of managing seaports in Croatia is concerned, the only relevant part of the Maritime Code is that referring to vessels. Hence, the Maritime Code will not be taken into consideration in the issue of managing seaports.

In practice, enforcing legal regulations is a very complex process, impeded by a number of issues and drawbacks of legal, as well as transport-related, importance:[7]

1) Legal issues and drawbacks:

[1] Pomorski zakonik, Official Gazette 17/94, 74/94, 43/96
[2] Zakon o morskim lukama, Official Gazette 108/95, 6/96 and 00/97
[3] Zakon o pomorskom dobru i morskim lukama, Official Gazette 158/03, 141/06 and 38/09
[4] Pomorski zakonik, Official Gazette 181/04
[5] Uredba o razvrstaju luka otvorenih za javni promet, Official Gazette 110/04
[6] Izmjene i dopune Zakona o pomorskom dobru i morskim lukama, Official Gazette 141/06 and 38/09
[7] Dundović, Č. et al.: Integracija i koordinacija lučkog i prometnog sustava Republike Hrvatske, Sveučilište u Rijeci, Pomorski fakultet u Rijeci, Rijeka, 2006, p. 103.

- the transformation of socially-owned enterprises burdened with financial difficulties and business losses through priority concessions
- granting of concessions followed by the publishing of a public invitation to tender for concessions – *concessions are granted piecemeal and only for services to be rendered*
- the exaggerated influence of the maritime domain institute.

2) Transport-related issues and drawbacks:

- ambiguities in establishing the place and role of port systems – *the problems of ports are often regarded as being the problems of independent economic and traffic entities, neglecting the fact that the port system is part of the national economy and overall transport system that has exceptionally high multiplying effects*
- the importance, position and scope of operations of individual ports in the port system have still not been unambiguously established.

In seeking the right solutions regarding the management of Croatia's port systems, the provisions of the *Maritime Domain and Seaports Acts*, which are considered as being *lex specialis*, must be taken into consideration, together with the *Maritime Code* (for issues not regulated by the Maritime Domain and Seaports Act) and the *Institutions Act*[8], which is of general importance and whose application is subsidiary (Article 48, Item 5 of the Maritime Domain and Seaports Act states: "*If otherwise not determined by this Act, the regulations of the Institutions Act shall apply to Port Authorities*."). It follows that the organization, management and operation of Port Authorities is regulated by the provisions of the Maritime Domain and Seaports Act.
A Port Authority is a non-profit legal entity. It gains this attribute by registering the decision on establishing a Port Authority in the Registry of Institutions (Article 2, Item 1 of the Institutions Act). Depending on the legal regime of the port, the Port Authority can be established by either the Republic of Croatia or the county in whose territory the port is located. Being a non-profit legal entity the Port Authority is subject to the regulations of the Institutions Act to ensure that its specific tasks are carried out using the appropriate resources. Unlike other public enterprises or institutions providing services of general interest regardless of their financial justification, a County Port Authority must prove and confirm its economic purpose as an entity whose overall business policy will contribute towards the better usage and improved management of the entire port area that it manages. It follows that the operation of any Port Authority is based on the laws of economics and that the profit accumulated is invested in the construction and operation of the port area in which it is located.

2.2 Characteristics of managing ports of county and local significance

The term *management* can be defined in many ways. According to one definition, management is knowing exactly want you want to do and then seeing that it is done in the best and most efficient way possible.[9] In essence, management is a highly complex process, and its complexity is greater than any known definition can express. The best way to explain management is to use the systems theory according to which every organization rests on four primary inputs from its environment: human resources, financial resources, physical resources and information resources.
To manage, develop and operate county and local ports open to public traffic in any county, several Port Authorities may be established at the request of a Municipal or Town Council; in this case the applicants of the request are also the co-founders. From a legal aspect, such a regulation gives counties the right to choose for themselves the best model for managing ports of county and local significance.
A decision to establish a County Port Authority can be passed after the port area has been established

[8] Zakon o ustanovama, Official Gazette 76/93, 47/99 and 35/08

[9] Griffin, R.W.: Management, Houghton Mifflin Company, 1987. Boston, u: P. Filipić, I. Šimunović: O ekonomiji obalnih područja, planiranje i upravljanje, Sveučilište u Splitu, Ekonomski fakultet Split, 1993, p. 92.

by the County Government for all ports of county and local significance open to public traffic in the county's territory in accordance with spatial plans and with the approval of the Croatian Government. The bodies of the Port Authority are the Administrative Council and the Director (Figure 1). The Administrative Council is made up of five members; two members and the president are appointed by the founders, one member is appointed by the Minister, and one member by the representatives of concession holders in the Port Authority's territory.

The existing model for managing ports of county significance is a decentralized management model: several independent Port Authorities exist within a county. An analysis of the operation of County Port Authorities suggests that such a model for managing ports of county significance provides more disadvantages than it does advantages.[10]

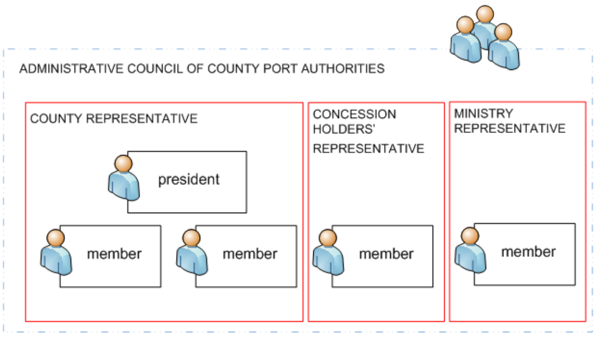


Figure 1. Organizational structure of the Administrative Council of a Port Authority of county significance
Source: the authors

The effectiveness of today's decentralized management of ports of county significance open to public traffic is ambiguous and as such it is unlikely that it can be used as a basis upon which to develop the elements of a new system to ensure the more efficient management of ports based on the provisions of the Maritime Domain and Seaports Act. The current system can generally be described as non-uniform, poorly organized and poorly systemized. Numerous drawbacks of the existing system underline this fact. For example, entities managing ports open to public traffic in a county may be towns, municipalities, public-owned enterprises (the utility companies of towns and municipalities) and private-owned enterprises. Understandably, each of these entities has varying interests, and a large part of the lack of uniformity in managing county ports is the result of these varied interests. Furthermore, ferry ports as a rule charge port fees per passenger and per vehicle; the classification of vehicles and the amount of fees varies from port to port. Entities managing ferry ports collect payment from ship owners who add these port fees to the cost of transport which they charge to passengers through ferry tickets. In some cases, entities managing ports open to public traffic (towns, municipalities) have invested funds to improve these ports but have failed to organize the collection of port fees to repay their investments. Instead their investments have been repaid through various indirect effects that the town or municipalities have had through the existence of a well-organized and functional port in their territories.

The revenue collected by Port Authorities includes:

1. Revenue generated from vessels: port fees, anchoring fees, maintenance fees, pilotage fees and fees for the use of berths, mooring fees, agency fees
2. Revenue generated from passengers: passenger fees
3. Concession fees

Fees charged for vessel services account for about two-thirds of the total amount of revenue generated.

Considering the way a port is managed and organized (Port Authorities, concession holders), other types of revenue can also be generated, the most important being:[11]

1. Revenue from leasing port premises for the needs of serving passengers and for administration purposes: duty-free shops, hospitality facilities, information points and public telephones, customs offices, police offices (the Schengen Border), souvenir shops and shops selling international newspapers,

[10] Kesić, B., Jugović, A., **Menadžment pomorskoputničkih luka**, Rijeka, Pomorski fakultet Sveučilišta u Rijeci: Liber 2006, p. 134

[11] Kesić, B., Jugović, A., Menadžment pomorskoputničkih luka, Rijeka, Sveučilište u Rijeci; Pomorski fakultet : Liber 2006, p. 159

rent-a-car agencies, currency exchange offices (banks), travel agencies, forwarding agencies, convenience stores

2. Revenue from leasing port areas for public purposes: museum, aquarium, promenade, conference halls, etc.
   Port areas used in these ways can attract both tourists and residents (potential customers) and can also help town authorities resolve issues that involve ensuring the town's access to the sea. These areas are particularly important for passenger ports that are not located in the town core.
3. Revenue from port passenger tariffs
   In addition to paying port fees which the ship owner pays per passenger, passengers are also obliged to pay port passenger tariffs (ranging from EUR 3.5 to EUR 4.46 per passenger in Croatian passenger ports).[12]

3. PORT SYSTEM OF ISTRIA COUNTY

This chapter looks at the port system of Istria County, how it is managed and how it has performed over the years. In particular, it analyses and explains the port system's revenue patterns and determines the role of its administrative resources in improving the outcome of the business process.

3.1 Establishment and activities of County Port Authorities

According to Article 75, Item 1 of the Maritime Domain and Seaports Act, "*for the purpose of managing, developing and using ports of county and local significance open to public traffic, more than one Port Authority may be established at the request of the Municipal or Town Council, in which case the applicants are the co-founders*". Item 2 of the same article states that the County is the founder of the Port Authority mentioned in Item 1; the decision to found a Port Authority is issued by the County Assembly. Accordingly, in 1997 the Istria County Government[13] issued the decision to establish County Port Authorities within Istria County in Umag-Novigrad, Poreč, Rovinj, Pula and Rabac.

Considering that Port Authorities are separate units, pursuant to the provisions of the Seaports Act and taking into account the relevant provisions of the Institutions Act, Administrative Councils were established and directors were appointed. Port Authorities were founded to manage, develop and operate ports open to public traffic and to carry out other activities specified in the Maritime Domain and Seaports Act, such as:

- taking care of building, maintaining, managing, protecting and improving the maritime domain representing the port area
- building and maintaining the port's shoring, activities which are funded from the budget of the founders of the Port Authority
- conducting expert supervision of the building, maintenance, management and protection of the port area (port shoring and superstructure)
- ensuring continuous and unimpeded port traffic, technical and technological unity, and the safety of navigation
- providing services of general interest or services for which other economic entities have shown no interest
- coordinating and supervising concession holders operating in the port area
- issuing decisions concerning the establishment and management of free zones within the port area in accordance with regulations governing free zones
- other activities established by the Maritime Domain and Seaports Act.

The Port Authorities of Istria County cover ports of county and local significance open to public traffic and ferry docks within public traffic ports. The areas managed by these Port Authorities reach from the Savudrija Port on the north-western part of the Istrian coast to Brestova Port on the eastern coast of the Istrian peninsula. Ports of county significance open to public traffic include the ports of Umag, Novigrad, Antenal, Poreč, Rovinj, Pula, Plomin, Brestova and Brijuni (a part of the

[12] ibidem, p. 159

[13] Pursuant to Article 1, item 1 of the Act on Amendments to the Maritime Domain and Seaports Act (Official Gazette 38/09), the words *County Government* are replaced with the words *County Assembly*.

port). Ports of local significance open to public traffic include 28 ports and boat harbours.
The ports of Umag, Novigrad-Antenal, Poreč, Rovinj, Pula and Rabac are open to international traffic[14]. The International Ship and Port Facilities Security (ISPS) Code is applied in these ports. The ports open to international traffic are located within urban settings. International marine border crossings take up a part of these ports, while the other parts of the ports are open to public maritime traffic and some ports have promenades along the seashore.

3.2 Analysis of management of ports of county significance in Istria County

Pursuant to the Maritime Domain and Seaports Act, a county may establish one or more Port Authorities at the request of the Municipal or Town Council for the purpose of managing, developing and operating ports of county and local significance open to the public. In legal terms, such a provision gives each county the right to decide for itself the number of Port Authorities it will have within its territory. The number of Port Authorities in a given county primarily depends upon the wishes of the local community as well as its financial means. In cases where local communities are co-founders, they are obliged to cover a part of the cost of establishing and operating a Port Authority.
The Istrian coastline, together with its islands and islets, is 539 kilometres long and accounts for 9% of the total length of the Croatian coast. Because of its indentedness, the west coast of Istria together with the islands is 327 kilometres long, longer than the east coast which together with its islands measures 212 kilometres.
According to the Decree on the Classification of Ports Open to Public Traffic, Istria County has seven ports of county significance:[15] Pula, Brijuni, Rovinj, Umag, Poreč, Novigrad and Plomin, as well as 26 ports of local significance. To facilitate the management of these ports and their large port areas, Istria County has established five County Port Authorities: Pula, Umag – Novigrad, Rovinj, Poreč and Rabac.

Table 1. Length of operational quay

PORT AUTHORITY	LENGTH OF OPERATIONAL QUAY (m)
Poreč	1,370.00
Rabac	6,262.40
Rovinj	2,499.31
Pula	17,544.83
Umag - Novigrad	38,600.00
Total	**66,276.54**

Source: Istria County Port Authorities, 2012

Table 1 and Table 2 show that the Umag-Novigrad Port Authority has the longest operational quay in Istria County. However, a financial analysis reveals that it does not generate the most revenue, leading to the conclusion that additional activities need to be undertaken to manage this area more efficiently.
Based on amendments to the spatial development documents of Istria County[16], the Poreč Port Authority plans to extend the port area in Fontana and the Lim Channel (separate port areas). Thus, in the coming years this Port Authority will have the longest operational quay in the entire Istria County.

[14] Uredba o određivanju luka otvorenih za međunarodni promet, Official Gazette 8/06.
[15] http://narodne-novine.nn.hr/clanci/sluzbeni/1997_01_2_33.html, 08.09.2013
http://narodne-novine.nn.hr/clanci/sluzbeni/1997_11_118_1753.html, 08.09.2013
http://narodne-novine.nn.hr/clanci/sluzbeni/1998_02_21_2500.html, 08.09.2013
http://narodne-novine.nn.hr/clanci/sluzbeni/2001_04_36_637.html, 08.09.2013
[16] Prostorni plan Istarske županije, www.istra-istria.hr/index.php?id=2454, 09.09.2013

Table 2. Surface of the port area – land and sea

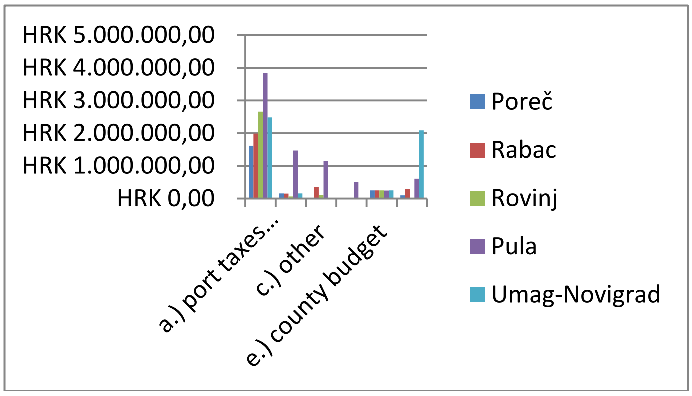
PORT AUTHORITY	SURFACE OF THE PORT AREA (m^2) - LAND	SURFACE OF THE PORT AREA (m^2) - SEA
Poreč	8,220.00	432,180.00
Rabac	31,312.00	197,401.00
Rovinj	14,995.86	129,157.60
Pula	105,269.00	55,817.00
Umag - Novigrad	231,600.00	607,000.00
Total	**391,396.86**	**1,917,555.60**

Source: Istria County Port Authorities, 2012

Charts 1, 2, 3 and 4 demonstrate that Istria County Port Authorities generate the most revenue from their *primary activities* based on port taxes and fees and concession fees. The highest amount of port taxes and fees is collected by the Rabac Port Authority and the Pula Port Authority, while the most *concession*-based revenue (concession fees) is generated by the Pula Port Authority and the Umag-Novigrad Port Authority. Although all ports in Istria County are of county significance, revenue from the State budget for building and remediating infrastructure facilities is an important item in their revenue patterns (Poreč Port Authority and Pula Port Authority).

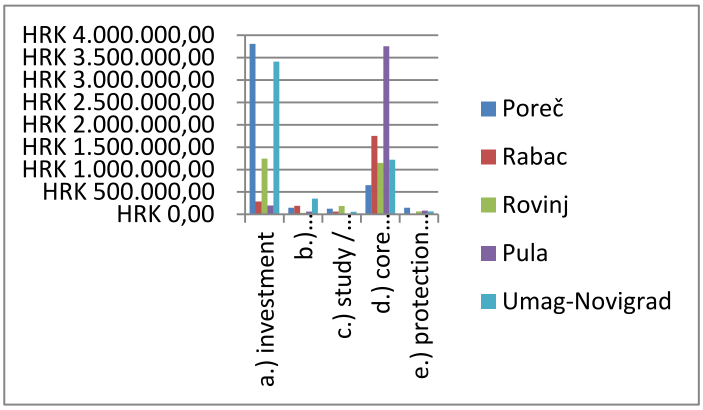
The below charts illustrate the revenue and expenditure of County Port Authorities in Istria County. Because items a, b, c, d and e are not comparable, it was not possible to show total revenue and expenditure in the charts.

Chart 1. Analysis of revenue of Istria County Port Authorities in 2009



Source: Istria County Port Authorities, 2013

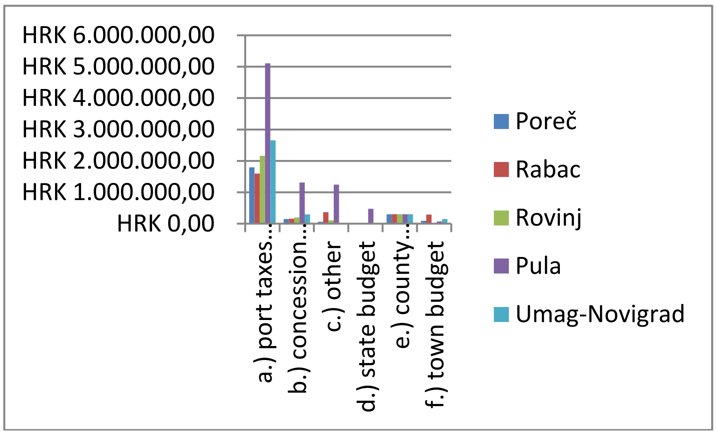
Chart 2. Analysis of expenditure of Istria County Port Authorities in 2009



Source: Istria County Port Authorities, 2013

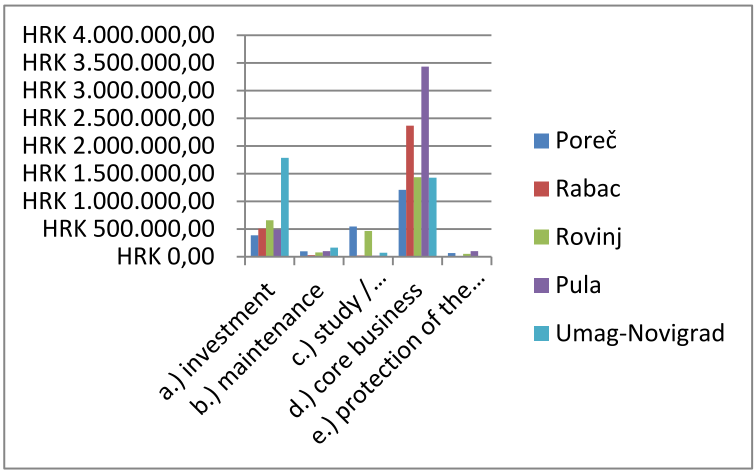
Expenditure patterns show large differences in the item *core business* between the Port Authorities of Poreč, Rabac and Umag-Novigrad, and between the Port Authorities of Rovinj and Pula. These differences become all the more important when it is taken into consideration that all these Port Authorities have the same or approximately the same number of employees. Expenditure relating to *maintenance* and *investment* is, to a certain extent, proportional to the total revenue of individual Port Authorities and on average accounts for about 54% of total expenditure. In this way, Port Authorities execute their primary function which is to develop, manage and operate their respective port areas. However, there is a substantial discrepancy between Port Authorities with regard to their share of *investment* in total expenditure and their share of *maintenance* in total expenditure.

Chart 3. Analysis of revenue of Istria County Port Authorities in 2010



Source: Istria County Port Authorities, 2013

Chart 4. Analysis of expenditure of Istria County Port Authorities in 2010

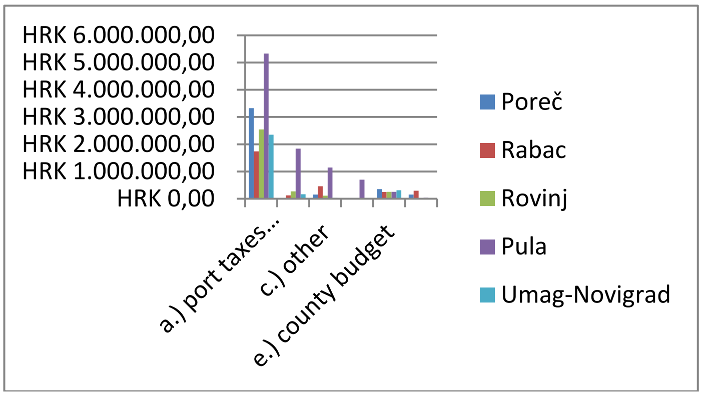


Source: Istria County Port Authorities, 2013

The item *other revenue* is a certain drawback in the revenue pattern, because it does not provide any insight to its structure, indirectly making it difficult to control such revenue.

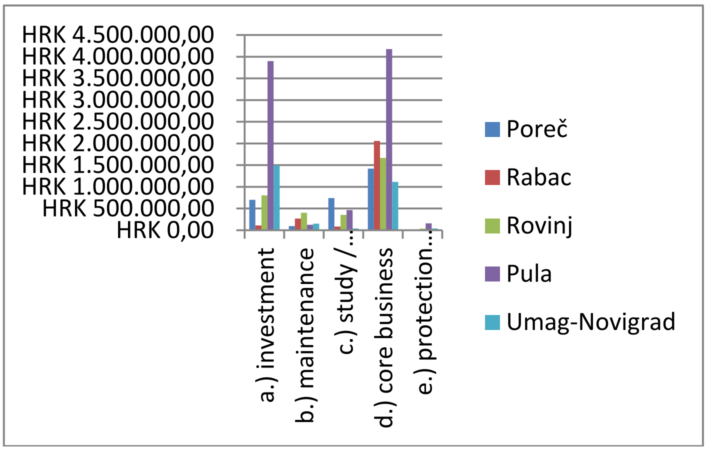
Because of capital investments in infrastructure, the Pula Port Authority (the Rijeka Quay) and the Umag-Novigrad Port Authority (the fishing quay) show very little growth in revenue and expenditure.

Chart 5. Analysis of revenue of Istria County Port Authorities in 2011



Source: Istria County Port Authorities, 2013

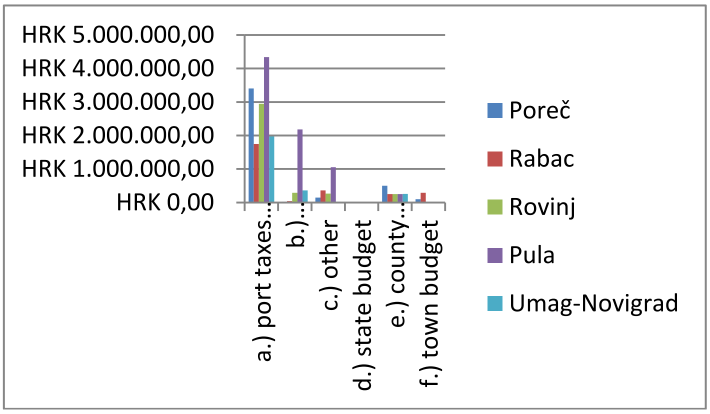
Chart 6. Analysis of expenditure of Istria County Port Authorities in 2011



Source: Istria County Port Authorities, 2013

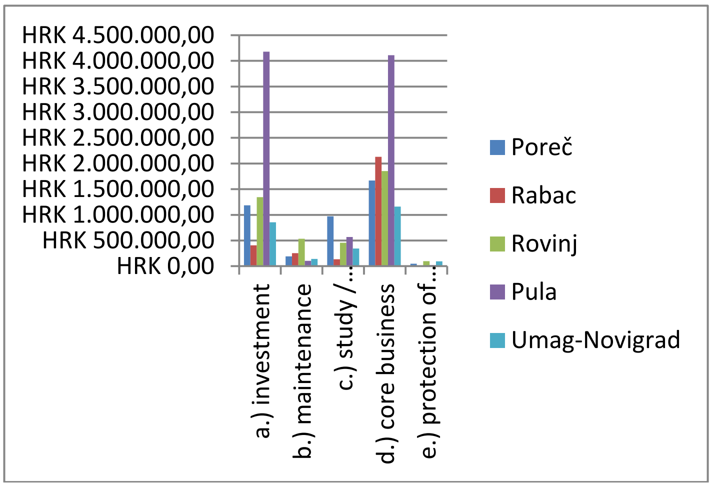
In the revenue pattern, there is a great discrepancy between the Pula Port Authority in the item *State budget* and the Rabac Port Authority in the item *County budget*. This discrepancy is justified by the investment plan of the Pula Port Authority for the remediation of the Rijeka Quay and the investment plan of the Rabac Port Authority for the construction of an additional operational quay.

Chart 7. Analysis of revenue of Istria County Port Authorities in 2012



Source: Istria County Port Authorities, 2013

Chart 8. Analysis of expenditure of Istria County Port Authorities in 2012



Source: Istria County Port Authorities, 2013

Of all Port Authorities, the Pula Port Authority has generated the most revenue from *port taxes and fees* because in addition to pleasure boat and passenger boat traffic it is seeing growing cargo ship traffic in the Port of Pula free zone and cement factory. Besides port taxes and fees, the Pula Port Authority also generates the highest revenue from fees on concessions for use of the maritime domain.

4. RESULTS AND DISCUSSION

The analysis of financial reports points to the fact that certain Port Authorities lack the resources needed for the development, reconstruction and maintenance of port infrastructure and superstructure. These are mostly ports and Port Authorities that generate less revenue from independent operations, that is, from port taxes and fees, which are the most important item in overall port revenue. These ports and Port Authorities have less revenue because they have less traffic compared with other ports and Port Authorities that generate a surplus of funds. Such a situation gives rise to the question of the priority of investments in ports and to the question of a systems approach. This implies channelling funds in a way that will ensure ports generating less revenue will also have a chance to improve their port infrastructure and superstructure, services, etc. The result would be improved services and more traffic, and ultimately more revenue. The analysis of Port Authority management is a separate issue within the context of specific features and organizational forms in every County to which a Port Authority belongs and whose co-founder is the County. This applies to the Port Authorities of Istria County as well. Another issue is the lack of appropriate administrative and intellectual capacities capable of operating in complex working conditions. Port Authorities exist and operate not only to maintain order but also to provide benefits for the broader community as well[17]. Due to the excessive influence of politics, the management and decision-making of Port Authorities is less effective, while a lack of intellectual capital has resulted in a failure to draw more heavily from EU funds. Although the efficiency of Port Authorities is good, many unresolved issues exist with regard to infrastructure needs and possibilities. Administrative and institutional obstacles are one

[17] Kovačić, M., Favro, S., Dundović, Č.: Valorising the Port Areas of Croatian Ports Open to Traffic of County and Local Standing for Nautical Tourism Activities, Technics Technologies Education Management Journal, Vol. 8. No. 3. 8/9. 2013. pp. 1189-1198

of the reasons for lower efficiency. It is reasonable to conclude that changes are needed and that in the application of knowledge special importance should be attached to the capabilities of human resources. Port Authority Directors are expected to:

- cast off the conventional mind-set to ensure the Port Authority becomes an organization based on intellectual capital[18], thus encouraging development
- Strive to efficiently manage marine and coastal resources, as a special objective.

5. CONCLUSIONS

The financial revenue of a County Port Authority is a measure of its performance and its role and importance in the port, traffic and economic system within a national framework as well as in terms of the broader, competitive traffic market. Especially important are the elements of a County Port Authority's structure in terms of technology, organization and economics, the level of its development, its traffic links, and how well these elements are matched to the environment. These elements directly and indirectly influence the financial effects each County Port Authority generates to improve and develop its port infrastructure.

An analysis of the business operations of the Port Authorities of Istria County points to their varying levels of revenue and expenditure. In their revenue structures, the Port Authorities differ according to revenue from c

Budgets and according to revenue from port taxes and fees. It is also obvious that revenue from concessions for the use of facilities as well as revenue from port activities is exceptionally low suggesting that the concession system has not yet become fully operational.

The knowledge and experience of the managements and intellectual resources of the County Port Authorities of Istria County enable them to achieve positive results. While the coordination among Port Authorities is assessed as being acceptable, there is nevertheless room for improvements in this area which could make it possible for more challenging projects to be undertaken.

[18] Kovačić, M., Gržetić, Z., Seršić, V.: Role and Importance of Public Administration Management with the Purpose of Integral Management of Maritime Estate. // 27th International Conference on Organizational Science Development. "Knowledge for Sustainable Development" 27 (2008); Portorož, 1197–1202.

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16. Griffin R. W., Management, Houghton Mifflin Company, 1987. Boston, u: P. Filipić, P., Šimunović, I., O ekonomiji obalnih područja, planiranje i upravljanje, Sveučilište u Splitu, Ekonomski fakultet Split, 1993, p. 92.

17. Kovačić, M, Gržetić, Z. Seršić, V., Role and Importance of Public Administration Management with the Purpose of Integral Management of Maritime Estate. // 27th International Conference on Organizational Science Development. "Knowledge for Sustainable Development" 27 (2008); Portorož, 1197–1202.

18. Kovačić, M., Favro, S., Dundović, Č., Valorising the Port Areas of Croatian Ports Open to Traffic of County and Local Standing for Nautical Tourism Activities, Technics Technologies Education Management Journal, Vol. 8. No.3. 8/9. 2013. pp. 1189-1198.

SUSTAINABLE MARITIME TRANSPORT

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ABSTRACT

Due to high fuel prices on the world market and regulations for emission reduction, nowadays many shipping companies are forced to experiment with different types of ship propulsion in order to minimize fuel consumption and meet the criteria for CO2 release into the atmosphere, and thereby to reduce the transportation costs. This paper will give an insight into the range of alternative energy sources and various possible alternative solutions for ship propulsion. According to IMO it can be noticed that cutting down emissions in shipping industry is developing in two directions; usage of hybrid systems for better performance where the main power source is still fossil fuel; and systems without fossil fuel. Ship owners united under International Chamber of Shipping stated that shipping industry is determined to cut down emissions from ships by 20% until 2020 with significant reductions thereafter. Interest in biodiesel is more enhanced nowadays primarily because of uncertainty in oil prices but advantages in environmental benefits cannot be ignored. Emission restrictions are coming in force internationally or regionally in Emission Control Areas.

KEY WORDS

Emission Control Area, Sustainable development, Biodiesel, Renewable energy

1. INTRODUCTION

It is generally accepted that more than 90 percent of global trade is carried by sea and for the most of these goods there is little or no alternative to transport by ship. It is estimated that 2.7 % of the global CO_2 emissions come from international shipping. Although it looks modest as contributor to an overall pollution, International Maritime Organisation is implementing guidelines to improve energy efficiency and better emission control. IMO measures include the reduction of greenhouse gas emissions from ships through the concept of evaluation (Energy Efficiency Design Index - EEDI), monitoring and improving ship performance, due to various factors that can contribute to CO_2 emissions (Ship Energy Efficiency Management Plan - SEEMP). As already acknowledged by the Kyoto Protocol, CO_2 emissions from international shipping cannot be attributed to any particular national economy due to its global activities and complex operation. Therefore, IMO has been energetically pursuing the limitation and reduction of greenhouse gas (GHG) emissions from international shipping, in recognition of the magnitude of the climate change challenge and the intense focus on this topic.

In July 2011, IMO's Marine Environment Protection Committee (MEPC), at its 62nd session, adopted a new chapter to MARPOL Annex VI that includes a package of mandatory technical and operational measures to reduce GHG emissions from international shipping, with the aim of improving the energy efficiency for new ships through improved design and propulsion technologies and for all ships, both new and existing, primarily through improved operational practices. The measures are on force since 1st of January 2013. In the upcoming years, the industry believes that they will also provide a significant decrease in discharge of greenhouse gases into the atmosphere.

2. WORLD MARITIME TRANSPORT AND REDUCTION OF HARMFUL EMISSIONS

The world seaborne trade is increasing each year with more number of ships (Table 1), with that in mind the releasing of CO_2 is also increasing. Taking into account that the sea transport is cheapest transportation alternative solutions in ships propulsion found their way in this sort of traffic. In July 2011 the International Maritime Organization (IMO) adopted a new package of measures to reduce CO_2 emissions in Annex VI of the International Convention for the Prevention of Pollution from Ships (International Convention for the Prevention of Pollution From Ships - MARPOL), which includes package of mandatory technical and operational measures to reduce greenhouse gas emissions in the international shipping industry, to improve the energy efficiency of ships, through improved design and propulsion technology, as well as through improved operational practices. These measures are expected to come into force on 1 January 2013 and the amendments include:

- Energy Efficiency Design Index
- Ship Energy Efficiency Management Plan

Emission restrictions coming in force internationally or regionally in ECA´s (ECA Emission Control Areas). The coming international rules for sulphur (SOx) content in fuel oil as decided by IMO will be as shown in Figure 1. Lately EPA (US Emission Pollution Agency) has put forward a proposal that will extend the ECA area to 200 nautical miles from the coast of Canada and USA. It contains demands concerning use of fuels with less than 0.1% sulphur from 2015 and 80% NOx reduction from 2016. Instead of using low sulphur HFO this proposal calls for exhaust gas cleaning devices ("scrubbers") which can remove the SOx from the exhaust gas. This method can be beneficial as the demand of low sulphur HFO most probably will exceed the total production worldwide in the future.

An EU directive limits the sulphur content of fuels to 0.10% or less in EU ports from January 2010. The rules coming in force concerning NOx emissions presented on the Figure 2 is internationally controlled by IMO and to some extent by local national governments stating separate demands for NOx within ECA areas.

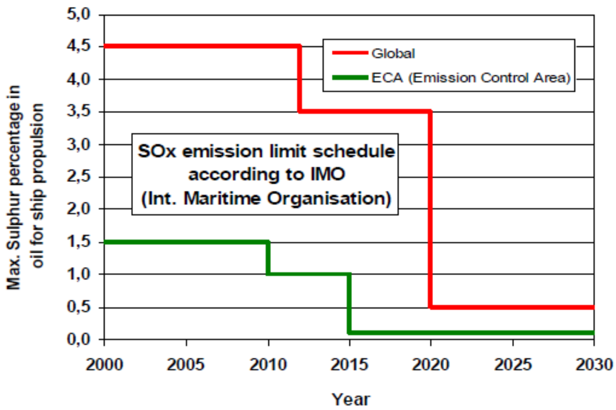


Figure 1. Future IMO requirements for maximum allowable sulphur content in fuel oil

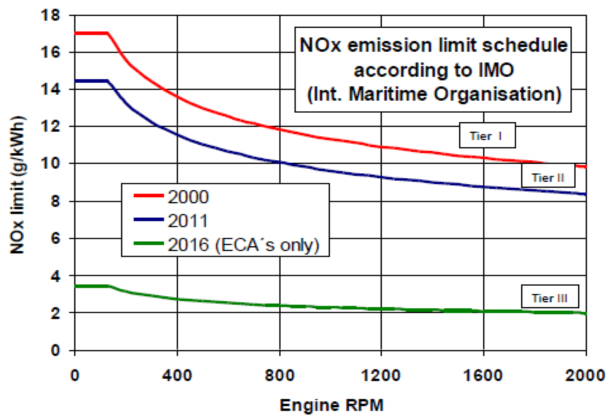
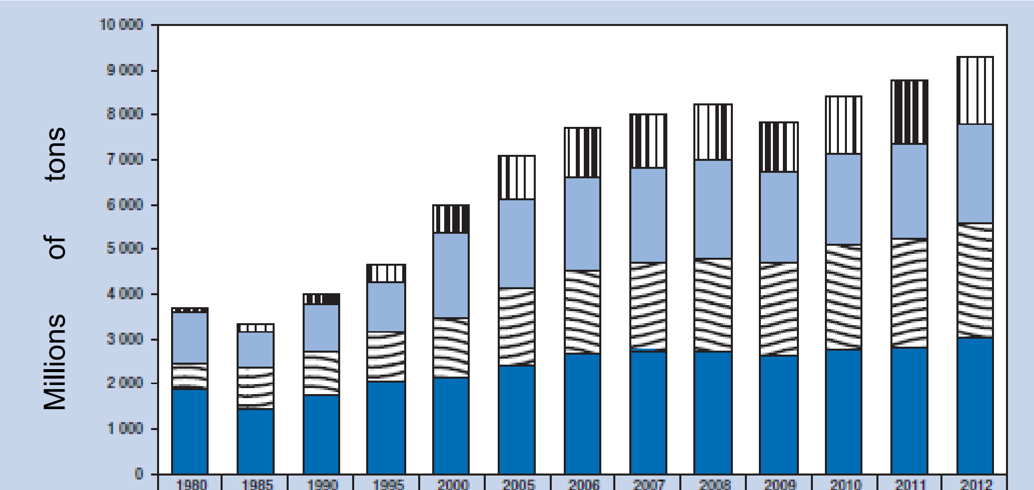


Figure 2. Future IMO requirements for maximum allowable NOx emissions for diesel engines.

Concerning CO_2 it is expected, that rules will come in force in the near future for ships both as internationally and regionally.

Table 1. Overview of seaborne trade



	1980	1985	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Container	102	152	234	371	598	969	1 076	1 193	1 249	1 127	1 275	1 385	1 498
Other dry cargo	1 123	819	1 031	1 125	1 928	2 009	2 112	2 141	2 173	2 004	2 027	2 090	2 219
Five major bulks	608	900	988	1 105	1 295	1 709	1 814	1 953	2 065	2 085	2 335	2 477	2 547
Oil and gas	1 871	1 459	1 755	2 050	2 163	2 422	2 698	2 747	2 742	2 642	2 772	2 796	3 033

Source: UNCTAD

As stated by the MEPC it is time for action. A recent study has shown, that international ship trade in 2007 contributed about 2.7% of the world´s CO_2 emission and also state that emission reductions are feasible through technical and operational measures including introduction of market-based reduction mechanisms (MEPC 59th session, July 2009). Different studies have stated CO_2 reduction of 10 to 30% over the coming years under different assumptions. What is sure is that the CO_2 will be reduced either by market based instruments or by introduction of technical requirements for new ships as stipulated by the introduction of the EEDI or by a combination of these two measures.

2.1. Energy Efficiency Design Index

Energy efficiency design index for new ships would be similar to concept evaluation which applies to cars and electrical appliances. With these measures, IMO Energy Efficiency Design Index will result in approximately from 25 % to 30% emission reduction by 2030 in relation to the present measures. So EEDI has only one goal, to reduce greenhouse gas emission from ships. In the last few years a discussion on environmental protection in the IMO, has resulted in the development of energy efficiency design EEDI, which has wide support of governments, industry associations and organizations that represent the interests of civil society. They are all united in the same mission: to ensure that EEDI delivers environmental effectiveness through improved energy efficiency and through significant reduction in greenhouse gas emissions from ships. The measures contained in the EEDI also promote technological development of all parts of the ship which affect the consumption of fuel on board. It should be noted that the EEDI formula is not suitable for all types of ships, especially those ships who are not designed to carry cargo and for all types of propulsion systems (for example, the one that comes with a diesel-electric, turbine or hybrid propulsion systems will require an additional correction factor). The first version of the EEDI is designed for the most energetic and most intense segment of the commercial fleet as follows: tankers, bulk carriers, general cargo ships and container ships. For ship types that are not included in the current formula, suitable formulas will be developed in the near future to solve the world's biggest polluters. EEDI formula gives a certain state for an individual ship design, expressed in grams of CO2 per capacity of the ship - miles (smaller EEDI value means more energy-efficient design of the ship) and is calculated by the following formula based on the technical parameters of the ship:

$$EEDI = \frac{CO_2}{transport\ work} \quad (1)$$

The CO_2 emission represents the total CO_2 emissions from fossil fuel combustion, including propulsion and auxiliary engines and boilers, taking into account the carbon content in fuels. If mechanical or electrical energy-efficient technologies are built into the ship, their effect is subtracted from the total CO_2 emission.

Energy collected by using wind or solar power is also deducted from the total CO_2 emission, which is based on the actual system performance.

Measures which came into force on 1 January 2013, the introduction of the EEDI for all new ship means that between 45 and 50 million tons of CO_2 per year will be removed from the atmosphere by 2020. This assumption is based on the current situation ˝business as usual˝, without the growth of the world trade. It is also expected that by 2030 the reduction will be between 180 and 240 million tons a year, since the introduction of EEDI. It can be said that EEDI establishes minimum energy performance requirements for new ships, depending on the type and size of the boat. EEDI also leaves the choice of technologies and solutions to use in the design of the ship, but only under the condition that the required level of energy efficiency is achieved. Reducing the level of the first stage is set to 10% and will be tightened every five years to keep pace with the technological development. The IMO has set reduction of CO_2 for 2025 up to 30% as presented in Figure 3.

Maritime shipping complicates the efforts for reducing emissions in maritime sector.

Ownership of the international maritime fleet is particularly complex.

Ship Type	Size	Phase 0 1 Jan 2013 - 31 Dec 2014	Phase 1 1 Jan 2015 - 31 Dec 2019	Phase 2 1 Jan 2020 - 31 Dec 2024	Phase 3 1 Jan 2025 - and onwards
Bulk carrier	20 000 DWT and above	0	10	20	30
	10 000 - 20 000 DWT	n/a	0-10*	0-20*	0-30*
Gas carrier	10 000 DWT and above	0	10	20	30
	2 000 - 10 000 DWT	n/a	0-10*	0-20*	0-30*
Tanker	20 000 DWT and above	0	10	20	30
	4 000 - 20 000 DWT	n/a	0-10*	0-20*	0-30*
Container ship	15 000 DWT and above	0	10	20	30
	10 000 - 15 000 DWT	n/a	0-10*	0-20*	0-30*
General Cargo	15 000 DWT and above	0	10	20	30
ships	3 000 - 15 000 DWT	n/a	0-10*	0-15*	0-30*
Refrigerated	5 000 DWT and above	0	10	20	30
cargo carrier	3 000 - 5 000 DWT	n/a	0-10*	0-15*	0-30*
Combination	20 000 DWT and above	0	10	20	30
carrier	4 000 - 20 000 DWT	n/a	0-10*	0-20*	0-30*

Figure 3. Reduction factors (%) for the EEDI relative to the EEDI reference line

For example, a ship owned by the company in Spain can be registered under the Panamanian flag and carrying cargo from Australia to China.
These political realities greatly complicate the task responsibilities of greenhouse gases in the international shipping and they must be taken into account when developing policies regarding solutions for discharge of greenhouse gases from international shipping. Figure 4 shows comparison of International Trade (Percent of Global Value of Merchandise Trade), Vessel Flag (Percent of Global Deadweight Tons, DWTs), and Vessel Owner (Percent of Global DWTs) by Country. Significantly reduced emissions in the maritime sector will require that any adopted significant measures apply on a global basis, to avoid a significant release of CO_2 into the atmosphere. Since, according to the current situation, many shipping companies have the free will to choose the ship flag of the country that has not signed and ratified the Kyoto Protocol Annex I. According to the data from 2009 only 35% of the world merchant fleet is registered in the countries that have signed the Kyoto Annex I.

For this reason, one should find a meaningful reduction of CO_2 in maritime transport, and this could be achieved through the MARPOL with included package of mandatory technical and operational measures for reducing
greenhouse gas emission in the international shipping industry, with a goal
to improve the energy efficiency of ships.
If the world merchant fleet continues to operate under ˝business as usual˝ (BAU), the emission from the global shipping fleet is expected to double by 2050. Greenhouse gases in the atmosphere can be limited through changes in operating practices and improving the fuel efficiency of ships. When combined together, these changes can reduce the proportion of emissions by 50% below "business-as-usual" by 2050, which would mean that the amount of emission remain at approximately current levels, despite a very large increase in the shipping fleet by the mid-century. International shipping complicates global political efforts to reduce emissions.

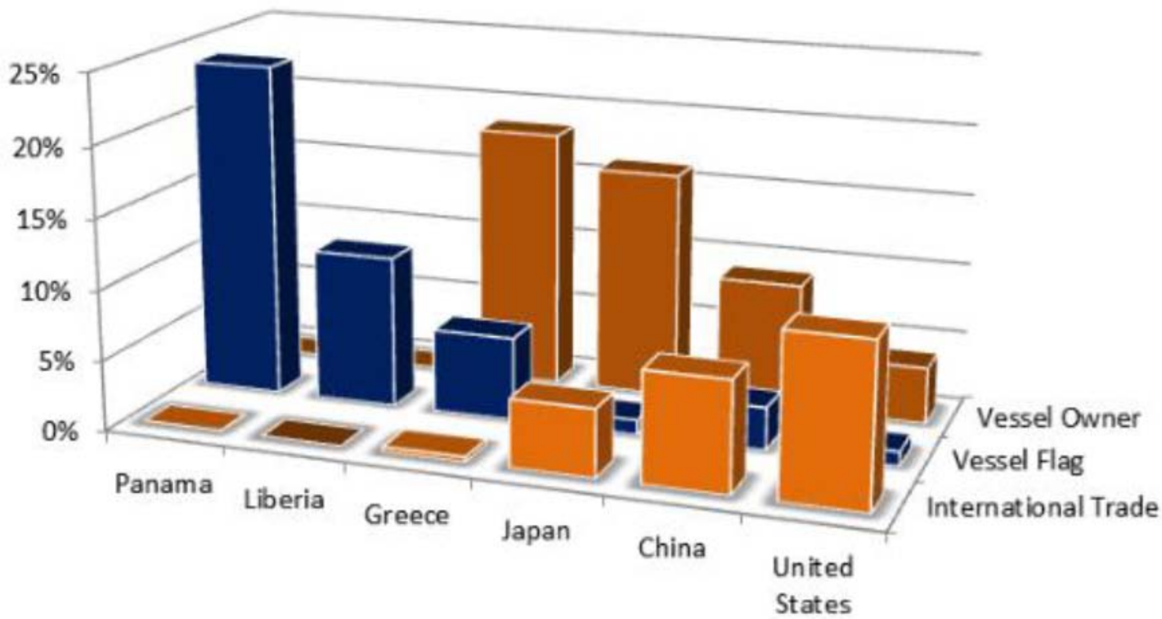


Figure 4. Comparison of International Trade (Percent of Global Value of Merchandise Trade), Vessel Flag (Percent of Global Deadweight Tons, DWTs), and Vessel Owner (Percent of Global DWTs) by Country

Working with transnational actors will be an important step towards creating meaningful global regulations. International and domestic shipping plays an important key role in a globalized world, moving goods within and between countries. Global demand for the transport of goods between the markets of international trade has increased. From 2000 to 2007 the volume (in tons) of world merchandise exports increased by an average 5.5% per year (almost twice the rate of world GDP), with the fact that more than 80% of trade is transported by ship (WTO, 2008; UNCTAD, 2008).

3. FUTURE OF SHIP'S PROPULSION

In the long term perspective, depending on technological development, the industry believes it will succeed and provide a greater reduction in discharge of greenhouse gases in the atmosphere. In the near future it is expected that the shipping will still depend on fossil fuels. Although today the shipping industry is energy-efficient, further improvements in the technology of the hull, engine, propeller design, will allow for less fuel consumption with that lower emissions. There is also the possibility of using waste heat to reduce consumption. Better operational measures (better speed control through the voyage) will also contribute to reducing fuel consumption and it will be in accordance with the SEEMP. The shipping companies also have a good reason to reduce fuel consumption, which contributes to CO_2 reduction. The reason for that is the cost of bunkering, which represents a significant part of operating costs, and which is an increase of about 300% in the last 5 years. It is expected that marine bunker prices will remain high. In addition, it is expected that the price of marine fuel will increase by 50%, as a result of increased use of distillate fuel, which will monitor the implementation of the new IMO regulations (MARPOL Annex VI) to be applied on a global level in areas that control the emission by 2015 (UNCTAD, 2009). In different parts of the shipping industry – ship-owners, shipbuilders and classification societies are conducting researches in order to reduce CO_2 emissions for new and existing ships, which were primarily related on the reduction in fuel consumption. Shipping industry is also investigating in a number of alternative fuel sources to reduce CO_2 emissions. Overview of the possibilities for reducing GHG given by the leading companies included in a marine industry is presented by the Table 2.

Table 2. Overview of the possibilities for reducing harmful emissions

Measure/Method	CO_2	NOX	SOX
Scrubber sys	-3%		-98%
LNG Powering	-25%	-35%	-100%
Water in fuel	+2%	-35%	+2%

Source: Green ship of the future concept study

The figure does not show the effect, when the measures and methods are combined in a ship. The effect of combinations depend on ship type, size, and finally but not least of the actual combination of technologies used in an actual project.

3.1. Eco friendly fossil-fuel systems

Industries market leaders suggest green solutions:

- M.E. Exhaust gas scrubber
- MGO fuel (Marine Gas Oil)
- Combined LNG/HFO
- Water in fuel

3.1.1 M.E. Exhaust gas scrubbers

The exhaust gas scrubber system removes sulphur oxides and particulates from exhaust gas. The scrubber system is a hybrid system being capable of operation both on fresh water as well as sea water. The shift between these operation modes can be made as flying changeover while the scrubber is in operation controlled by GPS signal informing about the position of the vessel. Normal operation of the scrubber system is done by means of a control panel placed in the engine control room. The scrubber can be operated in automatic mode or semi-automatic mode. When operating in auto mode, the 'engines running' signal starts the scrubber, and the signals from the ship's Global Positioning System (GPS) determine whether the scrubber operates in seawater mode or freshwater mode in a predefined manner. Normally the engines fuel flow index determines the amount of sea water used in the scrubber and/or the caustic soda dosing to the system if in fresh water mode. The performance of the scrubber is measured continuously, and the adjustment of the different operational parameters is controlled accordingly [9].

3.1.2 Shift to low sulphur fuel

In case of operation in ECA, the vessel will shift to low sulphur fuel in order to comply with the prevailing emission requirements. Low sulphur fuel referred to in this study comprises fuel with not more than 0.1% sulphur in the case of ECA operation as of 2015. In addition, it comprises fuel that will satisfy the global sulphur cap of 0.5% as of 2020 (or 2025). For simplicity reasons, all of these low sulphur fuels are referred to as 'MGO' (marine grade oil, i.e. distillates). The expectation is that the price difference between 0.1% and 0.5% sulphur fuel will be limited.

3.1.3 LNG and Diesel

Operating LNG tankers on LNG is not new. There are many years of experience in operating LNG tankers on the "Boil off gas" using steam turbines and Dual Fuel Diesel Electric (DFDE) engines. The most crucial aspect for the future success of LNG as a fuel is the implementation of, and adherence to, adequate safety standards. Both the technical and emotional aspects of safety must be fully addressed, to ensure all persons involved in LNG handling are equipped with the correct information and can respond in the correct manner. For technical safety aspects, unified standards and specifications can go some way in ensuring safe LNG operation. Harmonisation of standards both for LNG bunkering (ISO 28460), and for LNG as a fuel (IGF code), will ensure consistent safety standards for vessels operating with LNG [9]. On the emotional side, training of the crew in LNG handling and operation of LNG specific equipment is required, for example ME-GI training courses will be available, and equipment vendors will offer the same. Onshore staff will also require similar training, and in the case of LNG bunkering, the responsibilities of personnel must be clarified to ensure a safe process. A further issue is the public perception of LNG which is harder to address directly but nonetheless important to maintain that LNG is a safe alternative fuel.

Availability of LNG is also an important issue to consider when investigating such a conversion, and many projects are underway to develop LNG bunkering terminals at ports.

3.1.4 Water in Fuel - WIF

Water in fuel decreases the NOx because the highest temperature is lowered due to the high heat capacity of vapour compared to ambient and the heat absorption by water vaporization. It has also been observed, that the formation of PM is lowered when WIF is used, which can be explained by the phenomenon of micro-explosions or secondary atomization of emulsified fuel. This occurs, because the boiling point of water is lower than that of the surrounding fuel oil. The overall effect of the improved mixing of fuel with the combustion air is a decrease of the final CO, THC and PM concentrations [9]. The improved mixing is also due to an increased momentum of the vaporized fuel jet (the mass is increased due to addition of water), which also improves the mixing. The presence of water in the fuels leads to a potential ignition delay, which means that more time for premixing of fuel and air is available. The last effect of WIF is an increased amount of hydroxyl radicals due to the higher water concentration.

3.2 Price analysis for given examples

Scrubber vs. LNG vs. MGO for the ships already in use:

Table 3. Scrubber fitting on existing ship

Scrubber machinery and equipment	2,600,000 USD
Steel (150t) / pipe / electrical installation and modification	2,400,000 USD
Design and classification cost	500,000 USD
Off-Hire (20 days @ rate 17.000 USD/day)	340,000 USD
TOTAL	5,840,000 USD

Source: Potential of bio fuels for shipping

Table 4. Dual lng/fossil fuel engine fitting existing ship

LNG machinery and equipment, main engine conversion	4,300,000 USD
Steel (300t) / pipe / electrical installation and modification	2,000,000 USD
Design and classification cost	500,000 USD
Off-hire cost 40 days@17,000 USD/day	680,000 USD
TOTAL	7,560,000 USD

Source: Potential of bio fuels for shipping Current MGO prices are about 900USD/MT.

Complete cost analyses depend on how much time ship spends in the ECA, whether if the ship is new build. It is possible to apply dual fuel and scrubber system on existing ships to reduce GHG.
Scrubber system can be used both on main and auxiliary engine and if it is used parallel with MGO results can be most encouraging, although one must be careful about MGO/LNG fuel spread per MT.
Dual fuel system is in start more expensive for about 1,720,000 USD and is also dependable on MGO/LNG fuel spread per MT. Dual fuel system is more attractive if it is applied on newly build ship because of too many off hire days later on. As for now for the ship-owners it is cheaper to go only with MGO until 2020 when sulphur cap is expected.

3.3 Hybridization options in marine applications

There are many combinations of hybridization options. An effective power plant hybridization option is wind turbines and solar panels like on Figure 5. This is an easy plug and play option to the DC Power Grid concept. Solar panels are virtually maintenance and are ideal for charging storage batteries presented in Figure 6. There are designed to convert sunlight into electricity. The current and power output of a solar panel or photovoltaic module is approximately proportional to sunlight intensity. At a given intensity, a module's output current and operating voltage is determined by the characteristics of the load. If that load is a battery, the battery's internal resistance will dictate the module's operating voltage. Wind turbines and solar panels can be mounted in various configurations on-board a wide variety of vessels to harness wind and solar energy which is very abundant out at sea. The type of vessel will determine the best configuration for optimizing the available energy.
Another hybridization option is the use of super capacitors. Super capacitors can provide stability and efficiency to the DC grid. A super capacitor can provide a few seconds to a minute of reactive power in cost effective package. A 20 foot container can provide 1MW of power for 1 minute. Super capacitors have a longer life than lithium battery banks and are ideal for shipboard application because of their superior high power charge/discharge cycling with lifetimes over a million charge/discharge cycles at 100% depth of charge.
Fuel Cell technology could also be integrated as part of a hybrid solution for example, propulsion systems in conjunction with combustion engines. This technology using natural gas as fuel offers ultra-low emissions and high thermodynamic efficiency which makes for an excellent application for coastwise shipping, inland waterway and offshore applications and operations inside the North American Emission Control Areas. The high operating temperature of Solid Oxide Fuel

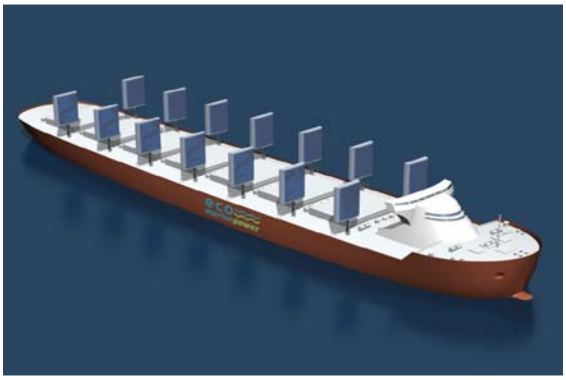


Figure 5. Aquarius eco ship

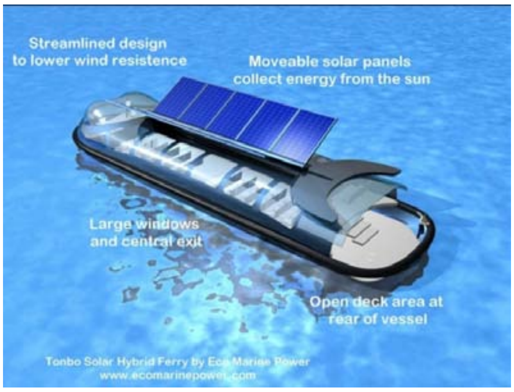


Figure 6. Solar Ferry Concept

efficiency which makes for an excellent application for coastwise shipping, inland waterway and offshore applications and operations inside the North American Emission Control Areas. The high operating temperature of Solid Oxide Fuel Cell or SOFC technology enables co-generation where the high value exhaust heat can be utilized in marine applications to produce electricity, steam and cooling—even freezing, depending on the vessel type. Recovery of the waste heat which is a by-product of the chemical reaction can raise the efficiency to as high as 90%. Additional by-products' of the chemical reaction include water, electricity and small amounts of NO_2 depending on the fuel source. Fuel Cell benefits include high efficiency (40-60%), ultra-low emissions, low noise, no vibrations, co-generation, fuel flexibility, high part load efficiency, high reliability and availability. Marine Fuel Cell Units can be installed on many types of vessels including offshore, short sea feeder, ferries and others. These highly efficient units can be operated with LNG or methanol and in the future with diesel oil. The power range and quality is sufficient for application as auxiliary power units for hotel load, power for harbour mode, hybrid solution for propulsion together with ship's main engines and main power source offshore vessels using dynamic positioning. Smaller vessels such as ferries and tugs could also benefit from fuel cell technology as the main power supply. Typically fuel cells don't respond well to transient loads, which could be a problem when being applied to propulsion. However hybridization of a prime mover can improve transient response. High exhaust temperatures of the units make for an opportunity to add waste heat recovery systems for improved efficiency.

Power plant hybridization is also possible using lithium polymer ion batteries. These batteries have been used for commercial and military marine applications. A typical battery bank will include a battery management system with connecting cables and communication harnesses to the vessel systems. The battery modules can be combined to produce megawatts of power that can replace a prime mover. These battery banks can act as the sole energy source for low load situations, handle peak loads without starting standby generators and act as an energy buffer. This energy buffer will optimize fuel consumption, emissions, lifecycle cost and transient response to power demands. This is especially important for gas engines which have slower transient response than their diesel counterparts. Auxiliary drives can easily be integrated in the DC grid system using inverter units for auxiliary motors lowering system size and power consumption. The batteries themselves are 100% biodegradable.

3.4 Systems without fossil fuels

3.4.1 Fuel cells

A fuel cell utilizes basic electrolytic properties of oxygen and hydrogen molecules to produce electricity. The transfer of electrons between the molecules can be used to supply direct current power. The supplied electrical power will be continuous as long as both oxygen and hydrogen flows are maintained and constant. The only waste by-product produced by this ideal system is pure water. Unlike batteries that also use this fundamental principle, this cell will not degenerate over time. This hypothetically provides a permanent electrical power supply needing minimal support, and requiring only the provision of a fuel and oxygen supply. Fuel cell power systems have attracted attention because of their potential for high efficiency, low emissions, flexible use of fuels and quietness. Application of fuel cell technology to the transportation field in general and marine transportation field in particular is still in the early exploratory stage. A unique problem related to transportation applications is the need for quick start up and rapid large power variations during operations. [1].

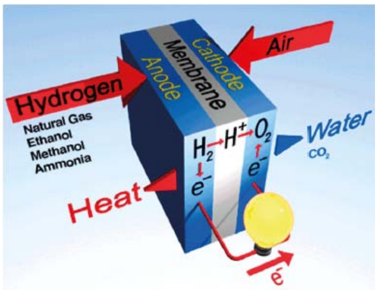


Figure 7. Fuel cell principle

A fuel cell power pack consists of a fuel and gas processing system, and a stack of fuel cells that convert the chemical energy of the fuel to electric power through electrochemical reactions. The process can be described similar to that of a battery, with electrochemical reactions occurring at the interface between the anode or cathode and the electrolyte membrane, but with continuous fuel and air supplies, see Figure 7. Different fuel cell types are available, and can be characterized by the materials used in the membrane.

3.4.2 Bio fuel

Bio fuels are currently globally available; they can be produced from many abundant types of biomass, and they can be optimized to match the existing distribution channels and applications of fuels in all forms of transport. [2]. Most commonly used and produced bio fuels are biodiesel (from oil containing agricultural crops) and bio-ethanol (from sugar or starch containing agricultural crops). Bio fuels are one of the options to minimize the effect of ship emissions on local air quality. Therefore IMO evaluating if and how bio fuels could be used in the shipping sector as an alternative fuel. To determine the potential of bio fuels for ships, a clearer picture is needed on technical and organizational limitations of bio fuels in ships, both on board of the ship as in the fuel supply chain to the ship. Economic and sustainability analysis of bio fuels should be included in this picture, as well as an overview on current and potential policy measures to stimulate the use of bio fuels in shipping.

Interviews with shipping and bunker fuel industry revealed that biodiesel could probably be mixed without adaptations up to about 7-10% in the current supply chain. Application of low blends of biodiesel in distillate marine fuels could be introduced relatively easily. Bunker fuel suppliers can decide to include a small fraction of biodiesel, if accepted by the client.
The application of biodiesel as marine fuel two technical bottlenecks that are potentially problematic are often found in this applied tests [2]:

- Biodiesel acts as a solvent and has a tendency to soften and degrade certain rubber and elastomeric compounds which often are used in older engines. Therefore at higher blends, rubber hoses and seals and other materials used in delivering and transporting the fuel through the ship may need to be replaced with synthetic, biodiesel resistant material.
- Biodiesel potentially removes deposits in the fuel system left by petroleum diesel, which could then clog filters. Filters should thus be checked and cleaned regularly. Alternatively, the fuel tanks should be cleaned prior to using biodiesel filling.

Also there are some technical challenges around biodiesel:

- A tendency to oxidation and long-term storage issues;
- Affinity to water and risk of microbial growth;
- Degraded low-temperature flow properties;
- BIO material deposition on exposed surfaces, including filter elements.

For the last 20 years DME (di-methyl ether) has been a known substitute for diesel. It has been tested on small engines but this is no guarantee for its suitability for use in larger engines. [6]. Based on interviews with parties in the shipping sector the following items are of importance concerning DME as a possible alternative shipping fuel. [4]
Fuels like DME, LNG and methanol that have a low flashpoint require a lot of attention in order to manage and prove their safe use and are therefore probably more suited for new build ships and engines. Infrastructure is missing to introduce DME in ships. Industry proposes to produce DME on-board from methanol, by means of a relatively

simple chemical installation. Furthermore, the on-board chemical installation, however simple, will require operation by dedicated and skilled personnel. In view of decreasing manpower on-board of ships, this option may not be realistic.

Vegetable oil (SVO) is suitable for replacing residual fuels 51. It is unknown if the vegetable oil has been tested for marine application, but there is some experience with land-based power stations that replaced HFO with vegetable oil, e.g. with engines from Man B&W and Wärtsilä.
Man B&W state that diesel engines designed for heavy fuel oil can be run on vegetable oil without problems, whereas engines designed for marine diesel or gas oil may have problems though due to higher density and viscosity of the vegetable oil. [3]. Wärtsilä has approved its engines to run on vegetable oils (within certain specifications). Rather, vegetable oil would be applied as a pure replacement (100% blend) of HFO. In that case, the bio fuel temperature has to be closely monitored to keep the correct viscosity levels. This ensures circulatory ability, optimal engine injection and efficient atomisation and combustion. For soybean and rapeseed oil, the viscosity is fine; palm oil needs to be heated before application to ensure a lower viscosity. An advantage of the application of vegetable oil is that less energy is needed for the preheating of fuels. This would result in a net fuel saving (on energy basis). As discussed above, the application of vegetable oil does imply some adaptations in the ship's fuel system and operation. Therefore, vegetable oil can, at first, only be applied to dedicated fleets with well-informed personnel and small operational changes.

Bio-methane or bio-LNG could be an alternative to LNG (liquefied natural gas) which gains increasing interest in the shipping sector. It could connect to existing and upcoming LNG terminals in Europe. Bio-methane would be applied in exactly the same way as bio-LNG and therefore not lead to any additional challenges. In principle bio-methane could also be applied as CNG (compressed natural gas). This would have the following disadvantages:

- High pressure of 200-250 bar in gaseous form;
- Bulky storage (3 times LNG);
- Very expensive storage (strong, heavy vessel);
- High pressure fuelling difficult and slow;
- And requires a bunker station with at least 10 times storage to avoid large pressure.

Bio-ethanol is produced all around the world in very large volumes, larger than biodiesel. In some locations, bio-ethanol is cheaper than gasoline (without incentives). In South America and South Asia it is produced from sugar cane, in the USA from maize and in Europe from wheat, maize and sugar beet [10]. The final product quality is rather independent from the feedstock. Bio-ethanol is not a logic option for diesel engines. It is a poor diesel fuel, with low cetan number, low energy content; it is corrosive and has a poor lubricating ability. Nevertheless, it is possible to apply ethanol in diesel engines, as a neat fuel. There is much experience in Swedish busses (Scania engines) running on ethanol. This option requires modification of the engine, namely the introduction of a glow plug ignition, and an ignition improver must be added to the ethanol. For introduction into shipping, it would therefore be recommended to introduce bio-ethanol in blends only and for high speed, auxiliary engines.
Pyrolysis oil is potentially very cheap, because it can be produced from any biomass/ residue and anywhere around the world. Several Wärtsilä heavy fuel engines are running on pyrolysis oil. [2].

3.5 Greenhouse gas balance

Mentioned bio fuels were analyzed on their sustainability compared to marine fuels. Two main items are discussed here: the greenhouse gas balance of bio fuels compared to the fossil reference, and the emissions to air. For every selected bio fuel the greenhouse gas balance was determined for the different biomass resources which could lead to the selected type of bio fuel. The full greenhouse gas balance overview per bio fuel type is presented on Figure 8.

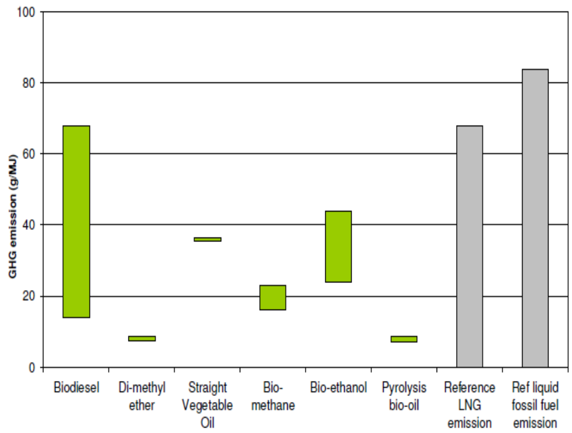


Figure 8. Overview of ghg balance comparison between selected bio fuels and fossil reference

4. COST ANALYSIS OF DIFFERENT FUEL TYPES

Figure 9 shows the market prices for biodiesel and several fossil derived diesel fuels over the past two years. The trend of future prices is impossible to predict. After the oil record of 145 USD/barrel in July 2008, prices have gone up and down between 35 and 100 USD [12]. Nevertheless, it is widely assumed that oil prices will increase in the next decades and that they will be increasingly more volatile as example shown in Figure 9.

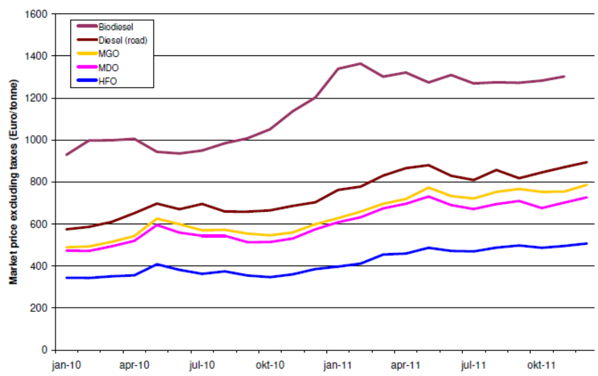


Figure 9. Historical prices for fuels without tax

Production costs of bio fuels are still more expensive than fossil marine fuels. However, the uncertainty in technological development, scaling and therefore cost reduction could lead to a competitive situation, if marine fuels are to be increasing in price, and if the obligation incentive for bio fuels remains within the renewable energy directive.

Operational costs are of major importance to ship owners and are largely dominated by the fuel costs (up to 50%). If Member States allow in their translation of the RED (Renewable Energy Directive) that bio fuels can also be introduced to the shipping sector to meet the obligation, biodiesel in ships would be evenly cost-effective as introduction in the road sector, based on the perspective of the obligation owner. It could also be the case that bio fuels are cost-economic beneficial if sulphur restrictions are increasing for marine fuels, especially the cheaper and widely available bio fuels like straight vegetable oils and biodiesel.

5. CLIMATE FINANCE

Climate finance is an important component that could help the shift towards low-carbon and climate-resilient transport development [11]. Climate finance relates to funding that can be used to support climate change mitigation and adaptation activities. It encompasses both public and private sources of finance and can be used to support activities in all sectors of the economy in both developed and developing countries [11]. Consequently, climate finance can be used to help achieve the shift and scale-up of funding for sustainable low-carbon freight transport that directly contributes to the enactment of sustainable development on a larger scale. Yet, climate and environmental concerns are not usually given all the necessary attention when evaluating transport investment projects. Generally, cost-time analysis remains the most significant focus in a project appraisal. There are, however, several sources and mechanisms of climate finance that can be applied in transport sector today (Figure 10). These mechanisms can be grouped into two categories: the carbon market and climate funds.

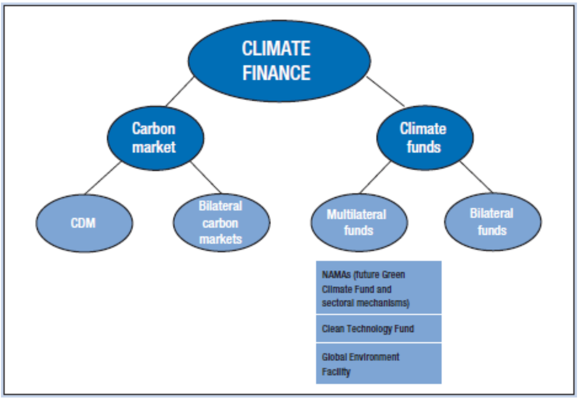


Figure 10. Climate finance mechanisms

5.1. Carbon markets

Carbon markets are mechanisms that provide an incentive to reduce GHG emissions by creating a market for emissions allowances and credits. The carbon market channels financial resources to low-carbon investments through, inter alia, project-based mechanisms such as the Clean Development Mechanism – CDM (regulatory/ compliance market) and voluntary markets. The CDM projects are supposed to contribute to sustainable development in developing countries, and also generate real and additional emission savings. The barriers which currently prevent the application of CDM projects in the transport sector relate to the size, scope and complexity of the sector itself. The narrow approach to measuring the mitigation potential of policy actions (and the associated incremental costs), together with the lack of data to allow for the measurement, reporting and verification of mitigation actions, limits the transport sector's access to this source of finance [11]. Nevertheless, within the context of the ongoing negotiations on climate change, the design of financial instruments is becoming increasingly concentrated on tools that can be applied to the transport sector, something that the existing instruments such as CDM have not succeeded in covering.

5.2. Climate funds for sustainable freight transportation

The term climate funds designate financial resources, investment funds and financing instruments that can be used to address the adaptation and mitigation of the climate change impacts activities. Recently, there has been a proliferation of climate fund initiatives (multilateral and bilateral), which seek to mitigate climate risks and help the most vulnerable adapt to climate change. Although not specifically devoted to transport, several of the existing climate funds can be used for the mitigation of GHG emissions or to reduce the negative effect of impacts activities in the transport sector. These include, for example, the Global Environment Facilities, the Clean Technology Fund, the Global Climate Change Alliance, the Inter- American Development Bank (IDB) Sustainable Environmental Climate Change Initiative, the ADB Climate Change Fund, and the ADB Clean Energy Fund. Many of the funds include a sunset clause that stipulates the necessary steps that will be taken to conclude operations once a new UNFCCC financial architecture takes effect. It is, however, far from clear what the future funding landscape will look like in the post-2012 regime. For sustainable freight transport, climate finance can be an important tool to support activities targeted to reducing GHG emissions[11]. The range of eligible activities is broad and encompasses supporting programmes, policies, projects and enabling measures and strategies. However, given the unpredictable size of climate finance and the conditionality associated with it, direct funding to support large infrastructure, even by way of co-financing, is probably out of range. Yet, climate finance can have a particular impact where sustainable freight transport programmes require funding from a combination of sources and when the availability of climate finance can push an activity beyond the tipping point that determines whether or not a given project can be implemented [11]. Climate finance instruments can also be used as a leveraging device that can help promote sustainable freight transport in several ways, including by awareness raising and capacity building, supporting national assessment and policy reforms, implementing pilot measures, identifying and implementing pilot projects, making marginal projects financially viable, and leveraging other funding flows.

6. CONCLUSIONS

Nearly 100 000 ships of different purposes, age, size and energy efficiency are in use every day. The world today would not be possible without transportation on daily basis; maritime transport is considered to be environmentally, ecologically and economically friendliest way of moving large quantities of cargo. Despite to that IMO is pushing limits considering harmful emissions from ships and it is highly criticized because of it. Nevertheless MARPOL Annex VI and its revision are setting new limits for the fuel sulphur and NOX content.

The fact is that there are not enough resources for implementing a complete biodiesel scheme for entire fleet, and manufactures are not still ready to put out warranties on ships engines to run on bio-fuels. The only way to use bio-fuels for now is to find right mixture of bio-fuels and fossil fuels as an interim solution until proven good. From a technical integration point of view, small percentage biodiesel blends (up to 20%) with MDO/MGO seem the most promising fuel for shipping.

Fuel cells will be used in wide range of products, however they are not fully commercialized yet. Considerable investment is still needed in research, development and manufacturing to reduce the high costs and improve functional performance and long term reliability. Fuel cells must be competitively priced, reliable, and durable if they are to be accepted by the maritime industry. They will be competing with other types of power plants, especially with well-established diesel-electric plants, for a share of the marine market.

For now most likely choice for ship owners who do their business "without of flags of convenience" is to buy costly MGO and run their on ships on it during the stay in ECA or rebuilt their ships and improve measures for reducing GHG and other dangerous emissions as stated.

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HOW LEARNING STYLES AFFECT THE EXPIRIENCE OF E-LEARNING

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ABSTRACT

Putting emphasis on the Moodle platform as a contemporary model of teaching, which is used at the Faculty of Maritime Studies Kotor, in this study we have investigated how students perceive such an alternative model of teaching through the use of different learning styles. The study has shown that individual learning styles and experience of e-learning are statistically significant. All that contributes to greater efficiency and improvement of active teaching models.

KEY WORDS

learning styles, e-learning, lms, moodle

1. INTRODUCTION

The teams consisting of engineers and psychologists have found relevant information regarding the optimization of handling different machines and efficient transmission and reception of information during the Second World War. The relevant fact is that in the transmission and reception of information there is a limitation caused by the addition of technical nature and cognitive systems. Attention, selection and optimization of information transfer, represent a major problem for further research. So important obtained data indicate that these, as well as further steps of research, should be considered an analogy between abstract communication system and style of functioning sensory-nervous system.

It is generally known that learning runs through every human activity. A large number of factors that play a role in indirect sign of learning. First of all, the perception of the primary information processing and individual ability of each individual. Perception has a strong relationship with intelligence, because intelligence is capable of adapting to the new situation helps to perceptual stimuli connect with past experience. An additional factor is motivation, because each individual has in each cycle of life more or less defined primary and secondary motives (Kolb, Fry 1975).

2. INFORMACION TECHNOLOGY

Today, we live in an information world where production, processing and storage of knowledge are important factors of the complete social progress.

In the last few decades, the development of information technology has recorded tremendous growth and every day there are more in progress. The central position of technological development occupies a large system of information and communication technologies. The integration of systems, standardizing equipment, distribution and internet speed depends on the further development of information technology. To take full advantage of modern computer systems it is essential that the processes in business are properly created. Thus, a prerequisite for the successful implementation of modern ICT (information and communication technology) is a good business organization. The 18th century is treated as the beginning of distance education although greater application is gained with the development of the Internet. Ease and speed contributed to the emergence of a large number of formal and informal institutions that practice this kind of education. The flexibility of this kind of learning proved to be a main priority and as a very good way to close the knowledge to the large number of people.

3. ATTITUDE

According to Dunđerović (2004) the attitudes are relatively permanent emotional tendencies, value and action relationships with people and phenomena. According to Rot (2004), they may simply be defined as the willingness to react to certain events, the positive or negative way. Every man is determined by its structure of attitudes. In this way man adapts to the environment and form his own experience of it, and all of this makes the willingness to engage (Šiber, 1998).
Allport (1936) makes a division of 4 models of attitude formation: mechanism of differentiation, integration mechanism, the mechanism of identification and mechanism of trauma. Kac (1959) speaks of the four functions of attitudes: the adaptation function, the function of ego-defense, function of value-expressive character and function of cognition.
An important driver of distance education was the development of the telegraph and postal services. The university who first enabled distance education was the University of London. At this University 1858th the program was established for distance education (External Programme), which allowed students to come to a degree without having to attend classes at the institution.

4. E-LEARNING

E-learning can be defined as the application of information and communication technologies in education. E-learning or distance learning means that the main carrier of communication between teacher and student separation (at different times and in different places - the separation of instructors - tutor of the student). It must include two way communication between teachers and students that aims to facilitate and support the process of education. Technology is used as an intermediary in the necessary two-way communication.
E-learning consists of three main parts.

4.1. LMS (Learning Management System)

LMS is a set of standardized components for learning, designed to connect learning with existing IT systems within an organization or through a web portal for learning.
The software that forms the basis of LMS manages all elements of teaching and records all parameters required for process monitoring. Based on these parameters, it is possible at any time to monitor the progress of each employee or group, and at the end of the Educational Process reliably measure and analyze performance. The student system access from your computer and included in the teaching process at a time when it is most convenient. According to the teaching program the module for learning and teaching approaches is selected (lesson).
The process is controlled and monitored by the LMS. The time of the access to the module, the success of learning steps, time spent and the final results are recorded. Data is recorded in a database and are available for analysis and presentation of the different users (project manager, mentor teaching, management ...). The system keeps track of all participants within the stipulated time, allows communication through the system: one to one, one to all, all to all, provides an insight into the details of previous education and experience of participants from other groups (http://www.herridgegroup.com/pdfs/lcms.pdf).

4.2. Content

Content is an essential part of the learning process. Modules for learning are not static but are intelligently guided by auditory and visual application with interactive feedback that leads students toward the goal of the system simulated real-life situations. Errors are signaled to the attendants immediately and are used as a means of direct teaching. Attended the goal can be reached only if all the steps correctly made.

Each module can be accessed as many times as necessary to the final result is satisfactory.

4.3. Co-operation (COLLABORATION)

The communication within the system is multidimensional. The primary goal of communication is cooperation (collaboration) students and mentors teaching, and students themselves. Since these two methods are aimed to the same goal the harmony of the communication process is achieved. Collaboration provides control systems and enhances learning, since the learning remote station (the computer and the student) connects the community gathered for the same purpose. Sharing experiences and advice is invaluable. Collaboration tools are e-mail forum (questions / answers / comments), chat (direct discussion), etc.

Registered sites	68,352
Countries	235
Courses	7,054,520
Users	67,703,247
Teachers	1,155,563
Enrolments	85,481,139
Forum posts	117,883,780
Resources	62,847,732
Quiz questions	168,585,683

Figure 1. Statistics Moodle platform in the world(https://moodle.org/stats/ 15/02/2014.)

5. MOODLE (MODULAR OBJECT-ORIENTED DYNAMIC LEARNING ENVIRONMENT)

Moodle is a software solution for the production and maintenance of online courses through the Internet. This is a free, open-source platform for e-learning. This platform is very popular. She herself has over 57 million users. According to many surveys that have been published on the Internet, Moodle is one of the most accepted platform in its segment. Moodle is a modernized providing the best tools to manage and promote learning. The built-in functionality that allows exactly the same work practices whether the two users, tens and hundreds or a few thousand active users. Because of its scalability has found its application in both residential customers who provide courses and a small number of users to large systems.

6. MODELS OF LEARNING

Each individual is unique in their own way. With its idiosyncracies, everyone has a particular style of learning that suits them in acquiring information.
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6.1. VAK model of learning

This model was created as a result of accelerated learning process in the world. It has its continued development. Despite the many advantages that this model contains,it has its disadvantages. Many researchers consider it more a tendency than style.
Any individual who is engaged in learning using three sensory channels (visual, auditory and kinesthetic), through which it is possible to receive new information and experience. One, possibly two of them are more dominant in the cognitive processing of information. Dominant and also the most effective means for adoption information. However, an individual style that can deal with mastering one type of material, while the second may be the more appropriate a different style.
According to the theorists who advocate this style of information is best presented in a way that will be represented on all three styles. And thus it gives everyone the ability to (Honey, Mumford, 1992).

6.2. Felder- Silverman mode l

In order to achieve the most effective learning we combine learning styles. According to scientists Richard M. Felder and Barbara A.Silverman there are styles that are inherently opposed and because of this opposition are working well. These two scientists presented the view that no one is using only one style of teaching and learning and in order to make them to be of a high quality and comprehensive people combine styles. According to the Felder-Silverman's theory the following styles have been developed (Felder, Silverman, 1988):
***1.** Active and reflective learning style;*

2. *Sensory and intuitive learning style;*
3. *Visual and verbal learning style;*
4. *Sequential and global learning style.*

7. METODOLOGY AND RESULTS OF THE RESEARCH

The survey was conducted on a sample of 100 respondents. The initial case of the study is to assess the nature and distribution (direction and intensity)of learning styles, on the one hand and the general attitude of e-learning on the other.
The scientific goal - to determine how learning styles, as independent variables influence on the overall satisfaction about e-learning as a dependent. The practical goal - the data can contribute to more efficient and convenient operation of educational institutions in the country in terms of effective engagement of individuals willing to work to improve the education system in Montenegro.
The research variables are dependent (general satisfaction with e-learning included) and independent (learning styles - VAK model and Felder-Silverman model).
Further work will present the results of researching. The correlation of overall satisfaction with e-learning at the Faculty of Maritime Kotor, and two models of learning.
In the statistical analysis, which was performed SSPS Windows 17 program, we investigated the x2 (chi-square)-measures the difference between the segments crossed variables, and its value should not be higher than 10 to confirm the value of p. The value of p is relevant in the sense that it is an indicator of association between the variables. The p-value is a number between 0 and 1 and interpreted in the following way: this means that if p is less than 0.05 and close to 0.01 indicates a strong correlation and the likelihood of association with 95% and 99%. C coefficient value shall indicate the degree of correlation between the variables (http://www.ef.uns.ac.rs/Download/statistika/2010-1020_testiranje_statistickih_hipoteza.pdf).

In the picture below affiliation, percentage are clearly shown according to each type of **VAK model**.

Verbal 29% Auditive 35% Kinestetic 36%

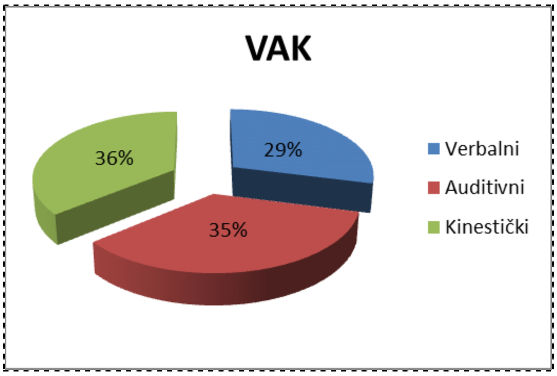

Figure 2. Percentage of VAK model

Table 1. General satisfaction with e-Learning and VAK model

General satisfaction and visual type VAK model x2=13,546 df=2 C=0,455 p=0,034
General satisfaction and auditory type VAK model x2=2,985 df=4 C=0,149 p=0,567
General satisfaction and kinesthetic type VAK model x2=2,098 df=4 C=0,201 p=0,621

From Table 1 we see that the general satisfaction with e-learning (positive attitude about the same) and the verbal type VAK model was found statistically significant at the 0.05 level (p = 0.034), which implies that with 95% confidence that respondents to the VAK model belong to the type of visual feature. Visual respondents have positive attitudes toward e-learning because it itself mostly runs this kind of creativity, reasoning, leaves room for idiosyncratic experience and convergent thinking. Next, jumble materials Moodle's platform placed, combining chart, diagram, written material induces human visualization. In the other two types there is no statistical significance or positive correlation. In cases where there is no statistical significance was not possible to make any conclusions about it, because that would fall within the subject matter of speculation.

Visual/verbal 28%, active/reflective 26%, sensory/intuitive 29%, sequential/global 17%
Felder-Silverman model

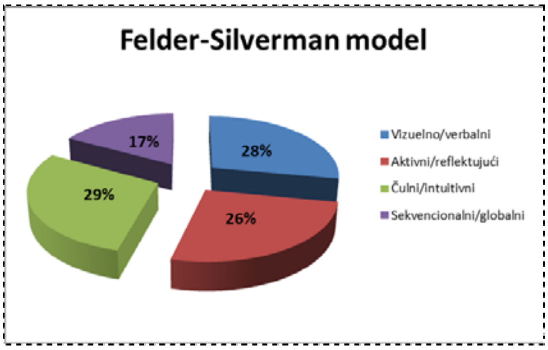

Figure 3. General satisfaction with e-Learning and F-S model

Table 2. General satisfaction with e-Learning and F-S model

General satisfaction and visual / verbal x2=8,988 df=2 C=0,235 p=0,045
General satisfaction and active / reflective x2=5,653 df=2 C=0,198 p=0,091
General satisfaction and sensory / intuitive x2=3,121 df=4 C=0,482 p=0,403
General satisfaction and sequential / global x2=1,954 df=4 C=0,607 p=0,620

From Table 2 we see that the positive correlation between the variables satisfaction of e - Learning and visual / verbal style is found. This is a very important indicator , because as we have seen in the theoretical part of the visual / verbal style is almost equivalent to the visual style of the VAK model.
This result is not only important for the efficiency of a practical aim, but also confirms that equivalent among different models of learning. In Felder - Silverman model the results indicate a positive correlation of visual type, according to the general satisfaction of e-learning at the level of 0.05 (probability of 95 %) - p = 0.035 . This means that with 95 % confidence that the respondents belonging to the visual / verbal learning style FS models have the highest satisfaction of e-learning. Although the value of x2 = 9.543 tends to a larger sample would be higher and would strengthen the correlation. That means that with the larger sample (for example 200 subjects) , the value of x2 would go over 10 , and it is known that the value which is greater than 10 is more reliable.

8. CONCLUSIONS

As you can see, the results show that the correlation examination of general satisfaction with e-Learning and learning styles, and the VAK model and Felder-Silverman model correlation was observed in both cases with a visual learning style This implies that it is important in the pedagogical terms take into account what kind of motivational material responds to students. As we know, except by adopting a knowledge and transmitting the knowledge that there is a bridge in the form of learning style that plays equally important role. Implications for the organization of adequate productive classes have a clear purpose and structure, learning material, which must be clear, interesting and logical, the course must have a clear concept, simple form and aesthetically appropriate, clear instructions, with discussions that are functional and effective, with constant interaction and communication and motivation, verbal-esthetic type.
Visual intelligence is a kind of ability of visual perception, in which the individual understands and easier adopts the visual material of our knowledge in a variety of formats, contexts, forms... Individuals who have expressed this kind of intelligence they have their own style of learning, thinking and impressiveness of mental presentations in the cognitive system. They think in pictures, remembers in pictures and most reliable material for learning, for them, it should be presented in this style. The moment when such an individual is trying to pull information from long-term memory, resorts mnemonic visualization and creating images in the mind. This kind of capability has a good disposition to work with geometry, operations with spatial reference, and the adaptation to the unfamiliar environment. Easier to interpret diagrams and maps of the written material. respondents tended visual style love to draw and match three-dimensional objects. Possible areas of interest are engineering, architecture, sculpture, visual art, mechanics, etc. All of this leaves room for further research and

thinking on the same or similar topics, but is also the argument that e-learning have specific attractive model of teaching that excites the visual perception of the individual. The complexity of the content of written, pictorial or other material acting as motivational factor for the verbal type of student / learner. It is important to note that, although the student / student belongs to the visual learning style, needs to develop and stimulate other styles, as much as possible, because it is relevant that he sees the difference between the styles. Seeing individual differences and understanding what his more corresponds to the adoption of different skills, thus increasing their efficiency of organized learning.

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QUALITY MANAGEMENT AS THE PART OF AIRPORT SUSTAINABLE DEVELOPMENT

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ABSTRACT

Term Sustainable development has evolved from 1987 until today; from basic organizing principle for human life on a finite planet to holistic approach for managing Economic viability, Operational efficacy, Natural resource conservation, and Social responsibility. Today modern airports are fully featured international gateway and destination catering to the needs of both travelers and visitors. They are an arm of the local economy focused on moving passengers and freight efficiently. Their impact on the local economy and the environment can't be ignored and every day is more challenging. The paper will analyze contemporary approach of Airport Sustainability; in particular Airport Quality Management as the part of Sustainable Management Plan.

KEY WORDS

sustainability, airport, management, quality, development

1. INTRODUCTION

During the last decades airports made an effort to achieve quality as a measure to increase their competitiveness. This quality goal was usually achieved by trial and error, costing, to airports, a great deal in terms of time and money. To organize the procedure of obtaining and maintaining quality, a significant number of airports have implemented ISO QMS model (QMS – Quality Management System). This way the improvement of quality could be obtained through standard procedures already tried and tested in many other enterprises.
One of the most striking environmental developments of the 1990s has been emergence of voluntary approaches for environmental management, for example, ISO 14001 Environmental Management System (EMS). Under this voluntary environmental program, participating airports make commitments to adopt progressive environmental policies above and beyond regulatory requirements. The expected outcome of voluntary environmental programs is that participating airports will achieve better environmental performance when compared to non-participants by adhering to stringent program standards.
Sustainability is based on a simple principle: everything needed for survival and well-being depends, either directly or indirectly, on the natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and environmental requirements of present and future generations. Sustainable practices can reduce the environmental impact of developed infrastructure while at the same time creating financial and operational benefits for a project and social benefits for the community at large.
Also in aviation, there has been a renewed environmental interest, green movement, or desire

for sustainable development. The air transport industry is one of the driving factors that enabled the economic development of many regions. Air trans-port growth is directly positively correlated to GDP growth, locally, nationally and globally. But on the other hand, air transport contributes to 2.4% of total global $CO2$ emissions from fossil fuel alone. It is seen as a mayor emissions culprit.

2. QUALITY, SAFETY AND ENVIRONMENTAL MANAGEMENT AT AIRPORTS

ISO 9001 is an international standard that specifies the basic requirements for a QMS. The two primary objectives of the standard are to help an organization demonstrate its ability to meet customer and regulatory requirements and to enhance customer satisfaction. To that end, the standard contains key requirements clauses focusing on (1) the QMS in general, (2) management responsibility, (3) resource management, (4) product realization, and (5) measurement, analysis, and improvement. Originally released in 1987, the standard was updated in 1994, 2000, and 2008. ISO 9001 is supported by a broader family of standards. These include ISO 9000 (QMS fundamentals and vocabulary), ISO 9004 (QMS guidelines for performance improvements), and ISO 19011 (guidelines for quality and/or environmental management systems auditing). According to the International Organization for Standardization, as of 2009, the total number of organizations certified to ISO 9000 exceeded one million.

ISO 14001 (EMS) is an internationally recognized environmental management standard that was developed by the International Organization for Standardization. The EMS generally consists of internal policies, assessments, plans, and implementation actions that affect facilities and their effects on the natural environment. It is must important that EMS meets ISO's five basic components: conformance to the facility's environmental policy, environmental planning (referred to in brief as "Plan"), plan implementation and operation ("Do"), periodic monitoring ("Check"), corrective action ("Act"), and management review, which generally occurs on an annual basis.

Up to the end of December 2012, at least 1,101,272 ISO 9001 certificates had been issued in 184 countries and economies. This in total represents an increase of 2 % (+21,625) over 2011. The top three countries for the total number of ISO 9001 certificates issued were China, Italy and Spain, while the top three for growth in the number of certificates in 2012 were Spain, China and Romania. In the same time, at least 285,844 ISO 14001 certificates, a growth of 9 % (+ 23,887), had been issued in 167 countries, nine more than in the previous year. The top three countries for the total number of ISO 14001 certificates issued were China, Japan and Italy, while the top three for growth in the number of certificates in 2012 were China, Spain and Italy. A statistics summary is shown in the Table 1.

Table 1. Number of ISO 9001 and ISO 14001 certificates in 2012 [11]

Standard	Number of certificates in 2012	Number of certificates in 2011	Evolution	Evolution in %
ISO 9001	1,101,272	1,079,647	21,625	2 %
ISO 14001	285,844	261,957	23,887	9 %

For the airport operator, ISO 9001 is not a static, inflexible international standard imposed on widely differing organizations; rather ISO provides a standardized process that makes quality systems an integral part of airport system.

Figure 1 shows the breadth of an airport's customer groups. Whereas in the past the airport's main customers would have been the group on the left of Figure 1, today airports are also focused directly on the air passengers, meeters and greeters, other airport visitors, and users of general aviation services. It is important to also note that the airport's business partners and suppliers are also their internal customers.

Figure 1. Airport customers. [3]

ISO acknowledges the importance of satisfying the quality expectations of both internal and external customers. Whether ensuring prompt, high-quality repair of facility work orders or consistent delivery of superior services to passengers and tenants, the ISO process can perform equally well. The reason for this is a typical ISO process of service realization shown in Figure 2.
According to Figure 2 typical process groups are: 1) management processes including strategic decisions, determination of quality policy and quality objectives and other management tasks, 2) processes of resource management including determination and allocation of human resources, infrastructure and work environment, 3) product / service realization processes which describe the sector which the organization is in, including the activities that are needed to produce the products and services to internal and external customers, and 4) measurement, analysis and improvement processes which ensure that the product and QMS meet the requirements and the system is continually improved.
In terms of quality, anything that can be measured can be managed: customer satisfaction surveys, bond ratings, environmental compliance, certification inspections, risk management and utility costs are just a few areas that lend themselves to quality measurement.

Airports all over the world measure Key Performance Indicators (KPI) in order to manage airport quality more effectively. International Civil Aviation Organization (ICAO) has provided guidance on airport performance management in two documents (Doc. 9082: ICAO's Policies on Charges for Airports and Air Navigation Services, and Doc. 9562: ICAO's Airports Economics Manual). In these documents, ICAO recommends that national authorities ensure that airports have Performance Management Systems in place, and that those systems include one or more performance indicators in four specified key performance areas (Safety, Quality of service, Productivity, and Cost Effectiveness). Based on this two ICAO documents, Airport Council International (ACI) has defined six Key Performance Areas (Figure 3).
Also KPI can be defined as benchmarks which can be used in airport benchmarking process.

Benchmarking is a management technique to improve business performance. It is used to compare productivity and efficiency, evaluate specific processes, policies and strategies and to assess overall organizational performance. Some of these benchmarks could serve equally well as foundation for an airports ISO quality program.

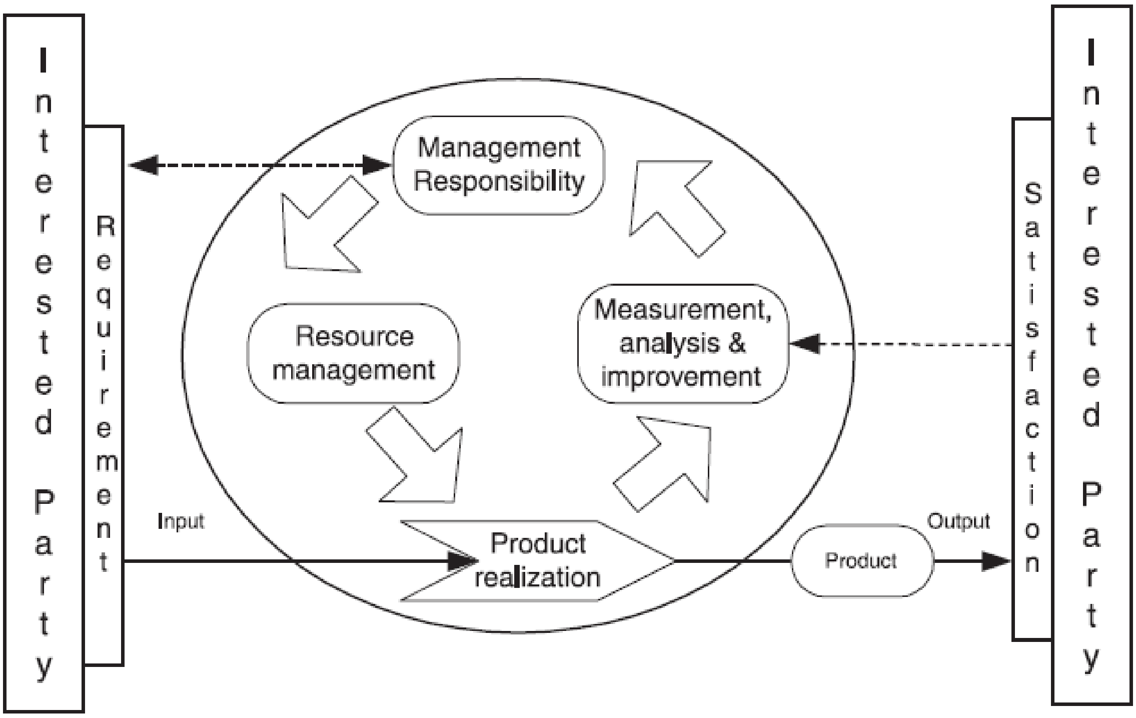

Figure 2. Typical QMS Processes. [1]

An added benefit of applying ISO at airport is its relevance to an impending ICAO requirement for implementation of a Safety Management System (SMS). SMS is a system for managing aviation safety. A SMS parallels the ISO process in a number of ways, from detailed written procedures, assessment of deficiencies and periodic audits to ensure compliance.
SMSs are based on the fact that there will always be hazards and risks due to human factor, so proactive management is needed to identify and control them before they lead to accidents. SMS requires creation of an internal system of oversight to ensure the safe provision of aerodrome services. Managing safety through creation of and compliance with an SMS could either be part of or an extension of an airport's ISO program.

Core	Safety and Security	Service Quality
1. Passengers	1. Runway Accidents	1. Practical Hourly Capacity
2. Origin and Destination Passengers	2. Runway Incursions	2. Gate Departure Delay
3. Aircraft Movements	3. Bird Strikes	3. Taxi Departure Delay
4. Freight or Mail Loaded/Unloaded	4. Public Injuries	4. Customer Satisfaction
5. Destinations—Nonstop	5. Occupational Injuries	5. Baggage Delivery Time
	6. Lost Work Time from Employee Accidents and Injuries	6. Security Clearing Time
		7. Border Control Clearing Time
		8. Check-in to Gate Time

Productivity/Cost Effectiveness	Financial/ Commercial	Environmental
1. Passengers per Employee	1. Aeronautical Revenue per Passenger	1. Carbon Footprint
2. Aircraft Movements per Employee	2. Aeronautical Revenue per Movement	2. Waste Recycling
3. Aircraft Movements per Gate	3. Non-Aeronautical Operating Revenue as Percent of Total Operating Revenue	3. Waste Reduction Percentage
4. Total Cost per Passenger	4. Non-Aeronautical Operating Revenue per Passenger	4. Renewable Energy Purchased by the Airport (Percent)
5. Total Cost per Movement	5. Debt Service as Percentage of Operating Revenue	5. Utilities/Energy Usage per Square Meter of Terminal
6. Total Cost per WLU	6. Long-Term Debt per Passenger	6. Water Consumption per Passenger
7. Operating Cost per Passenger	7. Debt to EBITDA Ratio	
8. Operating Cost per Movement	8. EBITDA per Passenger	
9. Operating Cost per WLU		

Figure 3. Airport six Key Performance Areas with Performance Indicators, according to ACI. [6]

3. AIRPORTS AND SUSTAINABILITY

Sustainability is about making decisions that meet our needs today without compromising our ability to meet our needs in the future. It means planning ahead and thinking holistically. Sustainability is more than just being "green." It also encompasses the social, economic, and operational elements of business. Airport Sustainability is a holistic approach to managing an airport to ensure Economic viability, Operational efficiency, Natural resource conservation, and Social responsibility.

On other hand, Sustainable Development is the development that meets the needs of the present generation, without compromising the ability of future generations to meet their needs. This define Sustainability as the state of a system, and Sustainable Development as (the rate of) progress of a systems toward more sustainability.

Airport Sustainability development is a broad term that encompasses a wide variety of practices applicable to the management of airports. This term refers to practices that ensure:

- Protection of the environment, including conservation of natural resources.
- Social progress that recognizes the needs of all stakeholders.
- Maintenance of high and stable levels of economic growth and employment.

Figure 4. Sustainable development - triple bottom line. [4]

These three components of Sustainable Development are often referred to as the environmental, social, and economic triple bottom line (Figure 4). There are opportunities for applying principles of sustainability in all areas of airport operation: airside, landside, terminals, and hangars, etc. New buildings, runways and taxiways, maintenance facilities, and concessions can all be designed using sustainable approaches. Sustainability can also be applied as a component of retrofit and repair activities. The most beneficial opportunities for employing sustainable principles may be during the planning and design phases of an airport development project, but there may be even more opportunities to consider in equipment replacement and maintenance. The Table 2 contains main topics of airport sustainable development according to synthesis conducted by the Airport Cooperative Research Program (ACRP).

Sustainability Master Plans fully integrate sustainability into an airport's long-range planning. A Sustainable Management Plan is a stand-alone document. Both documents achieve similar objectives. They use baseline assessments of environmental resources and community outreach to identify sustainability objectives that will reduce environmental impacts, realize economic benefits, and improve community relations.

The Federal Aviation Administration (FAA) it is trying to implement vision of sustainable development at airports in the United States. FAA's objective is to make sustainability a core objective in airport planning (Figure 5). The pilot program (Sustainability Master Plan Pilot Program), which began in 2010, involves funding long-range planning documents at airports throughout the United States. FAA will use the study as a model for conducting sustainability planning at other airports nationwide, leading the airport industry in innovative practices.

Table 2. The main topics of airport sustainable development [2]

Environmental sustainability	Social sustainability	Economic sustainability
1. water quality	1. public awareness and education	1. local hiring
2. climate change	2. stakeholder relationships	2. local purchasing
3. air quality	3. employee practices and procedures	3. contribution to the community
4. land use	4. sustainable transportation	4. quantifying sustainability
5. biodiversity	5. alleviating road congestion	
6. materials	6. accessibility	
7. waste	7. local culture and heritage	
8. noise and aesthetics	8. indoor environmental quality	
9. energy	9. employee well-being	
10. green buildings.	10. passenger well-being.	

A key principle of Sustainability is recognizing that addressing one concern does not necessarily come at the expense of another. Optimally, evaluating a project or activity based on environmental and social concerns will spur innovation that ultimately reduces costs over demand and investment in technologies that the life of the project.

Figure 5. Airport sustainable development according to FAA. [13]

Airport Sustainability as part of a business strategy has both immediate and long-term benefits that can be measured and when persistently managed, present rewards. Some benefits of sustainability initiatives that have been demonstrated at airports across the world include:

- Improved passenger experience
- Better use of assets
- Reduced development and/or operations and maintenance costs
- Reduced environmental footprints
- Facilitation of environmental approvals/permitting
- Improved relationships within the community
- Enhancement of the regional economy
- Creation of an engaged and enriched place to work
- Creation of new technologies through increased demand and investment in technologies that facilitate sustainable solutions

4. SUSTAINABILITY AS THE PART OF AIRPORT DEVELOPMENT AND QUALITY MANAGEMENT

Because sustainability, airport planning, and design practices are continuously evolving, the planning process must allow airports to capture new trends and initiatives based upon the airports current and ultimate goals. An airport's definition of sustainability should reflect its particular circumstances and role within its community, while also incorporating both stakeholders and local needs.

Sustainable Study (can also refer to: Sustainability Plan, Sustainability Development Plan, Sustainable Management Plan, Sustainability Master Plan, etc.) should be integrated into the airport Master Plan which is guide for airport development for next 20 to 50 years. Sustainable Study and Master Plan should share information and data where applicable creating long – term development vision for the airport that considers economic, environmental, social and operational factors. The coordination between the two is shown in the Figure 6.

There are challenges to implementing sustainable initiatives beyond identifying appropriate processes or technologies. When new facilities are designed and built, there is a strong impetus to hold down the construction and materials costs to adhere to capital budgets. When contractors and subcontractors are solicited, there is a preference for the low bid. And when materials are requisitioned, the low cost supplier frequently wins the contract. Throughout the facility design and construction, decisions are made based on the goals of the project team, usually total cost and time to completion. Once the facility is turned over to begin routine operations, however, the operating department has different cost concerns and goals driving its decisions, usually monthly or yearly operating costs. This simple example shows importance of quality in the process of airport planning and design for its Sustainable Development.

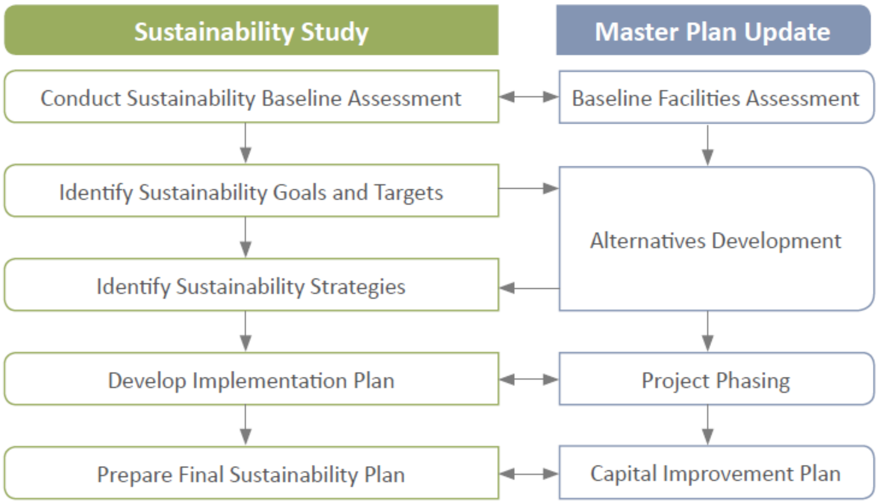

Figure 6. Sustainable Study and Master Plan integration. [5]

To ensure their success, sustainability programs must begin during planning and design and continue through construction and operation/maintenance, as well as decommissioning and demolition. This approach takes into account the lifetime impacts of processes and equipment and minimizes not only total costs but also lifetime environmental impacts.
The expense of green technologies, which may often be perceived as a detriment to implementation due to higher upfront costs than traditional systems, often produce lower life-cycle costs as compared to traditional systems. In some cases, significant cost savings can be generated when sustainable practices are incorporated instead of traditional practices.

A systematic approach makes managing a development both easier and more effective. For this reason Sustainability should be implemented within typical QMS process shown in Figure 2. Sustainability policy / mission statement should be consistent with overall airport mission statement, quality policy and quality objectives. To implement Sustainability into the QMS it is necessary to define KPI for resource management, service realization process (operations), environmental impact, airport safety and security, airport economy, and social impact on local community.
Based on sustainable and QMS approaches, the authors have described how the Sustainable Development should be implemented into the airport Quality Management (Figure 7).

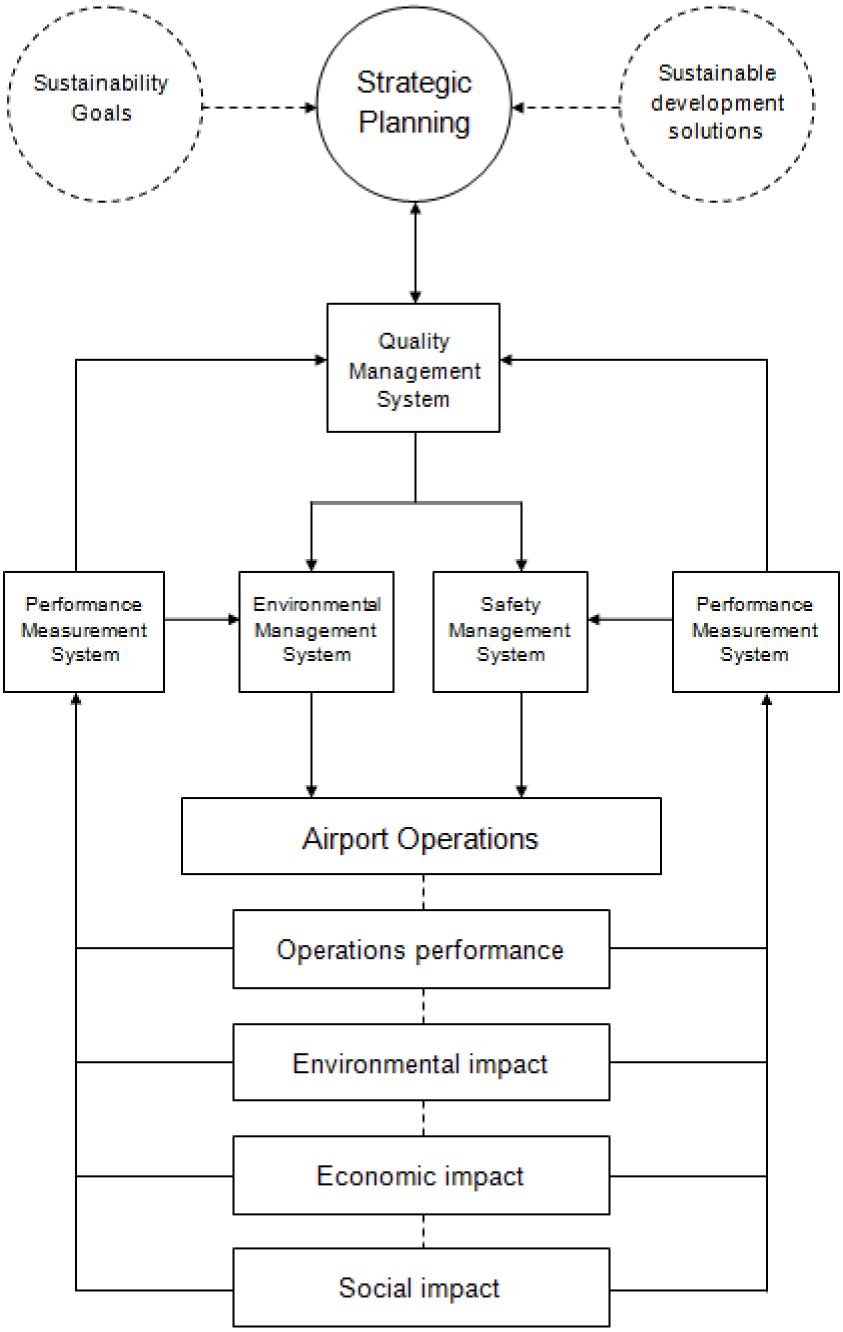

Figure 7. Model for implementation of Sustainable development into the airport operations through the strategic planning and QMS. [Created by authors]

4.1. Operations performance

Integrating sustainability principals into standard operating procedures is a key step toward ensuring lasting improvements at the airport. Operational efficiency saves time and money to airport.

Operational efficiency measures can demonstrate positive effects across various aspects of airport operations, from aircraft operations on the airside to paper use on the landside. Reducing idling, taxiing and approach times at airports will allow for more efficient airspace and airfield operations that will facilitate reduced air emissions and reduce fuel consumption.

4.2. Environmental impact

Globally, aviation accounts for around 3.5% of the total human contribution to climate change. The Intergovernmental Panel on Climate Change estimate that this will increase to between 5% and 15% by 2050.

One of the greatest concerns facing airports today is incompatible land use. With the pressure to convert open space for development and the proliferation of telecommunication structures, the demand on the national airspace and the ground area around airports continues to increase. The list of incompatible land uses that encroach on airspace and approach areas is long; it includes noise-sensitive and high-density land uses such as residential areas and parks/open spaces.

Today's aircraft are typically 75% quieter than jets in the 1960s; however, action is needed to prevent deterioration in the noise climate as air traffic growth overtakes the rate of technological advance.

Major sources of air pollution are ground transport, aircraft emissions and apron activities such as aircraft refueling. Airport operations may produce various regulated pollutants, including volatile organic compounds (VOCs), carbon monoxide (CO), and particulate matter (PM). Because globalization and the concomitant increase in air travel has been accompanied by rising emissions, environmental protection and efforts to prevent climate change have become the modern scientific challenge of times.

Activities of airport operators have the potential to influence local water quality. Operation of airports—from cargo to passenger terminals to airline movements—requires the use of water. Ensuring efficient use can minimize waste and conserve this precious resource. Transportation and storage of fuels, de-icing of aircraft and surfaces, and indirect pollution can lower the quality of watersheds and water bodies near an airport.

Energy efficiency is not a new concept among airport operators and designers. The activities and facilities operating at airports are very energy-intensive environments. The use of electricity, requirements for heating and cooling, and specific energy requirements for aircraft operations and maintenance keep energy demand at high levels.

Managing the waste streams from airport operations provides a variety of challenges, including separating and recycling waste at terminals, tenant requirements, and meeting/adhering to city or county ordinances.

Two key issues related to wildlife have an impact on airports: the conflict between wildlife preservation and aircraft safety, and the effects of noise on migration and nesting patterns. The effect of noise on wildlife is poorly understood for a number of reasons including the difficulty of separating visual and aural components of an event, and the applicability of experimental results to a natural setting.

4.3. Economic impact

Economic considerations are fundamental to sustainable development, because these involve trade-offs between the costs and benefits of protecting or improving environmental quality. Those who have the responsibility for making environmental management decisions must reconcile conflicts among environmental, economic, and social considerations. Economic appraisal ensures that the best option to meet an objective is selected, taking into account costs and benefits, risk and uncertainty, and other policy objectives and constraints. Local and environmentally responsible procurement can have a wider range of benefits than immediately apparent; for example, the environmental benefits of using recycled materials and the social benefits of reducing unemployment.

4.4. Social impact

Social sustainability principles emphasize social equity, meeting basic needs, personal development, and responsible citizenship. One measure of social sustainability is the ability to express a sense of identity through heritage, art, and culture.

The needs of disabled persons (PRM – Passengers with Reduced Mobility) coincide with the needs of the majority, and all people are at ease with them. As such, planning for the majority implies planning for people with varying abilities and disabilities.

5. CONCLUSIONS

Issues relating to the sustainability of specific industrial sectors such as aviation are relatively under researched. The sustainability involves the achievement of economic and social objectives within environmental limits designed to protect critical natural resources. Even though the airport development is very important to cater the demand, however, there are some policies and strategies that need to be done to balance the need and the future.

For modern airports it is important to meet the needs of different internal and external customers. To fulfill this airports are implementing Quality Systems that insure high-level of service. In enterprises such as airport a common practice is implementation of QMS through ISO 9001 certification. It is important to emphasize that constantly improvement of quality performance remains the final goal of QMS.

For this reason Sustainable Development as idea for reaching airport sustainability, needs to be implemented from strategic level to the everyday operations. On airports there are already systems that aim higher level of environmental protection and safety. The SMS is mandatory for airports and modern society requires that airports develop environmental protection programs.

Through the ISO 14001 certification airports can establish EMS that has proven as effective system for managing environmental impact. SMS has been designed and used to effetely influence airport safety performance. The QMS insures high-level of service (processes and procedures). If Sustainable Development is implemented to these systems through airport Strategic Planning it is reasonable to presume that Sustainability can be reached.

Fourth, many similarities exist between Quality Management, Environmental Management and Safety Management systems. For example, their purposes and implementation-related factors are very much alike. Considering these parallels, and since research on QMS and SMS are more fully developed than that on EMS, significant benefits can be expected from applying the knowledge acquired about QMS and SMS to environmental issues.

In the order to effetely mange Sustainable development it is necessary to be able to measure and analyze environmental, economic and social impact of airport operations, processes and procedures. The further research would include defining of Key Performance Indicators (KPIs) for operational performance, and environmental, economic and social impact, based on Sustainable Development requirements. These indicators could be collected by Performance Management System or process directly through QMS.

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DIAGNOSING FAULTS OF MARINE PROPULSION SYSTEMS BY MEANS OF VIBRATION PARAMETERS ANALYSIS

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ABSTRACT

The application of vibro-acoustic analysis methods in marine technology has been presented in the paper. This element of Base Diagnosing System (BDS) is accepted and used in the ships, which are powered by the COGAG power plant from a few years in the Polish Navy. The paper presents investigations of permissible in-service unbalance and appropriate assemblage of turbine rotors on the basis of selected vibroacoustic parameters, and finally determination of their permissible operation time resources. Another element of BDS is vibration control of misalignment of propulsion shafts. The described conception concerns evaluative process of the centring state in a transmission shafts within powered, marine gas turbine system as a function of ships displacement. Some structural components of the gas turbine unit and reduction gearbox have been selected for the analysis. Some results of the vibro-tests have been presented as well. All tests had been worked out during sea trials and have theoretical background.

KEY WORDS

propulsion plan, diagnosing, vibration

1. INTRODUCTION

Since 1984 the vessels equipped with gas turbine engines were operated in the Polish Navy. From the side of users, doubts are often expressed concerning maintenance times or making decision on further exploitation of engines. It is very important task in the case when all elements of propulsion system are foreign. There are two important persons for operational policy who introduced diagnostics in the Polish Navy: Professor Adam Charchalis (Gas turbine propulsion) and Stanislaw Polanowski, Ph. D. Prof Assist. (Combustion Engines) [2].
Application of periodical or on-line diagnostic procedures makes it possible to operate ship propulsion systems in accordance with their current technical state [3]. Especially, in the case when ships' gas turbines hourly period of scheduled maintenance is presently the criteria for maintenance time determination. Though such exploitation strategy makes early scheduling of maintenance operations and their logistic assurance possible, but it simultaneously contributes to increase of costs because of its replacement system of elements (technically often still serviceable ones) as well as it makes impossible to early detect primary symptoms of failures occurring before the end of maintenance time. Because of editorial restriction the paper presents only problem of diagnosing gas turbine propulsion systems.

2. OBJECT OF INVESTIGATIONS

The Tarantula class corvettes and O.F. Perry class frigates, among other Polish Navy ships, are also subject to a permanent basic diagnostic system. They are fitted with COGAG gas turbine propulsion systems. To obtain reliable data on diagnostic parameters, investigations of the gas turbines installed in the presented propulsion system were carried out by means of the multi-symptom diagnostic model whose one of the main features is recording and analysing vibroacoustic signals. The investigations were aimed at determination of permissible in-service unbalance and appropriate assemblage of turbine rotors on the basis of selected vibroacoustic parameters, and - finally – determination of their permissible operation time resources. The investigations were based on the following assumption: if technical state degradation of gas turbine rotor sets is a function of their operation time (at a load spectrum assumed constant) then it is possible to select from the recorded vibration signal spectrum such parameters whose changes can be unambiguously assigned to the operation time [2, 3, 4]. Second one important problem is shaft misalignment between engines and reduction boxes and propeller and reduction box. Dynamic reactions, resulting from exceedance of allowable alignment deviations of the torque transmission elements are able to cause failure of the propulsion system and even lead to loss of movability of the vessel in a relatively short time [2, 5]. Therefore diagnostic control of the gas turbine power plant in operation became necessary.

Appropriate assembling the main engines and the other torque transmission elements inclusive of propellers is practically determined by a set of tolerated dimension and geometrical location requirements, called geometrical dimension assembling chain [5]. Both typical and modular power plants are prone to coaxiality deviation from its permissible values and in consequence to possible failures one or more elements of the propulsion system. The excessive deviation can lead to the loads on bearings and gear teeth much higher than calculated and in result to their premature failures [4].

3. THEORETICAL ASSUMPTION OF ROTOR DYNAMICS

Application of computer simulation for diagnosing a technical state of gas turbines rotor sets should be applied during calculation and project process. In fact it is acted. A problem is started when the producer does not include this kind of know-how in the technical specification for user. Such situation steps out for the export objects like navy vessels equipped with gas turbine engines. During engine assembly, the rotating components are mounted with great care with the main objective of minimising shaft unbalance. However, even with the best of care, such factors as machining imperfection, differential thermal expansion etc cause a small residual unbalance of gas turbine rotor. The dynamic problems of Marine Gas Turbine Engines (MGTE) are connected with such basic elements: rotors, bearings, struts of bearings, engine body, type of substructure, hydro- and meteorological conditions during sea trials and gas flown parameters inside the engine. The quality of work process and stability of MGTE are connected with the state of such parameters as well. Dissipation of energy in rotating machines displays as a torque, revolutions, temperature, gas flown and vibration. Vibrations are connected to: rotors unbalancing, oversize of tolerated axis slope of shafts, abrade of blade tips with the inner roller, wear of axis and radial bearings, asymmetry of springiness and damping characteristics of rotor and their parts and irregularity gas flown forces. Emission of vibration brings a lot of information including opinion of the technical state. Measurements of vibration, their identification, classification, mathematical analysis, including trend function bring information on actual technical state and it allows predicting wear process in the future.

Every rigid body has six degrees of freedom, however a deformation body has unlimited degrees of freedom. Rotating machines like MGTE have an amount of degrees of freedom equal sum of all degrees of freedom engines' parts reduced by amount of rigid nodes connecting these elements of engine. Each part of engine can be represented by physical characteristics obtained from vibration measurements or from modelling of geometry and material – a rigidly joined structure. Application of specified model of rigid body gives ordinary differential equations. The deformation body needs partitive differential equations. The second assumption is much more complicated but it can approach to the real object, especially when it works in wide range of rotary speed. It was a reason of choice the second model. Scheme of diagnostics model MGTE is presented on figure 1.

The residual unbalance occurs on each and all stages of rotor but two vectors of unbalance at both ends of shaft can represent effect of that. They have different values and phase shift. This FE individual and average model creates responses of unbalancing and it can be compare with vibration reports of measurements. The most sensitive unbalance response point at the GT engine is the front frame over a vertical strut. It is an effect of minimal thermal expansion for radial and axis vibration in this point. The model is linear so it is clear that response is directly proportional to the amount of unbalance [5]. It should be noted here that the real GT engine response is unlikely to be linear over wide range (revolution of shaft). Furthermore, the received effect can be accepted only as a statistical approximation of the dynamic engine response.

Construction of rotor is forced from different sources. There are not only unbalancing or gas-flown forces but vibration of vessel's hull, enclosure module, propeller, shaft and gearbox as well. List of potential sources is very long. Generally, there are axis slopes, crack of shaft, blade tip, crack or wane. These sources were focused during modelling and investigation on real object.

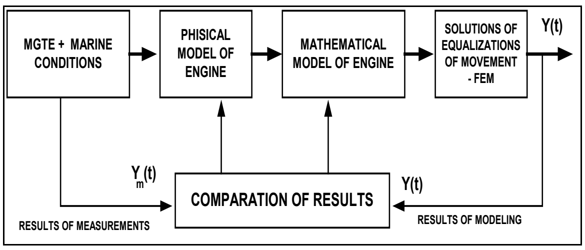

Figure 1. Scheme of diagnostics model MGTE

Losses of material make an influence for changes of moments of inertia of rotated parts. They cause the displacement of main axis of inertia, which is not coincident to the axis of rotation. Finally, it is main sources of unbalancing – vibration of rotor. Mathematical model of this question is difficult because of assessments of damping and stiffness coefficients of struts and bearings.

Shape of the axis deflection is defined as discrete sets:

- Set of static deflections - u_s;
- Set of dynamic deflections– u_d.

Both sets depend on actual technical state of rotor and geometry, which are changed through cracks and wanes of engine parts.

$$\mathbf{u}(\omega t) = \mathbf{u}_s + \mathbf{u}_d(\omega t) \qquad (1)$$

This equation is a discrete set of displacement values points of axis of rotor. Taking into account damping and stiffness of bearing's supports, it can be posit that they are functions of the temporary positions, so:

$$k_{ik} = f(u) \qquad c_{ik} = f(u) \qquad (2)$$

Simplifying problem, it cans asses that for constant rotation these values are constant as well. Using FE method the model presents a three-dimensional discrete model. Rotors of MGTE because of circular symmetry have been described by one-dimensional, two hatches balk – rod symmetry FE which have six degrees of freedom. All of parts have geometrical and material characteristics.

Movement parameters of discrete model have been found by solution of following equation:

$$\mathbf{Ku} + \mathbf{C\dot{u}} + \mathbf{M\ddot{u}} = \mathbf{F}(t) \qquad (3)$$

where:

K – matrix of structure's stiffness,
C – matrix of structure's damping
M – matrix of structure's inertia,
F – vector of forces,
$\mathbf{u}, \mathbf{\dot{u}}, \mathbf{\ddot{u}}$ – displacement and their derivatives (velocity and acceleration).

The issue can be solved as a linear problem but in MGTE's rotor has to allow changes of stiffness and damping which are functions of movement's parameters. In this case equation (3) can be expressed as:

$$\mathbf{K}(\mathbf{u},\dot{\mathbf{u}})\mathbf{u}+\mathbf{C}(\mathbf{u},\dot{\mathbf{u}})\dot{\mathbf{u}}+\mathbf{M}\ddot{\mathbf{u}}=\mathbf{F}(t) \qquad (4)$$

Main purpose of researches had been found sensitive vibration symptoms represented residual unbalancing of rotors and forces from misalignment of shafts. FEA (Finite Element Analysis) are used successfully for a wide range of problems and it may also be used for the modelling and analysis of rotor system. Presently, diagnostics teams commonly use FEA and rotordynamics in conjunction with vibration analysis for detection and identification of unbalancing and misalignment of shafts. A linear model obeys the basic principle of linear superposition. Applied to a structure, this means that displacement resulting from a combination of structural loads is the sum of the displacements due to each individual load making up the combination. Unfortunately we had not enough structural information to create FEA model of marine gas turbine engines. It is a typical situation that the product of operation is made abroad. So, it was decided to apply passive method of investigation that to find reliable symptoms of unbalancing and misalignment using statistical methods and verified them by endoscopic examination. For initial analysis from first to fourth harmonics of amplitude of velocity of vibration, the dimensionless parameters S1 and S2 were taken as sensitive symptoms.

4. THE ROTOR UNBALANCING

The dynamic problems of marine gas turbine engines (MGTE) are connected with such basic elements: rotors, bearings, struts of bearings, engine body, type of substructure, hydro- and meteorological conditions during sea trials and gas flown parameters inside the engine. The quality of work process and stability of MGTE are connected with the state of such parameters as well. Dissipation of energy in rotating machines displays as a torque, revolutions, temperature, gas flown and vibration. Vibrations are connected to:

- rotors unbalancing;
- oversize of tolerated axis slope of MGTE shafts - misalignment;
- blade tips with the inner roller;
- wear of axis and radial bearings;
- asymmetry of springiness and damping characteristics of rotor and their parts;
- irregularity gas flown forces.

Emission of vibration brings a lot of information including recognition of the technical state of machine. Measurements of vibration, their identification, classification, mathematical analysis, including trends, provide information on the actual technical state and it allows predicting wear process in the future. Vibration analysis of MGTE during sea trials are accomplished by two different procedures:

- On-line – in real time;
- Off-line – periodic or single measurements.

Both procedures have advantages and disadvantages. On-line system gives permanent control of vibration parameters in real time. It allows to monitor vibration parameters, holding memory and shutting down the engine in critical state. The data preview of memory can activate the trend functions and it shows changes of frequency or time parameters of vibration as a function of operational time. The disadvantages of this system are linked with costs because of software and hardware are stationary and sometimes individual. Our objects of researches did not have on-line monitoring systems and there are only four propulsion plants that it was a reason to apply periodical off-line diagnostic system.

For realisation of the investigations the measurement instruments: FFT-2148 analyser and PULSE v 9.0 software of Bruel & Kjaer, were used making it possible to collect and process measured data. Measuring transducers (accelerometers) were fixed to steel cantilevers located on the flange of the low-pressure (LP) compressor only. It was decided to carry out the investigations with the use of the transducer fixed to the LP compressor flange for lack of transducers and equipment suitable for measuring signals at the temperature as high as 200º÷ 300º C occurring on the high-pressure (HP) compressor flange.

The fixing accelerometers' cantilevers are characterised of a vibration natural resonance frequency value, differ enough from harmonic frequencies, due to rotation speed of the turbine rotors and their harmonics. The measurements were taken perpendicularly to the rotation axis of the rotors over main bearings. Such choice was made on the basis of theoretical consideration of excitations due to unbalanced shaft rotation, and results of preliminary investigations of the object [5]. As signals, usable for the „defect-symptom" relation, the following magnitudes were selected by the turbines' producer:

- Ysnc - 1st harmonic RMS value of vibration velocity amplitude connected with the LP rotor of compressor;
- Yswc - the same but connected with HP rotor of compressor;
- Yrms – RMS value of vibration velocity amplitude within the range of 35 Hz ÷ 400 Hz.

The choice was justified by the time-between-repair values scheduled by the turbines' producer. For the purpose of these investigations a simplification was made consisted in assuming values of the after-repair turbine vibration symptoms as those of the new turbine. To make such assumption was necessary due to rather low number of the investigated objects (only eight turbines of each type). The turbines' producer specified the limit values of RMS vibration velocity amplitude with filtration depend the rotation speed of rotors and the power.

In order to obtain uniform diagnostic procedures regarding unbalance assessment of the turbine rotors the dimensionless parameters characterising that states were applied. On the basis of theoretical considerations as well as results of other diagnostic investigations carried out for some years the following parameters were selected as the most sensitive:
S1 – ratio of the mean vibration velocity amplitude of a given rotor (1st harmonic) and the velocity component relevant to 2nd harmonic excitation frequency of the rotor in question;
S2 - ratio of the mean vibration velocity amplitude of a given rotor (1st harmonic) and the velocity component relevant to 3rd harmonic excitation frequency of the rotor in question.

5. VIBRATION ANALYZING OF THE RUN-UP PROCESS

First test was analyzing the run-up process in the turning of engine process, often called the cold start process. The cold start process is useful for vibration analyses due to the elimination disturbances from the combustion process [1]. Characteristic of acceleration of the LPC rotor presents Figure 2.

Synchronous signal was collected from the tachometer coupled with the auxiliary drive gear box where the transmission ratio average *i*=0,125, so the LPC rotor had 8 times higher rotational speed than presented in the Figure 2. The main goal of the synchronous analyzing vibration signals during the run-up process was the identification of dynamics disturbances. The influence of "other" signals is presented in the Figure 3.
The run-up process was started in point t = 7 second (see Figure 3) so all vibration signals recorded before start point contain "other" signals coming from dynamics of another rotated machines in the power plant, natural frequencies of engine or their combinations. It allows to identify main "other" signals like: f_1 = 305 Hz, f_2 = 600 Hz, f_3 = 1,6 kHz i f_4 = 2 kHz which originate from the natural frequencies of the engine foundation.

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Figure 2. Rotors LPC rotational speed characteristics during run-up process

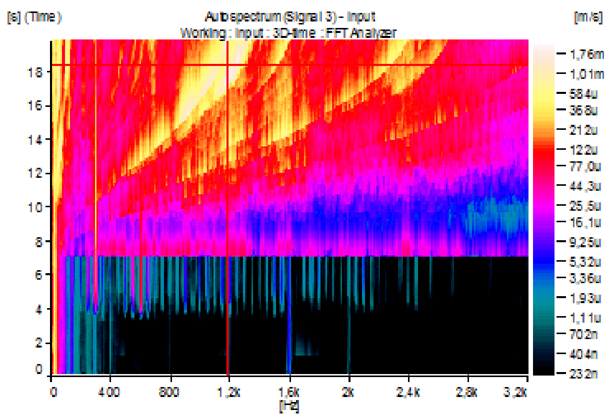

Figure 3. Synchronous spectra of the velocity of vibration during run-up process with using the band – pass filter of 0,1Hz – 3,2 kHz range

The most energetic signal in the domain of the velocity of vibration, recorded during rotors acceleration is the I harmonic. The synchronous spectra recorded after t = 7 seconds confirms the difficulty of the unambiguous identification of the spectral components including I harmonic as well.

6. VIBRATION ANALYZING OF THE SHUT-DOWN PROCESS

Next test, connected with analyzes of vibration parameters, was the shut-down processes in the turning of engine process. The Order Tracking lies in the fact that tacho signal delivering the tracking reference must be selected from rotating shaft. Tacho, speed level and speed interval triggers are available when a Tachometer are inserted in a measurement setup. They can be used for triggering measurements and starting, updating and/or stopping storage of time signals and/or spectra to multi-buffers. Order analyzers can measure time (revs) signals, autospectra for signals and the cross-spectra of selected pairs of signals.

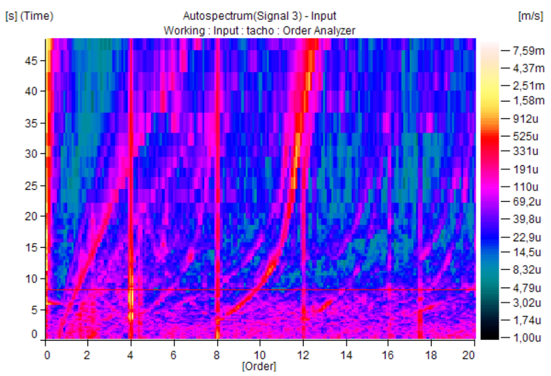

Figure 4. Autospectrum of velocity of vibration in the shut-down process with the use of order tracking procedure, in the domain of time function

The Figure 4 presents autospectrum of signal 3 of velocity of vibration with the use of Order Tracking procedure [8]. Changes of parameters are presented in the domain of time function – fig. 4. In contrary to run-up process the main vibration signal in the shut-down process of rotor is subharmonic (1/2 of harmonic) – presented as a 4 Order. Gradient slope of pressure characteristic of the lubrication oil in the radial bearing brought the upgrowth the misalignment between of HPC and LPC rotors (HPC shaft rotated inside the LPC shaft – see Figure 1) and typical in the technical diagnostics domination of subharmonic.

Upgrowth of stiffness of bearing system confirm the "right-hand branches" of harmonics appeared from the time point equal 4 second from 4, 8 and 12 orders when the pressure of lubrication oil fall down.

Analyses of gas turbine rotors dynamics in the non-steady states with the use of PULSE system should be made in both processes. The start-up process allows to recognize "other" signals but the identification of dynamics features is very difficult regard to the high rotors acceleration. Identification of dynamics features of rotors system is well recognized in deceleration as a main orders characteristics – Figure 5 and 6. Both characteristics confirm results of modes of the rotor system calculated with the use of FEM [6].

Analyze of the I harmonic (8 order) enables to observe changes of dynamics features as a trends. Application of the domain of rotors rotational speed function is the most important thing in basic orders analyze during shut-down process. It allows to identify changes of natural frequencies without any disturbances signals coming from thermo-dynamics processes typical for "hot work" of gas turbine engine – Figure 5 [7,8].

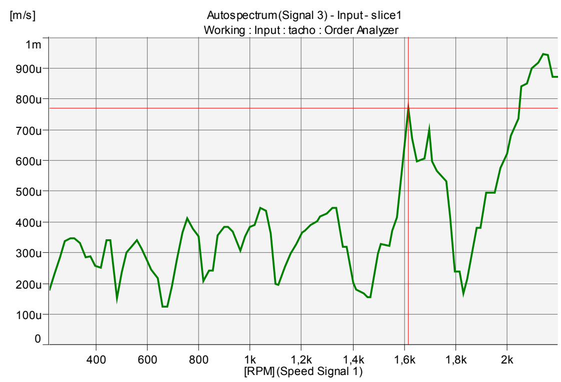

Figure 5. Autospectrum of 8 order (I harmonic) of velocity of vibration in the shut-down process of LPC rotor stoppage.

Analyzes of subharmonics signals are very useful as well. The autospectrum of 4 order (subharmonic) of velocity of vibration in the shut-down process of LPC rotor shows individual features of analyzed rotor system. Increase of subharmonic value in the domain of rotors rotational speed is like a fingerprints of rotor system.

Every changes of technical state like changes of stiffness and damping, unbalancing or misalignment caused changes in the characteristic of subharmonic – Figure 6.

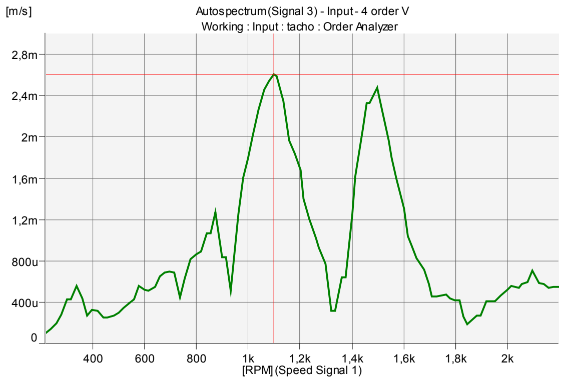

Figure 6. Autospectrum of 4 order (subharmonic) of velocity of vibration in the shut-down process of LPC rotor stoppage.

7. CONCLUSIONS

The realization of the investigations with the use of Order Tracking procedure made reliable verification of the investigation results possible. The following detail conclusions were drawn for further diagnostic inference of compared method:

Both programs – start up and stoppage, have their own advantages and disadvantages but they can fulfill all technical requirements for diagnosing rotors systems of marine gas turbine engines.

The synchronized measurement of vibration signals allows to recognize specified symptoms of resonance and changes of natural frequencies during processes of run-up and stoppage of rotor systems.

Application Order Tracking procedures for monitoring system of gas turbine engines enables recognize changes of technical state characteristic for modes changes.

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HOW DEPENDENT IS THE COMPETITIVENESS OF PORT OF KOPER ON ITS RAILWAY CONNECTION

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ABSTRACT

North Adriatic ports, namely Venice, Trieste, Koper and Rijeka operate in a common market and serve similar gravitational area which extends up to the Central European counties. By theory, the functioning of any single port deeply depends on its hinterland connections. Four North Adriatic ports are located in three different countries, and each of them has certain national strategic priorities, however all of them share the same goal, which is to establish a competitive railway connection on corridor V. Slovenia seems to be rather indecisive in achieving this goal, and the construction of second railway track linking port of Koper to the corridor V has not yet been confirmed.
The paper presents three developmental possibilities of the port of Koper in regards to its hinterland railway infrastructure development. First forecast is based on "status quo" scenario, meaning that no significant improvements would occur on the port's railway connection. The second scenario considers some major upgrades to the existing line, while the third scenario implies the construction of second railway track in the length of 27 kilometres.

KEY WORDS

ports, hinterland connections, railways, infrastructure development, traffic flows

1. INTRODUCTION

Ports are complex entities that play an important role in the transportation of freight, given the fact that around 90 % of the world's commodity trade is transported by sea. However, ports around the globe are not equally important for the maritime trade; About 4,600 commercial ports are in operation worldwide, but only less than one hundred ports have a global importance (Rodrigue, Comtois, & Slack, 2013). In fact, various studies (e.g. Slack (1985), Tongzon (2002) or Wu (2011)) point out to many factors affecting the selection of the seaports by the shippers. These factors are: port's infrastructure and equipment, port's efficiency, sailing frequency, location of the port, port's hinterland accessibility, port charges and the costs of auxiliary services, reputation of the port etc.

Majority of listed factors are deeply dependent on port's policy and management, however in this paper the authors are focused on determining the importance of land connections on port's selection in the North Adriatic zone and consequently on port's performance.

The existing studies clearly indicate that when a port or its hinterland facilities are more strongly congested than is the case for competing ports, the quality of that port's service may be lower in that it takes more time to access and egress the port and the reliability of service declines, and this weakens its competitive position (OECD/ITF, 2008). In addition de Langen (2008) stated that in most door-to-door transport chains, the costs of hinterland transport are higher than maritime transport costs and port costs combined. And this is without taking into the consideration the external costs of transportation.

2. THE NORTH ADRIATIC PORTS

The port of Koper is the only Slovenian international cargo port. It is situated in northern Adriatic zone and it is geographically as well as strategically connected to several other ports of North Adriatic, namely Venice, Trieste and Rijeka. These ports cooperate within the North Adriatic Port Association (hereinafter NAPA) to attract cargo flows to the North Adriatic area, in particular container traffic between Asia and Eastern European countries, but at the same time they compete among each other to attain strategically and financially important cargos as they share very similar gravitational area.

Figure 1. The geographic proximity of NAPA ports

Although North Adriatic ports are positioned in a very small area, they are located in three different countries and are given different importance by the national governments.
These ports differ in ownership and institutional aspect as well as in size and cargo specialization. The main characteristics of NAPA ports are presented in Table 1.

Table 1. Main characteristics of NAPA ports.

	Koper	Rijeka	Venice	Trieste
Port area [000 m^2]	2,800	1,500	20,450	2,300
Quayside [m]	3,300	8,652	30,000	12,000
Berths	26	58	163	
Terminals	11 +1		26+8	> 20
Max sea depth [m]	18	28	14	18

Source: (NAPA, 2014), (Port of Venice, 2014)

The port of Venice and the port of Rijeka are focused on project and general cargo, liquid cargo represents more than 70% of throughput in the port of Trieste, while port of Koper is giving advantage to vehicles and containers. So, although all of the north Adriatic ports are international multipurpose ports they have certain specialization and do not affect each other's business considerably. However all of these ports want to improve their container records.
The total productivity of NAPA ports is shown in Figure 2.

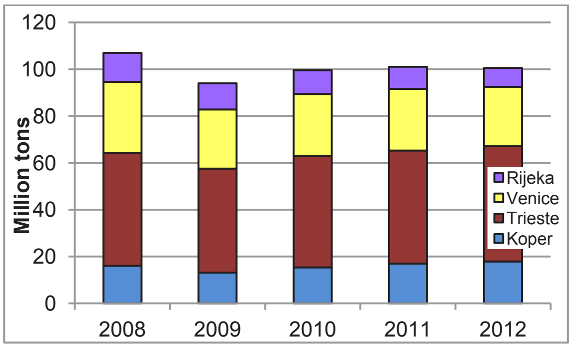

Figure 2. Throughput in North Adriatic ports.
Source: (Luka Koper, 2009), (Luka Koper, 2011), (Luka Koper, 2013), (Port of Venice, 2014), (Port of Trieste, 2014)

Just as port's maritime connections are important for the port's performance so are also the links with the hinterland. None of North Adriatic ports has a connection to the hinterland through the inland waterways therefore they entirely depend on the permeability of road and rail infrastructure. While Italian ports Venice and Trieste are well connected both with rails (high capacity double-track electrified route) and roads to the main European transport corridors, the port of Koper and port of

Rijeka lack good railway connections with their hinterland.

3. THE PORT OF KOPER

The port of Koper is a modern and well equipped multipurpose port which is managed by Luka Koper, plc.
The port of Koper had a throughput of 17.88 million tons in 2012 (including transhipment), and this amount was distributed to eight main markets as can be seen in Figure 3.

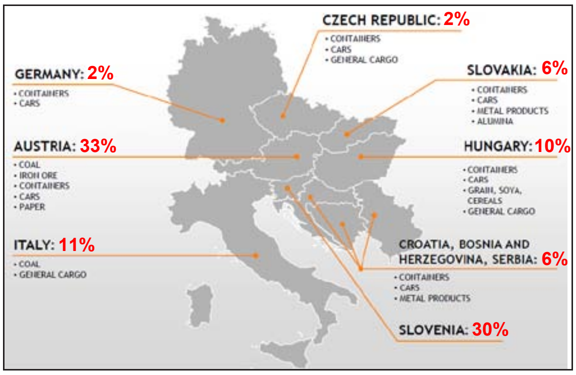

Figure 3. Port of Koper hinterland markets by share and type of cargo (in 2011).
Source: Authors, based on (Morato, 2010) and (Luka Koper, 2012)

All terminals at the port of Koper have a suitable road and rail infrastructure, which enables direct manipulations ship truck and ship wagon. While Slovenian motorways system is pretty much completed, the railway system has been neglected for many years, and the port of Koper is connected to its hinterland by a single track line constructed back in 1967. The Slovenian rail system is currently characterized by the following problems (Žerak, 2011):

- replacement of tracks in the length of more than 36 km is needed,
- immediate replacement of 39,000 individual cross-ties is needed,
- lower speed is in force on 30 spots of railway network (in total 60 km),
- presence of 18 potential landslides and dangerous slopes (totalling in more than 8 km).

Furthermore, the existing railway lines, with the frequent curves radius of about 300 m, and frequent level crossings as well gradients of up to 27 ‰, do not meet the needs of modern transportation nor in terms of their parameters nor in terms of their capabilities (NPRSZI, 1996).
Railways productivity is also lowered due to the fact that the permissible axle load of 22.5 $^{tons}/_{axle}$ is not provided on the entirety of the two corridors passing across Slovenia (Slovenian railways, 2014).
In addition cargo trains travel with approximate speed of 40 $^{km}/_{h}$ on Slovenian rails (Slovenian railways, 2013) and the current port's single track railway connection between Koper and Divača requires 21 minutes time span between two consecutive freight trains with gross weight of 1,750 tons. The same applies to trains with the gross weight of 1,450 tons that use two traction locomotives (Damjan, 2012).
However, although port hinterland services in Europe mostly rely on road transport (Fremont & Franc, 2010), and given the condition of Slovenian railways which is in general unsatisfying, surprisingly, around 60 % of the goods headed to or from the port of Koper are transported by train. This means that approximately 470 waggons per day arrive or depart from the port of Koper (Luka Koper, 2014).
The analysis of the throughput of north Adriatic ports shows recovery in all ports besides the port of Rijeka, and the Slovenian port of Koper is in forefront. This suggests that the poor railway connection between Koper and Divača at the moment does not affect port's performance, at least not significantly.

3.1. The port of Koper expansion plans

With the five-year strategic plan published in 2011, Luka Koper revealed that they intend to achieve an annual cargo throughput of 21.4 million tonnes by 2015 (Luka Koper, 2011).
Furthermore, Luka Koper has ambitious development plans for the port zone, including an extension of the two existing piers and the construction of the third pier, which would be dedicated solely to container handling. The planned expansions should provide around 1,500 m of additional quayside and lead to the growth and changes of structure of port's throughput.

According to Damjan (2012), the throughput of the port of Koper could range from 28 to 39 million tons excluding transhipment in 2030. However, such growth could be endangered by inadequate hinterland connections, more precisely by an out-dated and saturated railways connection. Further problem might arise if European Union manages to internalise the external costs of transportation.
Consequently this could threaten broader economic benefits as the calculation by the Ljubljana Institute for Economic Research showed that every euro earned through port operations generates 1.12 euro of value added at the state level, and each employment post within Luka Koper engenders 1.6 private sector jobs (Luka Koper, 2011).
Modernization of the railway connection between Koper and Divača is currently undergoing, and when finished, it should provide a capacity of 14,3 million tons.

Table 2. Current and planned permeability and capacity of railway direction Koper – Divača

	Permeability [trains/day]	Capacity [mio t]
Existing line	72	9,2
Modernization of existing line	82	14,3

Note: * Subsection Koper – Črni Kal

Source: (Računsko sodišče RS, 2010, p. 46)

However, Damjan (2012) asserted that the modernized existing line Koper – Divača could become saturated by the year 2018 (or even by the year 2017), and would as such represent the bottleneck in the dynamics of the development of the port of Koper. Therefore he created three scenarios in relation to the railways upgrade in Koper's proximity. The scenarios are based on:

- construction of new railway track Koper – Divača,
- construction of railway line Koper – Trieste
- no constructions at all.

It is clear that the first option would be the most expensive as it would, besides construction costs, include also the maintenance costs of a new track. However, this option would allow unhindered growth and development of the port of Koper according to Luka Koper's developmental plans. In addition, Slovenian economy would benefit from the multiplicative effects of the second railway track Koper – Divača.
This of course would not be the case if the railway connection Koper – Trieste is to be built instead. Cargo throughput from the port of Koper, exceeding the capacity of the modernized connection Koper – Divača, would then be moved both to the Slovenian motorways as well as to Italian railways. The question is how long would that be a functional option, as the port of Koper's development would be impacted by the policy of Italian railways and Italian government.
The latest option is at *prima facie* the cheapest one, but in long term this option would for sure obstruct the development of the port of Koper as Slovenian motorways would not be able to accommodate all the freight traffic arising from the needs of the port of Koper. This option would drastically affect the operation and the state of the Slovenian motorways and the level of traffic safety in Slovenia. Damjan (2012) estimates that in such case the extra external costs of road transportation in the period from 2018 to 2030 would range from 590 to 2,019 million EUR, way more than the construction of the railway connection Koper – Divača would cost. Sooner or later external costs of transportation, at least in the segment of emissions, will be internalised as a tight carbon budget for the transport sector is listed as one of the future challanges of Euopean transport sector (EC, 2011).

4. CONCLUSIONS

Compared to the northern-European ports, the shipping route from Koper to the Mediterranean countries and those further away from Suez, is shorter by more than 2000 NM (Luka Koper, 2014). The port obviously has the growing potential.
As the calculations show, the throughput of the port of Koper has not been hindered due to the poor railway connection Koper – Divača, as the port of Koper has registered the highest improvement in throughput among the north Adriatic ports in recent years. In fact, in contrary to European practice, port of Koper still manages to transport around 60 % of cargo handled in the port by rails.
But short trains (<540 m) due to the high gradients and lack of investments, low tonnage

limits and low speeds, might well hinder the future development of the port of Koper.

Firstly, Luka Koper would need to conduct a research to determine which are the key factors for the shippers to select the port of Koper. If land transportation costs and times are highly ranked, the expansion of the port would not be a good idea until the decision of the construction of second railway track Koper – Divača is confirmed.

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P&I COVERAGE REPATRIATION COSTS OF CREW MEMBER IN CASE OF SHIPOWNER INSOLVENCY

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ABSTRACT

Repatriation of crew member as a consequence of death, personal injury, illness or desertion is a subject of the standard insurance cover under the P&I clubs rules. Repatriation costs in other circumstances – shipowner bankruptcy (insolvency), until recently, were outside the scope of insurance cover. According to the solutions Regulation 2.5 – Repatriation, Standard A2.5.1. (b) and Guideline B2.5.1. (b) (iii) – Entitlement to repatriation of the Maritime Labour Convention (2006) provides that Member States Parties shall ensure that crew members on vessels flying their flag are entitled to repatriation in case where the shipowner is no longer able to fulfill his legal and contractual obligations as an employer of a crew member ie. he is unable to pay the repatriation costs. The author presents and analyzes the P&I cover repatriation costs of the crew member under the P&I clubs rules before and after entering into force of the Maritime Labour Convention (2006) on international level (20 August 2013) pointing to the necessity of amendments to the relevant P&I Clubs Rules in relation to the following insurance period. The author concludes that the application of international legal solutions in order to provide a better living, working and social conditions of the crew members, the extension of P&I insurance coverage and negative effects of the global financial crisis on the maritime insurance market will be reflected in the payment of supplementary calls members of P&I clubs and changes in insurance terms in P&I clubs rules.

KEY WORDS

P&I cover, repatriation costs, crew members, shipowner insolvency

1. INTRODUCTION

An estimated 90% of world trade is carried on ships and seafarers are essential and integral part of international maritime trade and shipping industry. The imperative condition for successful further development of maritime trade as a world industries represents strengthening of marine insurance in all sectors and its adaptation to complex factors of globalized maritime transport. The purpose of this paper is to analyze the impact of international harmonization social, living and working conditions for seafarers on ships on the marine insurance market. This paper interprets the most important standards of the P&I coverage repatriation costs of crew member under the sources of maritime and insurance law and P&I clubs rules.[1] Trying to provide globally acceptable working and living conditions for seafarers on ships in order to promote a better shipping environment on the 23rd February 2006 Maritime Labour Convention (MLC) was adopted as a "Seafarers' Bill of Rights". MLC as labour-legal instrument came

[1] The following discussion, outlining the cover of repatriation costs of crew member in case of shipowner insolvency, is based upon the rules of the North of England Protection and Indemnity Association; the Japan Ship Owner's Mutual Protection & Indemnity Association; the London P&I Club; the Swedish Club and circulars of the American Club; the North of England P&I Association Limited and UK P&I Club.

into force internationally on 20 August 2013[2] providing set of comprehensive rights and protection at work for seafarers[3] and aiming to achieve minimum on bord working conditions covering a wide range of matters, including working hours, health and safety, crew accommodation, seafarers' welfare and seafarers' contractual arrangements.[4] Title 2. "Conditions of employment" of the MLC deals with seafarers' employment agreements, wages, hours of work and hours of rest, entitlement to leave, repatriation, seafarers compensation for the ship's loss or foundering, manning levels and career and skill development and opportunities for seafarers' employment which confirms that MLC is the most important international convention on labour in the shipping industry.

2. REPATRIATION COSTS OF CREW MEMBER IN CASE OF SHIPOWNER INSOLVENCY UNDER MLC

In order to ensure success of the application of uniform standards of rights and duties for seafarers, MLC establishes rights and duties for shipowners[5] and states particularly on repatriation[6] as a fundamental right of seafarers. According to the Guideline B2.5.1 of MLC, seafarers are entitled to repatriation in these caeses: i) in the event of illness or injury or other medical conditions which requires their repatriation when found medically fit to travel; ii) in the event of a shipwreck; iii) in the event of the shipowner not being able to fulfil their legal or contractual obligations as an employer of the seafarers by reason of insolvency, sale of ship, change of ship's registration or any other similar reason; iv) in the event of a ship being bound for a war zone, as defined by national laws or regulations or seafarers' employment agreements, to which the seafarer does not consent to go; and v) in the event of termination or interruption of employment in accordance with an industrial award or collective agreement, or termination of employment for any other similar reasons.

According to the Standard A2.5.1 of MLC each Member (States Parties to the MLC) shall ensure that seafarers are entitled to repatriation in the following circumstances: a) if the seafarers' employment agreement expires while they are abroad; b) when the seafarers' employment agreement is terminated (by the shipowner or by the seafarer for justified reasons) and c) when the seafarers are no longer able to carry out their duties under their employment agreement or cannot be expected to carry them out in the specific circumstances.[7] Member States Parites to the MLC will require from ships[8] flying their flag to maintain financial security to ensure that seafarers will be repatriated at no costs to themselves and

[2] Until 03 February 2014, 56 states have ratified the MLC and the vessels flying the flags of those states represent in excess of 70% of world's gross shipping tonnage. The current list of states which ratified the MLC may be found on Ratifications of MLC – Maritime Labour Convention, 2006. available from: http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11300:0::NO:11300:P1130...[Accessed 03 February 2014]. Text on MLC 2006 available from: http://www.ilo.org/wcmsp5/groups/public/..ednorm/...normes/documents/normativeinstrument/wcms_090250.p, pp.1-112, [Accessed 10 December 2013]

[3] Seafarers means any person who is employed or engaged in any capacity on bord a ship to which MLC applies (ar.2 f MLC).

[4] UK P&I Club Circular 8/13: Enry into Force of the Maritime Labour Convention, 2006 (MLC), 07/03/2013. Available from :http://www.ukpandi.com/knowledge/article/circular-8.13.entry-into-force-of-the-mari [Accessed 11 November 2013].

[5] Shipowner means the owner of the ship or another organization or person, such as the manager, agent or bareboat charterer, who has assumed the responsibility for the operation of the ship from the owner and who, on assuming such responsibility, has agreed to take over the duties and responsibilities imposed on shipowners in accordance with this Convention, regardless of whether any other organization or persons fulfil certain of the duties or responsibilities on behalf of the shipowner (ar.2. j MLC).

[6] Handbook Guidance on Implementing the Maritime Labour Convention, 2006 Model National Provisions, International Labour Organization, Geneva, Switzerland, 2012., pg.32.: In the case of illness or injury of a seafarer or when a seafarers' employment agreement expires abroad or whenever service on bord exceeds a prescribed period (which must be less than 12 months of service) seafarers must be confident that the flag State concerned requires that shipowners will return the seafarers to their homes or to the place where they joined the ship or place required by any applicable collective bargaining agreement. This rights – called „repatriation" – must normally be without charge to the seafarer concerned.

[7] See more about repatriation of seafarers under MLC 2006. on http://www.ilo.org/wcmsp5/groups/public/..ednorm/...normes/documents/normativeinstrument/wcms_090250.p, pp.35-38, [Accessed 10 December 2013].

[8] Ship means a ship other than one which navigates exclusively in inland waters or waters within, or closely adjacent to, sheltered waters or areas where port regulations apply (ar.2. i MLC).

shipowners wil provide financial security for the liabilities established in Standard. Shipowners are responsible for the following seafarer's repatriation costs: a) passage to the destination[9] selected for repatriation,[10] b) accomodation and food from the moment the seafarers leave the ship until they reach the repatriation destination, c) paying the allowances from the moment the seafarers leave the ship until they reach the repatriation destination, d) transportation of 30 kg of the seafarer's personal luggage to the repatriation destination and e) medical treatment when necessary until the seafarers are medically fit to travel to the repatriation destination.[11] The shipowner's duty to cover the costs of repatriation continues until the seafarers concerned are landed at a repatriation destination or are provided with suitable employment on bord a ship proceeding to one of those destination.[12]

Repatriation of seafarers in cases of shipowners insolvency is one of the key areas of the MLC which has caused concern amongst shipowners and their insurers. Standard A2.5.1 (b) and Guideline B2.5.1 (b) (iii) of the MLC provides that Member States Parties shall ensure that seafarers on ships flying their flag are entitled to repatriation, including repatriation in casees of shipowner's insolvency[13] although insolvency is not a typical marine liability,[14] and may leave insurers out of pocket with no chance of recouping their outlay from their assured.[15]

3. REPATRIATION COSTS OF CREW MEMBER IN CASE OF SHIPOWNER INSOLVENCY AND P&I INSURANCE

P&I club cover liability to pay damages or compensation for personal injury, illness or death of any seaman of the entered vessel who is on bord or proceeding to or from the entered vessel.[16] P&I insurance also covers a shipowner's liability (the most extensive liability insurance in the world)[17] to pay the costs of repatriating crew members who become sick or are injured on bord and hospital bills and costs of sending replacement personnel to the ship if necessary.[18] These claims for repatriation have been covered in the past under standard P&I cover - shipowner's P&I policy. Where a member's (shipowner's)[19] liability arises under the terms of a crew agreement and would not have arisen but for such terms the club will cover the liability only if the terms have previously been approved by the managers (club's managers)[20] in writing.[21]

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[9] The destination should include the countries with which seafarers may be deemed to have a substantial connection including the place at which the seafarer agreed to enter into the engagement, the place stipulated by collective agreement, the seafarer seafarer's country of residence or such other place as may be mutually agreed at the time of engagement – the normal mode of transport should be by air (Guideline B2.5.1. para. 6).

[10] Seafarers have the right to choose from the prescribed destination the place to which they are to be repatriated (Guideline B2.5.1. para. 7).

[11] Guideline B2.5.1 para. 3.

[12] Guideline B2.5.1 para. 5.

[13] See also An ITF Guide for Seafarers to the ILO Maritime Labour Convention, A Seafarers' Bill of Rights, 2006, The International Transport Workers' Federation, London. Available from: http://www.itfseafarers.org/files/publications/23556/SBoR_English_inside_small.pdf [Accessed 11 November 2013].

[14] Mutualisation of insolvency risk is a significant departure from the traditional areas of marine liability cover provided by the clubs (see more on http://www.intermanager.org/2013/04/cover-for-crew/) [Accessed 04 February 2014].

[15] Ayres, E. „MLC – implications for insurers“, Marine Insurance Bulletin, London, October 2013, pp. 2.

[16] Hazelwood, S. J. „P&I CLUBS Law and Practice“, Third edition, LLP, London – Hong Kong, 2000, pp.212.: Also covered is liability for hospital, medical, funeral or other expenses incurred in relation to injury, illness or death. See also P&I Rules North of England Protection and Indemnity Association limited, The Roundhouse, Newcastle, UK, 2011/2012, pp-23., section 3., Risks covered, rule 19 (1) Liabilities in respect of seamen, (d) – Repatriation and substitution expenses necessarily incurred as s consequence of the death, personal injury, illness or desertion of any Seamen of an Entered Ship.

[17] Billah, M. M. „Effects of Insurance on Maritime Liability Law“, Springer, 2014, pp.2

[18] An introduction to P&I insurance for mariners, SKULD, pp.10. Available from: http://www.fd.unl.pt/docentes_docs/ma/wks_MA_16683.pdf . [Accessed 13 January 2014].

[19] Hazelwood, S. J., *op.cit.*, pp.83.: Club membership is usually made up of shipowners, corporate and individual, managing owners, ship's operators and charterers. More about club's member see Bennet, P. „Mutuality at a distance? Risk and regulation in marine insurance clubs, Environment and Planing, vol. 23., 2000., pp.155-156.; Pavić, D. „Pomorsko osiguranje pravo i praksa“, Književni krug, Split, 2013., pp.442.

[20] Hazelwood, S. J., *op.cit.*, pp. 20-21: In the majority of the modern P&I clubs the management is now undertaken by a

MLC prescribes that shipowner has to provide financial security for their liability to repatriate sefarers at shipowner's expense including repatriation in case of insolvency. P&I insurance is not a financial security system and does not cover shipowner "credit default" i.e. the failure through insolvency or otherwise to meet the costs of contractual commitments with respect to a crewmember's repatriation.[22] While many shipowners were hoping that P&I cover would be sufficient for covering repatriation costs of seafarers in case of shipowners insolvency, repatriation costs under Guideline B2.5.1. para.1.(b), iii) – v)) were generally outside the scope of insurance cover excluded by all Group clubs. P&I clubs do not allow recovery for losses arising out of irrecoverable debts or out of the insolvency of the shipowner.[23] The owners' and operators' response to the finacial security obligations under MLC was to put pressure on the P&I clubs to confirm that the repatriation obligation will be covered even in case of shipowners insolvency, while under MLC seafareres have the right to be repatriated at no costs to themselves in the event of the shipowner not being able to continue to fulfil their leagal obligations as an employer of the seafarers by reason of insolvency. On the 12th May 2013 all 13 P&I clubs in the International Group of P&I Clubs[24]- which represents a unique system of mutual insurance in shipping economy covering more than 95% of the world's fleet[25] (approximately 89% of world tonnage and 100% of European tonnage is covered by P&I Clubs which are members of the International Group),[26] have agreed to provide cover for repatriation costs under MLC and extend the scope of standard P&I cover - including repatriation in cases of insolvency (although it will not be poolable)[27] and in the other circumstances listed in MLC where seafarers are entitled to repatriation.[28] For the purpose that club rules and scope of the club cover should not only be similar in character but should also receive similar or consistent interpretation by the clubs of the International Group,[29] P&I clubs issued a circular to its members in which they gave details of the financial security required of shipowners in respect of repatriation, death or long term disability of seafarers.[30] In circular they confirm that club cover

separate specialist legal entity, either a limited company or a partnership. The job og the managers is to put practice the decisions and policies of the directors. In addition, the managers are also responsible for, inter alia, collecting calls, looking after the accounts, appointment of correspondents, claims handling, underwriting, investments, maintenance of records, signing policies and issuing certificates of entry, paying claims and laying reports before the committee of directors and keeping minutes of such bord meetings. More about legal structure of P&I Clubs see De la Rue, C., Anderson, C. B. „Shipping and the Environment", Informa, London, UK, 2009., pp. 728-729..

[21] Hazelwood, S. J., *op.cit.*,pp.213.

[22] Sixth session on the Joint IMO/ILO Ad Hoc Expert Working Group on Liability and Compensation on regarding Claims for Death, Personal Injury and Abandonment of Seafarers, 19-21 September 2005, pp.6. Available from: www.seacrews.com/pdf/seacurus_imo_ilo_paper-pdf [Accessed 05 February 2014]. See Tilley, M. „The Protection and Indemnity Clubs and Bankruptcy", Journal of Maritime Law and Commerce, Baltimore, vol.17., no.4., 1986., pp. 531-537.; Montgomery, R. A. „Marine Insurer Insolvencies – Who Pays the Claims?", Journal of Maritime Law and Commerce, vol. 18., no.3., 1987., pp. 395.-409.

[23] Coper, A. D., Stanberry, B. A., Boerne, G. L. „ Voyages of Abuse: Seafarers, Human Rights and International Shipping", Pluto Press, London, 1999., pg.161.

[24] Each Group club is an independent, non-profit making mutual insurance association, providing cover for its shipowner and charterer members against third party liabilities relating to the use and operation of ships. More about the members of the International Group of P&I Clubs available from: http://www.igpandi.org/Group+Clubs [Accessed 03 February 2014].

[25]Coper, A. D., Stanberry, B. A., Boerne, G. L., *op.cit.*, pp.161.

[26] Chrstodolou, D. „Protection & Indemnity Clubs and Competition", in: Competition and Regulation in Shipping and Shipping related Industries, Martinous Nijhoff Publishers, Leiden, Netherlands, 2009, pp. 321.

[27] Ayres, E., *op.cit.*, pp. 2.

[28] UK P&I Club Circular 10/13: Entry into force of the Maritime Labour Convention, 2006 (MLC) – Financial Security Requirements, 24/05/2013. Available from: http://ukpandi.com/knowledge/article/circular-10-13-entry-into-force-of-the-ma..[Accessed 11 November 2013]. See also American Club Circular No. 09/13, 06/03/2013 available from: www.american-club.com/files/files/cir_09_13.pdf [Accessed 05 February 2014].; Insurance market clashes over MLC provisions for unpaid waes, Lloyd's List, Web Edition, 22. May 2013., pp.1-2. Available from http://www.crewmatics.net/uploads/news-master/0230990001369296735.pdf [Accessed 03 February 2014].

[29] Hazelwood, S.J., *op.cit.*, pp.387.

[30] See The North of England P&I Club Circular Ref: 2013/022 – Club Cover for MLC liabilities – Amendments to P&I Class Rules 19(1), Liabilities in Respect of Seamen, and Rule 20, Payments First by the Member, 24/05/2013. Available from: http://www.nepia.com/publications/clubcirculars/pandigeneral/1355. [Accessed 13 January 2014].

would be extended accordingly and that extension represents a departure from the standard P&I position that, being mutuals, they will not indemnify in respect of the insolvency of a member.[31]

By extending cover for repatriation costs in cases of shipowners insolvency, P&I clubs have enabled members to avoid having to buy a new insurance cover although providing this cover via P&I market represents a conflict of interest. The Board's decision to extend the scope of P&I cover including repatriation expenses under MLC means that additional amendments (cover for repatriation liabilities incurred under Guideline B2.5 of Regulation 2.5 of MLC) should be made to the relevant P&I Club Rules for the next policy year[32] (2014/15)[33] and these amendments took effect immediately – before entering into force of the MLC.

P&I insurance is shipowner's insurance cover for legal liabilities to the third parties arising in connection with the operation of ships founded on the basis of mutuality. Cover provided by P&I clubs is not liability but indemnity cover.[34] General rule contained of most P&I clubs represents the application of Payment first by the Member ("pay to be paid") provision which means that the members have the right to recover from the funds of the P&I club in respect of any liabilities, costs or expenses that he shall first have discharged or paid the same.[35] Club can insist that it is under no liability unless and until the member has first paid the relevant costs or liabilities out of his own funds.[36] Thus when a shipowner finds himself with a cash-flow crisis on his hands, even if he manages to avoid his P&I club cancelling his insurance, he must still pay the cost of a crew's repatriation – he must "pay to be paid".[37] Since 2008, the Club have waived the application of the "pay to be paid" and retrospective cancellation of cover for non-payment of premium Rules in respect of claims by seamen or their dependents, where there would otherwise be no enforceable right of recovery and the claim would go uncompensated.[38] In case where shipowner becames insolvent and unable to pay the repatriation costs to the crew member under new provisions 20(2) it was prescribed that notwithstanding the provisions in Rule 19 (1) – e) which reflectes on MLC 2006 Liability – the Association shall discharge such MLC 2006 Liability in the Member's behalf directly to such Seafarer or dependant thereof.[39]

[31] Countdown to 20 August 2013, the Maritime Labour Convention 2006, Part 2 – Problem Areas, pp.6. Available from: http://www.skuld.com/Documents/Topics/People/MLC%202006/Clyde_Maritime_Labour_Convention_part2.pdf. [Accessed 13 February 2014].

[32] Policy year is a year from noon GMT on any February to noon GMT on the next following 20 February (P&I Rules North of England Protection and Indemnity Association limited, 2011/2012., *op.cit*., pp.6).

[33] Approved changes to the Club's Rules would take effect for the next policy year 2014/15 from Febuary 20, 2014.

[34] Rhidian, T. „The concept and measure of indemnity in marine policies", in: „The modern law of marine insurance", volume 3, Informa, London, 2009, pp.35. More about the legality of indemnity insurance see Hazelwood, S.J., Semark, D. „P&I Clubs Law and Practice", Taylor &Francis, Informa, 2013, pp. 7-8.; Bennett, H. „The Law of Marine Insurance", Oxford University Press, 2007., pp.484-487.

[35] See The North of England P&I Club Circular Ref: 2013/022, *op.cit*. Hodges, S. „Law of Marine Insurance", Cavedish Publishing Limited, UK, 2013., pp.323.: To be entitled to an indemnity in respect of liabilities or expenses incurred by a member (the insured), he must first prove that he himself has discharged the liabilities or expenses.

[36] De la Rue, C., Anderson, C. B." Shipping and the Environment", *op.cit*., pp.749. See more Rose, F. D. „Marine Insurance: Law and Practice", Informa, UK, 2013., pp.153.

[37] Coper, A. D., Stanberry, B. A., Boerne, G. L., *op.cit*., pp.162.

[38] About the main areas of concern about P&I cover see on http://www.ukpandi.com/knowledge/article/mlc-club-facq-6133/ [Accessed 05 February 2014].

[39] See The North of England P&I Club Circular Ref: 2013/022 - Amended Wordings for Rule 19(1) and Rule 20. Available from: http://www.nepia.com/cache/files/8648-1369409969/AMENDEDWORDINGSFORRULE19AND...[Accessed 13 January 2014]; The Japan Ship Owner's Mutual Protection & Indemnity Association, JPI'S Rules 2012/2013. Available from:https://www.piclub.org.jp.[Accessed 05 Decenber 2013]; The Swedish Club, Rules for P&I Insurance, 2013/2014, pp.13. Available from;http://www.swedishclub.com/upload/Insurance_Services/TSC_Rules_for_PI_and_FDD_Insurance_2013_2014 [Accessed 03 February 2014]; The London P&I Rules 2013-2014., pp.15-16. Available from: http://www.londonpandi.com/_common/updateable/downloads/documents/5rules2013.pdf [Accessed 03 February 2014]

4. CONCLUSIONS

MLC represents codifying framework of rights and duties for seafarers and shipowners with purpose to protect the rights of the seafarers, reduce accidents at sea and secure economic interests in fair competition for shipowners. As a new international convention with comprehensive implications across all sectors, MLC introduced compulsory insurance for contractual liability of the shipowner to ensure that seafarers are repatriated at no cost to themselves „in the event of the shipowner not being able to continue to fulfil their legal obligations as an employer of the seafarers by reason of insolvency". Shipowners obligations to pay compensation for deaths, personal injuries and illnesses of seafarers under MLC were already covered by the P&I Clubs. Repatriation costs in case of shipowner's insolvency represents a new obligation of shipowner under MLC and has previously been excluded by all Group Clubs. Responding to the needs of shipowners under MLC, trying to help them as members of P&I Clubs, with their new obligations in complying with financial security requirements under the MLC (particularly in case where shipowner is unable to pay repatriation costs of seafarers while he became insolvent) - P&I insurance market (IG P&I Clubs) have agreed to extend the scope of P&I cover to include repatriation costs under the MLC in the event of shipowners insolvency. Legal consequences of expanding insurance cover took effect immediately (even before entering into force of the MLC), but for the next 2014/2015 policy year all P&I Clubs need to introduce such an insurance cover - crew repatriation costs from shipowners insolvency in P&I clubs rules. Enactment of the MLC which globalized maritime industry providing opportunity for better labour practice would not have drastical impact on higher premium,[40] but growing number of international convention introducing new maritime compulsory insurance and exceptional financial situation in the world with major casualties to which the P&I clubs had to respond would have influenced on increasing vessel operating costs by 3% in 2013 and 3.2% in 2014 and the cost of P&I insurance by 2.4% in 2013 and by 2.5% in 2014.[41]

[40] UK P&I Club Circular 15/13: Review of open policy year & 2014 policy year general increase, 30/10/2013. Available from: http://www.ukpandi.com/publications/article/circular-15-13-review-of-open-policy-year [Accessed 05 December 2013]. The Bord has concluded that for the 2014 policy year the premium rating of all Members shall be increased by 10 per cent.

[41] Survey: Ship Operating Costs to Rise 3-4%, available from: http://www.marinelink.com/news/operating-survey-costs360434.aspx [Accessed 04 February 2014].

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ALBANIA NATIONAL STRATEGY IN RESPONSE TO COASTAL POLLUTION FROM SHIPS AND MARITIME DISASTERS

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ABSTRACT

Coordination of national operations, reaction and time interaction with all stakeholders maritime and logistical means necessary, including all activities necessary to reduce the damage and to conduct and coordinate operations from the ground. Operations managed by the Marine Department, according to a local emergency plan to deal with the components of the civil service and national defense, under the emergency plan to protect coastal areas from sea and marine pollution caused by maritime shipping accidents. Information will be provided by the Ministry of Environment on the situation of marine disasters at sea in coastal areas pollution. The plan shall be implemented in accordance with all required operational procedures related to logistics, planning, and administrative and legal aspects of the guidelines set out in the planning stage to actual implementation in a given situation. This strategy finds its first application by the coordination service activation key units from the prime relevant ministries and local governments. Sea area in which the emergency plan is implemented and how it's application refers to the Albanian government laws are in effect. The authors will determine available resources and equipment necessary to meet the pollution of coastal areas in Albania and will explain all the procedures.

KEYWORDS

Marine pollution, marine environment, ship, emergency plan, environmental pollution, coastal marine protection

1. INTRODUCTION

Albania is located in the west of the Balkan Peninsula between 39° 16' latitude and 49° 39' longitude. Albania is located along the eastern shores of the Adriatic and Ionian seas, 72 km from the Cape of Otranto (Italy) and 3 km from Corfu Island (Greece). The coastline has a total length of 427 km, 273 km and 154 km Adriatic Sea Ionian Sea.

Albania is a member of the United Nations Convention on the Law of the Sea 1982, and so has the obligation to protect and preserve the marine environment. National Contingency Plan for responding to accidental marine pollution is one of the measures to be undertaken by Albania in compliance with this obligation.

The purpose of this plan is must ensure the existence of a temporary reaction, uniform and effective national level incident occurred in the sea, that cause or may cause pollution of the marine environment by oil or other substances to be harmful and hazardous, the exceeding the capacity of the individual reaction vessels, ports, oil terminals of shipyard, naval platforms, and the local or regional authorities.

The main objective of the plan is to organize a rapid and effective response to spills of oil and other hazardous substances and the poisonous that tend to influence or affect the marine area of the Republic of Albania and its coast, as well as to facilitate national cooperation and international in Adriatic, Ionian and Mediterranean.

National components of the reaction are Interoperability marine center, prefect of the region, the Regional Environmental Agency, Albanian Naval Force, Marine General Directorate, private and public contractors, consultants, ministries, agencies and related services.

Massive pollution from maritime disasters and pollution in general have not been worrying considerable problems finding past centuries. They became a global concern problem during the second half of the last century and will remain in the account for a very long time. About the 60s of the last century have a vigorous development of the shipping industry and the discovery of oil at the sea. This was the turning moment when mankind realized that what nature had made for millions of years man was destroying the performance. This was also the moment where taking institutions began to think about preserving aquatic environments and hydrocarbons.

2. MATERIAL AND METHODS

2.1. Risk Assessment

Risk management principles are widely recognized as an integral part of good management practices. Risk management is an iterative process, which supports making better decisions contributing to giving a greater insight into risks where they occur, and their overall impact. Risk assessment supports the preparation and planning for oil spill prevention and response strategies.

Risk assessment is a step in the overall process of managing it.

This study analyzes the potential risks, the possibility of occurrence of disasters in Albanian territory, seriousness and what actions can be taken to prevent it from happening, or to reduce the risk to an acceptable level, given the costs of prevention and mitigation strategies.

In order to accurately identify the risks, existing safeguards, barriers and measures related to operations at sea are some of the practices of preventing disasters at sea. Some of these risks and potential areas of occurrence are: sudden change of weather, strong winds and the sea are potential risks that may cause in possible offshore accident in terms of loss of life, environmental damage and economic loss. We heavily trafficked area of Saranda, Vlora Bay and Porto Romano that are the most dangerous areas where these factors are present. Therefore we must estimate the maximum operations and processing ships during their stay. The impact and consequences of the oil spill will depend largely on their location and type of spill.

2.2. Maps of the areas with the greatest sensitivity of marine pollution

Most polluted areas and most likely to marine accidents are areas with dense traffic, ports, channels and areas with a combination of shipping thoroughfare. Here we concentrate our attention on the implementation of traffic rules and schemes marine lines.

Albanian coast, the area of Corfu and Greece appear coastal areas as the most likely area for marine pollution and accidents due to large shipping traffic coming from the Mediterranean and Greek ports. In this sense, it is imperative implementation of bilateral maritime agreements and joint construction of schemes to control sea traffic. In Albania, two ports were constructed of large quantities at the disposal of hydrocarbons, mainly gas oil and its products below. Ports are in Vlora Port "PETROLIFERA ALBANIA" and Durrës "ROMANO PORT". There is an influx of ships in number and deadweight which is given by the following tables for every port.

Table 1. Shipping traffic in the Petroliferous port and Romano port from June to December 2013

Month	Petroliferous	Romano Port
June	12	9
July	12	11
August	12	11
September	11	9
October	15	10
November	15	9
December	11	7

2.3 The main international conventions and albanian laws for environmental protection

In a summary, international conventions for the protection of the marine environment object are:
a) MARPOL 73/78 with its annexes is the main instrument for pollution prevention in general and especially oil pollution. On this basis are set and port state control structures, were built design emergency plans and certification of ships. Of course, the impact of MARPOL in preservation and conservation of the marine environment is vital, but pollution arising from maritime accidents are unpredictable and require special structure and eliminating their response.
b) 1969 CLC Convention together with the 1976 protocols for legal responsibilities in case of oil pollution and the Protocol of 1992 which obviously improves this convention. It is important to note that Albania is a member of the CLC Convention and its protocols to which no liability in reaching the standards of this Convention on the transportation and maritime industry;
c) OPRC Convention 1990 which became mandatory creation of structures response to oil pollution;
d) Barcelona Convention for the Protection of the Mediterranean Sea;
e) Law for the Protection of the Marine Environment of the Republic of Albania from pollution and damage 2002;
f) The law on environmental impact assessment in Albania 2003 etc.
Albania is far from these standards due to the situation of the Albanian navy ships and financial inability of the owners to make investments are essential in this field. Albania has received technical assistance and limited funding because for our good fortune in regions dotted seas that Albania has not been any catastrophic accident pollution which requires international intervention made not only for the fact that a single state is unable to meet the cost the higher the elimination of the consequences of pollution but also the fact that the risk to banks of all neighboring states.

2.4 The structures of response against pollutions and maritime disasters

Strengthening the role of structures and disaster response to marine pollution is an imperative duty to Albanian state in particular Albanian ports where great movements of hydrocarbons. Especially these structures must be on call at both ports of oil and gas hydrocarbons where there is a large ship traffic movements cistern and millions m^3 of oil, gas and its derivatives.
Support structures response to oil pollution in case of marine disasters should consist of:

- assistance and supervision in cases of pollution;
- expeditions and analysis techniques;
- assessing the damage and real expected;
- the necessary documentation;
- transfer techniques and use of equipment;
- establishing and monitoring structures voluntary reporting oil pollution;
- establishing free telephone numbers for reporting any pollution;
- opinion glance crews of fishing boats and tourist for environmental preservation;
- reporting any type pollution in the sea;
- routine monitoring and control;
- training and qualification.

All the above elements that depart from rationality to avoid maritime disasters and environmental protection can not be done without raising the opinion of the society and community of all seafarers. Even for the most powerful country it is impossible to control every part of the state means the sea but are themselves seafarers, tourists and fishermen voluntarily report and take active part in avoiding such situations at any hour of the day and night.
Environmental cultures should be implemented by the school, the family, society and imposed by law.

Structures of marine pollution response to collaborate closely with a ser institutions to accomplish their mission. They collaborate:

- With harbor offices for obtaining accurate coordinates, size, composition and elements of motion trajectory relative to oil stigma. Masters ports also must feed them with the information necessary for the meteorological situation and forecast for next few days, wind direction and currents, marine traffic in the region and the possibility of its deviation during clearance operations, sending experts to investigate maritime accidents, etc.
- With regional environmental agencies, to assess the risk and potential damages, compilation of regional schemes and weak points in the respective region, with expert assistance and specialist staff training and assistance with the necessary technical material etc.
- With environmental protection associations for absorbing information necessary and providing volunteers for the interim and cleaning coastal area pollution.
- The port authority, for equipping with technical, financial, personnel, materials needed basis, calculating the cost and the management of financial and other resources.

Of course, all of the elements mentioned above are relative to sea because situations are very complex and in some cases cash schemes do not work properly. In this sense initiatives and flexibility are elements that should be taken into account by the parties in the operation.

2.5 Equipment for oil spill response and available tools

Necessary tools for combating marine pollution and coastal caused by hydrocarbons and toxic substances can be used for purposes of monitoring, recognition, rehabilitation, and supportive ancillary purposes.

What might be some of the equipment as part of the structures used in the fight against pollution and maritime disasters?

They can be divided into two categories:

- The tools used to fight pollution in the coast;
- The tools used to fight pollution in coastal areas;

often some of the tools of the first category can be used in operations against pollution of coastal areas although.

This category includes the following tools:

- Marine tools for operations against marine pollution agreed upon by the Ministry of Environment by shipping companies in accordance with available resources and within their limitations.
- Military ships and other vessels used for operations against pollution.
- Special ships, towing boats and other private vehicles to used for recovery operations or ancillary logistical support, including control and recovery tools and systems.
- Naval and aircraft for patrolling and monitoring used by the Harbor Master, Coast Guard, Air Force, State Police and the Fire Department bodies.

Tools and resources implementation against pollution in coastal areas.

We hereby provide the following list of available tools and equipment needed to cope with pollution of coastal areas:

Special tools

- trucks, heavy transport / four- wheel-drive, tractors, excavators, mechanical shovels and similar tools, earth moving equipment and mobile cranes;
- trucks with suction pumps and pipes;
- organic chemicals, decontamination products;
- absorptive material;
- truck mounted and portable compressors;
- light fittings with power generators;
- cameras for video conferencing satellite television;
- portable pumps;

General Equipment:

- protective clothing for operators and support staff, extra clothing;
- auto respiratory protective masks and filters; safety vests;
- cleaning materials (rags, cloths, soap, detergents, brushes);
- contaminated equipment and clothing;
- plastic and metal containers for the collection of different materials with fat;
- cardboard boxes/containers, sheets and bags for collection and transport of marine fauna;

- movable tubs for treatment of marine fauna;
- heavy plastic sheet and layer material storage areas, especially for temporary storage;
- shovels, earth diggers, rakes, pitchforks, ropes;
- beds and trampled in the water;
- lights and portable generators;
- power generators and first aid materials,
- portable radio transmitter;
- equipment for measuring the explosion;

Each provincial emergency plan should include in agreement with the Maritime Authority and the region a list of resources needed for emergency response in terms of the protection and rehabilitation of the area, as well as a list of voluntary organizations and specialized centers for the treatment of fauna, marine mammals and reptiles and a list of authorized centers for the collection, transport, storage and disposal of pollutants and all other resources available in the territory of the Public administrations or by private companies able to support emergency response efforts.

A special importance has training and qualifying of the staff to use carefully the equipment. Without this is impossible to fulfill properly its mission.

3. CONCLUSIONS

The most prone areas to maritime accidents in Albanian coast are coastal regions bordering with Greece. In this regard, Vlora's Bay and the area of Porto Romano in Durres, which are vulnerable regions, should be regulated and monitored systematically. Near them there are located many protected marine areas where environmental impact of hydrocarbon contamination is large, so monitoring must be realized through conventional and advanced monitoring methods and developing local emergency plans against marine pollution to reply similar situations.

In light of these considerations, the national contingency plan and disaster marine pollution preparedness through various exercises and drills in areas which are threatened by marine pollution should be tested for efficiency. This will be achieved through increasing the national governing authorities responsibility to prevent any difficult situation. The marine emergency response plan on national level must be completed at all relevant links considering the national plans and joint strategies of the European Union.

Adopting national laws and regulations in accordance with international IMO laws and conventions in advance to protect marine environment from pollution and marine disasters is another important task for the national authorities. Lastly, the coordination of national operations to react to the national marine pollution and disasters through the promotion of the process of preparation and response to the national system under the auspices of the Directorate General Maritime should be in the forefront of all duties.

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LOGISTIC ROLES AND RESPONSIBILITIES CONSIDERING OPERATIVE LOGISTIC CHALLENGES

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ABSTRACT

The paper elaborates roles and responsibilities that represent the key functions of logistic operations. The study has been primarily aimed at the analysis of the specifics of daily operative logistic functions. Logistics has been one of the most changing and developing functions in modern business over past few decades. Following and respecting the constant changes and improvements within the logistics operations resulted indemand of the change and improvement in logistic experts' skills and competencies in respect to the logistic roles and responsibilities. Authors of the paper researched the current logistic job positions demand as well as the detailed descriptions of some logistic positions in companies that have logistic or supply chain department. Principal aim of this paper has been to present consolidated logistic functions with highlight at specific logistic skills and competencies. The research has been expected to result in competent and expert advice to the educationalinstitutions with existing and new educational programs related to logistics and supply chain.

KEY WORDS

Logistics, logistic functions, logistics skills and competencies

1. INTRODUCTION

Supply chain and logistics have been one of the most emerging and developing parts of the modern businesses. Increasing demand in quality logistic services from internal and external clients caused the need for optimal supply chain and logistic solutions and subsequently, a need for supply chain and logistic experts.Logistics has been the integral part of every business project and efficient logistic system represents one of the basic preconditions for achieving business goals; expert and structural supply chain and logistics management enables additional logistic cost savings resulting in customer satisfaction and company's profitability[5]. Modern logistics needs to achieve operational efficiency through improvement and integration of supply chain and logistic individual processes[9]. Logistics processes can include various activities such as: services to customers or users, demand forecasting, documentation flow, distribution problems, control of machines and other technical means, order processing, packaging, maintenance and service problems, production or services organisation, purchase, return products management, warehouse and distribution centre management, etc. [8].

There is a number of supply chain and logistic education programs in Croatia, from high schools, training centres to universities,which even include a doctorate studies. However, since supply chain and

logistics are still developing business branch in Croatia, there has been a need of evaluation of current logistics position as well as education and training programs offered. Also, there are anumber of published papers related to logistics processes and education; however, since logistics is of an ever changing nature, an update of current logistic needs of competencies and skills might be necessary.
One of the reasons for starting educational programs has been an effort to response to market's permanent needs for special logistic employees and experts which will be able to monitor and control the entire transport process from the origin to the destination using up to date economic and technologic knowledge[4]. Logistic experts have to be able to have the special competencies and skills to adequately respond to day to day logistic management and operative challenges. Only excellence assures further existence in the competitive market[9].Therefore it is necessary for educational and training programs to be adequate for current and future business and market needs in order to educate and train logistic experts that will have adequate individual logistic competencies and skills. Logistic experts, after completion of their training and educational programme, would have to be able to be employed and work in various logistic sectors in private and public companies and institutions.
The principal aim of this paper is to systematically list the roles and responsibilities including key activities of logistic experts in modern logistic departments which can be used as a guideline for optimising the existing educational and training programs as well as a starting point in building a successful logistic department. Some of the logistic work position descriptions from various Croatian companies have been used in order to elaborate the operative logistic key activities in more detail. The paper also gives a short overview of current logistic job demand in Croatia which represents a sample of a current logistics position in the current Croatian job market as well as an indication of logistic position and perception in Croatian employment institutions and companies. Finally, the conclusions give the final synthesis of the paper.

2. SHORT OVERVIEW OF CURRENT LOGISTIC JOB DEMAND IN CROATIA

The economic recession has been felt in Croatia for past years which affected all types of businesses also including the logistics. The number of unemployed in Croatia outnumbers the available jobs and positions on the job market. The intention of the research was to give a short overview of the current job demand related to logistics. There is a need to outline the perception of logistics within the non – logistics institutions, companies and organisations which arouse during some of our other on-going researches including this one.
A short overview of current job demand in Croatia presented in this paper is not representative and it has not been researched in detail due to not being the primer object of the research. Nevertheless, we consider it to be indicative concerning the current logistic situation in Croatia.
During November of 2013 the authors have searched the current job demand on 3 most influential job websites in Croatia (Croatian employment department and two privately owned websites). The results were following:
At the Croatian employment department website there is no possibility of searching the open positions within logistics since there is no defined searching object connected to transport and/or logistics. It is possible to make the search by categories linked to Motor vehicle drivers/mobile machine drivers/marine crew and Simple construction, manufacturing and transport positions (which are the only two categories linked to logistic services). The total number of open positions in these two categories in the range of entire Croatia was 77.The searching possibilities at this website indicate the perception of logistics within the Croatian employment department. The reality is that there are logistic departments within companies in Croatia as well as logistic companies and there is no search possibility by logistic and/or supply chain category. However, it is possible to search the website by inputting the key word, therefore we have inputted logistics as the key word which gave the result of 0 open positions, supply chain as the key word gave the result of 0 open positions, transport as the key word gave the result of 5 open positions (4 open positions for drivers and 1 open position in administration with no detailed requirements related to logistics).

Privately owned website moj-posao.net had the option of categories linked to logistics: Traffic/transport/maritime and Storage and logistics. Both of the categories list the same open positions which in total were 48 in the range of entire Croatia. It is possible to search the website by inputting the key word, therefore we have inputted logistics as the key word which gave the result of 4 open positions, supply chain as the key word gave the result of 0 open positions, and transport as the key word gave the result of 13 open positions.
Privately owned website posao.hr had the option of one category linked to logistics: Transport – Storage and logistics which had the total number of 17 open positionsin the range of entire Croatia.It is possible to search the website by inputting the key word, therefore we have inputted logistics as the key word which gave the result of 2 open positions, supply chain as the key word gave the result of 6 open positions (5 for sales representatives and 1 for the manager in furniture production company), and transport as the key word gave the result of 4 open positions.
Considering the search possibilities and the open job positions it is possible to conclude that there is no high awareness of logistic specific position demand within the employment departments and companies. The open job market clearly depends on the current economic situation and it is evident that there is no significant number of open positions within logistics. However, employment departments and companies should update their database of open and possible job positions in order to correspond to the modern business.Therefore, the suggestion for employment institutions and companies would be to include separate categories of logistics and supply chain in their database and form separate categories linked to logistics and supply chain.

3. ROLES, ACTIVITIES AND RESPONSIBILITIES OF LOGISTIC EXPERTS

Main logistic goal has always been very simple and has been repeated in many publications: deliver the right product at the right time to the right place, in the best condition at minimal costs. Logistic experts performing the logistic task need to ensure that the entire process runs smoothly, without interruptions and obstacles; and if some problems do occur, logistic expert needs to have the right competencies and skills as well as the right tools to resolute the problem in the fastest and easiest way. One of the most important key elements is the human element within the logistics; depending on the level of expertise of the human resources within the logistic organization, there are more options in having the possibility to control and overview processes in the entire logistic network[7]. Logistic expert within the supply chain is a very important figure which can be considered as an added value to the entire chain and represents a company resource; his tasks can be viewed from management and operational level which considers the fact that logistic expert links the management level and operational level[6].
The basic decsriptions of job positions used in Croatian companies ussualy includes the following key categories for every specific logistic position:

- General role
- Key activities
- General qualifications

3.1. General role

General role is defined for every specific logistic job position describing the main position within the organisation and organisational department with its main functional roles and responsibilities. General role describes the general role of specific logistic positiondepending whether it is a managerial or operative function. It is defined for activities connected to order reception; administration and deliveries to production, distribution centres and final customers; organisation and planning of deliveries; control of order fulfilment, cost control and overview of specific logistic and supply chain processes etc. General role also defines the responsibilities considering the information flow of procurement/sales processes according to the procurement/commercial strategies and current standards and procedures. Depending on the managerial and/or operative level, general role also defines general guidelines considering people management and coordination between different stakeholders.

3.2. Key activities

Key activities describe the key activities of specific logistic position such as detailed description of business processes related to the specifics of logistic position and depending on the logistic position (whether it is a management or operative position). The main key activities that are present in the general logistics positions usually include the following:

- Responsibilities related to *cost management*: control and overview of cost including the detection and implementation of possible savings in logistic cost (direct transport cost and/or other related costs such as administration cost, forwarding agent costs, quality and quantity control costs, distribution centres' cost etc.), understanding of basic accounting, interpreting of financial reports
- Responsibilities related to *transportation management*: detection and implementation of optimal transport routes and modes of transport, coordination with transport operators and other suppliers, contracting the transport operators and other suppliers, planning and organisation of transport including transhipments, manage transport scheduling, loading and unloading operations, quality and quantity control of transported goods, maintaining transport equipment etc.
- Responsibilities related to *inventory management*; classification of items, defining and ensuring safety and optimal stock levels, various inventory activities including monitoring, updating, analysing, quality control etc.
- Responsibilities related to *warehouse / distribution centre management*: managing reception, stocking and despatch operations, managing the inventory levels, managing the use and maintenance of equipment etc.
- Responsibilities related to *production planning*; monitoring production plans, monitoring capacity plans, planning material requirements and organisation of material and equipment supply etc.
- Responsibilities related to *procurement planning*: evaluation of sourcing environment and possibilities, identification of sources of materials and services, planning supply schedules, managing quality controls, monitoring reception activities, controlling and evaluating suppliers' performance etc.
- Responsibilities related to *maintaining and improving the level of logistic services* towards internal and external clients, improvement of operational effectiveness
- Responsibilities related to *selecting, contracting and evaluating* various logistic services suppliers
- Responsibilities related to *information flow* towards internal and external clients; evaluation and presentation of information to other company departments, suppliers, clients and institutions, production and control of all documentation
- Responsibilities related to *implementation of logistic software programs, tools and IT solutions*; budgeting and forecasting tools, inventory management tools, establishing the electronic data connections, planning and managing the IT support etc.
- Responsibilities related to *legal requirements* as well as internal procedures, complying with relevant legislation and regulations
- Responsibilities related to *budgeting and forecasting processes* (related to cost, transportation capacities and other); implementation of processes and monitoring the actual data against budget and forecast
- Responsibilities related to *daily, weekly and monthly reports*; implementation of reporting tools and processes, implementation of logistic measures etc.
- Responsibilities related to *archiving* the documentation according to the predefined regulations
- Responsibilities related to *achieving specific logistic goals*, initiatives and plans
- Responsibilities related to *people management*: contribution, development, planning, organisation and working with the logistic team including suppliers, external and internal clients
- Responsibilities related to *specific and delicate information* (business secrecy)
- Responsibilities related to *health and safety work environment*, ensuring the necessary equipment for health and safety work environment, planning and organising education and training related to health and safety work environment etc.

There can also be certain special key activities listed for the special logistic job position depending on the particulars and special requirements; logistic expert might have a responsibility in obtaining necessary transportation permits for transport of specific goods, logistic expert might have a responsibility in project development support to multiple departments within the organisation and also provide support for special projects, logistic expert might have a responsibility and a role in risk management etc.

The logistics covers great number of various functions which might and might not be closely linked to primer logistic function; all of those various functions do have their own challenges and require knowledge of specific skills, therefore, the logistic experts need to have a great range of knowledge, competencies and skills in order to respond to operative logistic challenges at managerial and operative function level. The challenges of current logistics require the basic knowledge that covers different logistic areas and needs for specific skills and competencies that represent a basic requirement and also and added value to the entire chain.

Suggestion for educational and training programs is to include the educational and training option and possibility of continuous improvement in order to respond to ever-changing logistic challenges. Working closely with logistic companies and companies that use logistic services in order to improve and update logistic educational and training programmes is an asset for educational and training organisations which should result in up to date educational and training programs. At the end, the result should be logistic expert that has competencies and skills to successfully contribute to the efficient logistic service and supply chain in total.

3.3. General qualifications

General qualifications refer to the specific level of education and skills required for the specific logistic position. They can include following specifics:

- *Education level* – requirements related to necessary degree level and type (example: Bachelor's degree in management, administration or related field)
- *Foreign languages* – requirements related to necessary level of knowledge of foreign languages (example: fluency in oral/written English necessary, knowledge of a second language as an asset)
- *Work experience* – requirements related to necessary prior work experience (example: minimum 3 years of experience in the field operations and logistics preferably within logistics company)
- *Computer skills* – requirements related to necessary computer skills (example: knowledge of computer applications especially the Microsoft suite of programs)
- *Communication skills* – requirements related to necessary communication skills (example: excellent interpersonal skills and ability to work in a multi-stakeholder environment)
- *Specific software skills* – requirements related to necessary additional computer software knowledge and skills depending on the job requirements (example: knowledge of SAP necessary, knowledge of specific logistic software tools as an asset)
- *Driving skills* – requirements related to driving licence depending on the job requirements (example: motor vehicle driving licence B category necessary, forklift licence as an asset)
- *Other specific requirements* depending on the job position (examples: problem solving skills, strong attention to detail, professional aptitude, presentation and demeanour, detail-oriented skills, possibility of quickly learning new skills, integrity, innovation skills, customer focus etc.)

General qualifications represent the basic requirements for operative and managerial positions in logistics; they represent the basic level of knowledge, competencies and skills needed for specific position within logistics. An upgrade to the basic level of knowledge, competencies and skills enables the optimisation of logistic service and added value to the entire supply chain.

4. CONCLUSIONS

Modern business is inseparable from supply chain and logistic service and it generates a great need for specific knowledge, competencies and skills related to the specifics of logistics service. Apart from the need for logistic basic knowledge, there are also requirements for specific logistic competencies and skills related to the specifics of the organisation and specific logistic job position. Logistic experts can work in various types of organisations and companies which can include production companies, military, transportation companies, medical institutions, construction companies, humanitarian organisations, public sector etc. Referring to the ever-changing nature of logistic service as well as the various types of logistic services, there is a need for logistic experts that can respond to everyday logistic challenges on operative and managerial levels. Logistic expert has a responsibility for accurate and quality fulfilment of various logistic tasks which reflects the logistic status of the organisation.

Educational and training programs need to provide the basic supply chain and logistic knowledge to future logistic experts and also to give the basis for continuous improvement in logistic skills and competencies. The basic qualifications for operative tasks and additional knowledge responding to the continuous changes and improvement are a necessity.

It is a common saying that business and companies do change faster than the educational institutions; therefore there is a great need of close relations between business sector and education institutions in order to update the educational and training programs and foresee the future movements and improvements within the logistic sector.Some companies (mainly bigger and multinational companies) do have their own custom made educational programs that include logistic and supply chain training and education. However, those companies' training and educational programs are usually highly specialised for specific business branch and are custom made to suit specific needs of the specific company. Therefore, there is a need for institutional education and training of basic logistic knowledge as well as specific logistic competencies and skills in order to optimise the level of logistic service and respond to ever changing market. Business and educational institutions should both benefit from such cooperation since the result should be a more professional level of logistic service and more knowledge of supply chain processes in total.

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SHIP'S CLASS AS A MARINE INSURANCE CONTRACT TERM

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ABSTRACT

Ships must be designed, constructed and maintained in compliance with the technical standards of seaworthiness provided by the international conventions, national regulations and rules of classification societies, ensuring an acceptable level of ship stability and safety, its environmental impact, etc. Classification societies supervise the ships' technical soundness, i.e. their compliance with the respective technical standards, through a specific system of inspections and certification. There are a number of classification societies, the leading ones being the members of the International Association of Classification Societies (IACS) promoting the new unified technical standards for ships, internal quality management systems and the members' code of ethics. The class certificate, *inter alia* , serves as a proof of a ship's sound condition upon contracting the hull or P&I insurance. Commonly, the insurance cover or the insurer's obligation to indemnify under the insurance contract is subject to the ship's class being maintained. Change, suspension, discontinuance, withdrawal or expiry of the ship's class may lead to a termination of insurance, exclusion of the insurers obligation under the insurance contract or a similar legal consequence negatively affecting the coverage. The standard marine insurance clauses containing the special terms regarding the ship's class shall be analysed hereunder. The aim, nature and effect of such terms shall be discussed in the context of Croatian law and comparatively in the foreign laws governing the most common standard marine insurance clauses, particularly the Institute clauses, P&I rules and the Nordic Marine Insurance Plan.

KEY WORDS

marine insurance, classification societies, ship's class

1. INTRODUCTION

Marine insurance is older than the rise of the international maritime safety standards. The marine insurers early recognized the need of the professional and objective ship inspections. [1] In fact, the marine insurers were historically the instigators of the ship classification. They needed to be informed of the condition of the ships they insured, so they began to collect the relevant information from the mariners and others acquainted with the condition of the

[1] Bennett, H.: *The Law of Marine Insurance*, 2nd Edition, Oxford University Press, 2006, p. 592.

particular ships. [2] That is how the first classification societies were developed, in order to fulfil the insurers' needs. [3]

Historically, besides the insurers, there were many others with the interest to ensure the success of the maritime adventures and who therefore insisted on the improvement of the ship safety. These were primarily the shipowners, the owners of cargo, merchants, banks and other creditors financing the shipbuilding, ship sale and purchase, sale of goods, etc. Today, because of the importance of the safety at sea, there is a serious intervention by the states in the field of the safety of navigation. The states, fulfilling their obligations from the maritime conventions on the safety of navigation and the protection of marine environment, delegate many of their tasks to the classification societies. [4] The international conventions imposing on the flag states a duty to implement a whole range of the ship inspections and surveys, allow them to entrust the classification societies, as "the recognized organisations", with such tasks. [5]

The leading classification societies today are the members of the International Association of Classification Societies (IACS), promoting the new unified technical standards for ships and internal quality management systems as well as the code of ethics for its members. The certificate of class attesting that the ship is classed by a particular classification society, especially if it is a member of IACS, will serve, *inter alia*, as a proof of a good ship's condition for the purposes of the hull and machinery or P&I insurance. [6]

2. AUTOMATIC TERMINATION OF INSURANCE UNDER THE ITCH 1983

In the Institute Time Clauses – Hulls 1/10/1983 (hereinafter: the ITCH 1983), the first time in the history of the law of marine insurance, a clause on automatic termination of insurance in the case of change, suspension, discontinuance, withdrawal or expiry of the ship's class was introduced. Namely, according to the ITCH 1983, clause 4.1, the mentioned facts regarding the ship's class present a cause for an automatic termination of insurance, unless the insurer agrees to the contrary in writing. It is prescribed that the insurance shall terminate automatically at the time of the: [7]

a) change of the classification society with which the ship was classed at the commencement of insurance, or the
b) change,
c) discontinuance,
d) suspension,
e) withdrawal,
f) or expiry of class.

Exceptionally, if such events resulted from a loss or damage to the ship otherwise covered by insurance, the automatic termination of insurance shall only operate should the ship sail from her next port without the prior approval of the classification society. [8]

[2] Terzić, B.: „Održavanje klase kao uvjet iz ugovora o osiguranju", *Osiguranje - hrvatski časopis za teoriju i praksu osiguranja*, No. 3-4, 1997, p. 21.

[3] It is interesting to point out that the *Lloyd's Register* founded in 1760 was amongst the first classification societies and until today it has been most highly esteemed. Its history, like the one of the Lloyd's insurance market, is tied to the Edward Lloyd's coffee shop in London. *Lloyd's Register* issued its first publication titled *Register of Ships* in 1764 in order to provide the insurers and merchants with the information regarding the condition of the ships they insured or chartered. This was the beginning of the classification of ships. See TERZIĆ, *ibid*, pp. 21 – 22.

[4] TERZIĆ, *ibid*, p 22.

[5] BENNETT, *The Law of Marine Insurance*, *op. cit.*, p. 593.

[6] *Ibid*, p. 592.

[7] TERZIĆ, *op. cit.*, p. 22.

[8] An example of the application of this clause in practice is found in the English court case *The Caribbean Sea* [1980] 1 Lloyd's Rep. 338, see pp. 349 – 350. The court found that the cause of the sinking of the ship was a latent defect in the ship's hull, and therefore the hull insurer was found liable for the loss under the *Inchmaree* clause. The court did not find the basis for the application of Section 39. 5. of the UK Marine Insurance Act 1906

According to *Arnould*, in case of a retroactive suspension, discontinuance, change or withdrawal of class, any loss or damage occurring in the meantime, i.e. prior to such suspension, change, discontinuance or withdrawal of class, would be covered, even though it occurred after the respective date that the classification society determined retroactively. [9] A change or a suspension of class taking place prior to the inception of insurance is entirely outside the scope of application of the relevant clause 4.1, ITCH 1983. [10] The question whether in a particular case there is a change or a suspension of the ship's class should be answered according to the rules of the respective classification society and in compliance with its own interpretation thereof. [11]

The clause on the automatic termination of insurance in relation to the ship's class is a clause paramount, i.e. it has a priority over any other contract insurance clause (written, printed or typed).

(hereinafter: MIA), i.e. it did not accept the insurer's defence that the loss can be attributed to unseaworthiness of which the insured was aware. The court did not accept the insurer's defence that there was an automatic termination of insurance due to the class withdrawal, because the reasons for the withdrawal, change, termination, discontinuance, suspension or expiry of class were not fulfilled according to the rules of the classification society (*Bureau Veritas*). The automatic end of validity of the ship's certificate of class does not, on its own, mean the withdrawal of class. In this case the ship was insured under the American Institute Hull Clauses of 1977, which, however, contain the respective clause on the automatic termination of insurance related to the ship's class.

[9] Gilman, J., Merkin, R., Blanchard, C., Cooke, J., Hopkins, P., Templeman, M.: *Arnould's Law of Marine Insurance and Average*, 17th Ed., Sweet & Maxwell, London, 2008, p 816. See also *The Pride of Donegal* [2002] 1 Lloyd's Rep. 659, para 142, p. 678.

[10] See *Sun Alliance & London Ins plc v Pt Asuransi Dayin Mitra TBK* [2006] Lloyd's Rep. I. R. 860. Cited according to *Arnould's Law of Marine Insurance*, *op. cit.*, p. 816.

[11] See *The Caribbean Sea* [1980] 1 Lloyd's Rep. 338, p. 348; *The Buena Trader* [1978] 2 Lloyd's Rep. 325, p. 335.

3. THE WARRANTY OF CLASS UNDER THE HULL CLASSIFICATION CLAUSES 1989

The English insurers realized the insufficiency of the statutory protection from the claims related to the unseaworthiness and the poor maintenance of ships provided under Section 39.5 of MIA on the legal consequences of unseaworthiness in the context of hull time policies [12] and under the standard clauses on the automatic termination of insurance (cl. 4, ITCH 1983). Therefore, in 1989 the Joint Hull Committee [13], introduced a new set of standard insurance clauses to be used with the Institute Hull Clauses, as a step towards the improvement of the safety of navigation and the loss prevention. These were the so-called Hull Classification Clauses (hereinafter: the JHC HCC), a set of express warranties of the ship's full compliance with the classification society's requirements and with the statutory and regulatory requirements related to seaworthiness. [14] The said clauses provided for the following express warranties: [15]

a) the ship is classed with a specific classification society named in the policy and the existing class is maintained throughout the insurance period (JHC HCC, cl. 1.1)
b) all the recommendations, requirements or restrictions imposed by the classification

[12] S. 39.5 of MIA provides the following: "In a time policy there is no implied warranty that the ship shall be seaworthy at any stage of the adventure, but where, with the privity of the assured, the ship is sent to sea in an unseaworthy state, the insurer is not liable for any loss attributable to unseaworthiness."

[13] The *Joint Hull Committee* is the oldest committee of the London market insurers, founded in 1910. It consists of the representatives of the hull insurers. The committee discusses all matters related to marine hull insurance, including the developments in the field of the entire marine industry. It represents the interests of all the London market insurers covering the hull and machinery risks.

[14] O'May, D. - Hill, J.: *O'May on Marine Insurance. Law and Policy*, Sweet & Maxwell, London, 1993, p. 86.

[15] *Ibid*, pp. 86 – 87.

society related to the seaworthiness are complied with by the required dates (JHC HCC, cl. 1.2)

c) if there was a change of the classification society within 12 months prior to the commencement of insurance, it is warranted that all the outstanding recommendations, requirements or restrictions relating to the seaworthiness and imposed by the prior classification society have been reported to the insurers; if the insurers so require, the said recommendations, requirements or restrictions shall be complied with as specified (JHC HCC, cl. 1.3)

d) all statutory or regulatory requirements whether arising before or during the period of insurance shall be complied with insofar as they relate to the seaworthiness (JHC HCC, cl. 1.4)

e) the insured shipowner, the managers and superintendents shall comply with all requirements of the classification society regarding the reporting to the society of accidents to and defects in the ship (JHC HCC, cl. 1.5).

Furthermore, the JHC HCC provide for an automatic termination of insurance at the time when the classification society's periodic docking survey or special survey of hull, boilers, machinery or control equipment becomes overdue (JHC HCC, cl. 2). Exceptionally, in the event of any first extension normally permissible by the classification society the insurance shall not terminate until the expiry of such first extension. The said provision is additionally qualified by a held covered clause according to which the insurance remains in force at an additional premium until the ship's arrival at the next port if at the time of such automatic termination the ship is at sea. The cited provision applies unless the insurers agree to the contrary in writing. In the case of such an automatic termination of insurance, the insured is entitled to a pro rata daily net return of premium, unless a total loss of the ship has occurred during the period of insurance.

The JHC HCC also impose an obligation on the insured to provide the insurers with the necessary authorisation to approach the classification society direct for any information on the ship's class (JHC HCC, cl. 3).

Finally, the insured is obliged, for the purposes of any claim, to provide certification by the classification society that the ship's class has been maintained (JHC HCC, cl. 4). [16]

The described JHC HCC clauses were not created as a part of the Institute Hull Clauses, and, naturally, their inclusion into the insurance contract is a matter of contractual freedom of the parties. However, when these clauses are contracted and used with the ITCH 1983, they must be interpreted in relation to the clause 4 of the ITCH 1983 on the automatic termination of insurance. [17]

The fact that the ship is regularly classed by a classification society is not on its own the final proof that the ship is seaworthy, neither is the lack of class the final proof that in the case of the ship's unseaworthiness the insured was privy of that circumstance. However, when the insurance contract contains an express warranty of the ship's class being maintained, e.g. as it is provided in the JHC HCC, the insurers are released from any further liability under the insurance contract from the moment of the breach of the warranty. The insurer's liability remains only in respect of the losses occurring prior to that breach. These are the legal effects of an express insurance warranty under English law. [18]

The question is, what would be the legal consequences of a breach of the express warranty of class if the competent law of the insurance contract were Croatian law. Would it be correct to interpret the

[16] *Ibid*, pp. 87 – 88.

[17] *Ibid*, p. 88.

[18] See Sections 33 and 34 of MIA.

respective insurance clauses as *the special conditions* defined under Article 718 of the Croatian Maritime Code (hereinafter: the CMC) [19]?

It is submitted that the relevant provisions of the standard insurance clauses should be interpreted as express warranties, i. e. in their original meaning prescribed to them under English law. This is *inter alia* due to the fact that the respective insurance clauses are worded and construed in the context of English law (the common law and MIA) and practice. The legal concept of insurance warranty is defined under English law, whilst under Croatian law it does not exist as such. Considering the fact that the relevant provisions of the CMC are dispositive, the parties are free to contractually regulate the legal consequences of the breach of those special conditions.

If one insisted on the interpretation of the express warranties in the context of Art. 718 of the CMC, the first problem would be the legal uncertainty regarding the distinction between the warranties material for the insurer's decision to insure, and those relevant only for the assessment of risk and the scope of damage. Furthermore, if a specific warranty were to be interpreted as material for the insurer's decision to insure, and if the insurer therefore had the right to rescind the contract *ab initio* due to the breach of that warranty and to claim damages suffered as a consequence thereof, the consequences would be much more stringent on the insured than under the rules on the breach of an express warranty under English law.

The insurance warranty is a specific legal concept of English law and its exact understanding and interpretation is not even possible outside the context of English law. The meaning of the term is simply unattainable under Croatian law. Therefore, for the interpretation of the respective standard clauses contracted in their original contents but under Croatian law as the competent law of the contract, it is necessary to apply the original meaning of the specific legal concept as it is defined under English case law and in MIA. [20] A similar conclusion should be derived in the case where the competent law of the insurance contract incorporating the English standard clauses is the national law of any other country.

4. THE WARRANTIES OF CLASS UNDER THE ITCH 1995

When in 1995 the new revision of the Institute Hull Clauses was published (hereinafter: the ITCH 1995), the additional clauses very similar to those of the JHC HCC were included therein. The aim of introducing the new improved clauses on class was to give an additional strength to the work of the IMO and IACS in the raising and maintaining of the safety standards, and indirectly contributing to the preventive protection of the marine environment. At the same time, the point of introducing the ITCH 1995 was to additionally protect the insurers from the losses attributable to the poor condition of the ship, their unseaworthiness and poor maintenance.

In the ITCH 1995 a new clause 4 was introduced entitled „*Classification clause*" prescribing the insured's, shipowner's and manager's obligation at the commencement and throughout the period

[19] The Maritime Code of the Republic of Croatia, Official gazette no. 181/04, 76/07, 146/08, 61/11, 56/13. Art. 718 reads as follows: "(1) If the special conditions material for the insurer's decision to provide the insurance cover are not complied with, the insurer is entitled to rescind the contract. (2) If the special conditions relevant only for the assessment of the individual risks and the scope of damage are not complied with, the insurer may deduct from the insurance indemnity the part of loss probably arising from the lack of compliance with those special conditions."

[20] On the interpretation of the foreign standard insurance clauses when the competent law of the contract is Croatian law, see D. Pavić, *Ugovorno pravo osiguranja*, Tectus, Zagreb, 2009, str. 128 – 134.

of insurance to provide the following (ITCH 1995, cl. 4.1):

· that the ship be classed by a classification society approved by the insurer and that the class with that society be maintained, [21]

· that all the recommendations, requirements and restrictions determined by the classification society relating to the seaworthiness or the maintenance of the ship in a seaworthy condition shall be complied with within the periods determined by the classification society.

If any of the said obligations is breached, the insurer shall be released from any further liability from the time of the breach, unless he agrees to the contrary in writing. If the ship at the time of the breach is at sea, the insurer shall be released from liability under the insurance contract from the time when the ship arrives to the next port of call (ITCH 1995, cl. 4.2). Therefore, although the term "warranty", or the formulation "warranted that..." are not expressly used, this is an express warranty, [22] since the legal consequences of the breach are regulated exactly in the manner in which MIA regulates the legal consequences of the breach of a warranty. [23]

Furthermore, the "Classification clause" of the ITCH 1995 provides that the insured, the shipowner and the manager of the ship are obliged to promptly report to the classification society any incident, condition or damage in respect of which the classification society might make recommendations as to repairs or other action to be taken (ITCH 1995, cl. 4.3). Finally, the insured is obliged to make all the necessary authorisations for the insurer to be able to receive the relevant information or documentation on the ship's class directly from the classification society (ITCH 1995, cl. 4.4) [24]. The breach of the two cited provisions is not clearly sanctioned. Under the JHC HCC the reporting obligation had the legal nature of an express warranty (JHC HCC, cl. 1.1.5). However, in the ITCH 1995, as opposed to the obligations provided under clauses 4.1.1 and 4.1.2 (maintenance of the ship's class and compliance with all the conditions of the class) the obligation to report the circumstances that might influence the class is not formulated as an express warranty. If, however, the insurer proves that the prompt reporting of such circumstances to the classification society would result in a recommendation, requirement or restriction of class, and that the compliance therewith would prevent the loss to occur, then such breach of clause 4.3 of the ITCH 1995 (reporting of the incidents to the classification society) would represent a justified reason for the insurer to entirely refuse the claim for the loss arising from that incident, damage or condition. [25]

The revision of the ITCH 1995 additionally increased the importance of the maintenance of the ship's class by the amendment of the automatic termination clause. [26] An additional reason for the exceptional termination of insurance was added, and that is the case of a periodic survey becoming overdue without the classification society having agreed an extension period for such survey. When the periodic survey becomes overdue as a consequence of a loss otherwise covered by insurance, the automatic termination of insurance shall not operate if the

[21] According to *Arnould* , the respective warranty contained in clause 4.1.1 should be interpreted as a warranty of the formal existence and maintenance of the ship's class, i.e. on the basis of the class documentation. It should not be understood that the ship must actually at any time be in such a condition as required by the class. See *Arnould's Law of Marine Insurance*, *op. cit.*, p. 816.

[22] *Ibid*, p. 815.

[23] The respective provisions are similar to clauses 1.1 and 1.2 of the JHC HCC 1989 as discussed *supra*.

[24] The provision is similar to the clauses 3 and 4 of the JHC HCC 1989.

[25] *Arnould's Law of Marine Insurance*, *op. cit.*, p. 816. In the International Hull Clauses 2003, cl. 14.4. such sanction for the breach of the obligation to report the incidents to the classification society is expressly prescribed.

[26] In the ITCH 1983 this was clause 4, whilst in the ITCH 1995 it is cl. 5.

classification society approves the extension for the periodic survey (ITCH 1995, cl. 5.1). In the rest, the respective clause remained equal to cl. 4 „*Termination Clause*" of the ITCH 1983. [27]

The ITCH 1995, cl. 4 „*Classification Clause*" must be interpreted in relation with the ITCH 1995, cl. 5 „*Termination Clause*", providing for an automatic termination of insurance in the case of a change of the classification society, or of a change, suspension, discontinuance, withdrawal or expiry of the ship's class or in the case of a periodic class inspection becoming overdue. It seems that there is an overlap between these two clauses. However, they still cannot cover all the various procedures commonly found in the rules of the classification societies that could influence the ship's class. For example, the classification society can make certain remarks on the certificate of class, but such remarks might not influence the validity of the certificate or qualify as a recommendation, requirement or restriction, i.e. such a procedure would not be covered by the ITCH 1995, cl. 4.1.2. Furthermore, such remarks would not necessarily imply a breach of the obligation of the class maintenance in the sense of the ITCH 1995, cl. 4.1.1. They would not amount to a suspension, discontinuance, withdrawal or expiry of class, nor would they mean that the periodic class survey became overdue. Similarly, a change of the class conditions would not equal to a change of class in the sense of the ITCH 1995, cl. 5.1. [28]

Although the ITCH 1995, cl. 5 provides for an automatic termination of insurance, according to *Arnould* it should not be interpreted as an express warranty, because, as opposed to the ITCH 1995, cl. 4 "*Classification Clause*", it does not impose any obligation on the insured. [29]

[27] The described addition represents an implementation of the provision of clause 2 of the JHC HCC 1989.

[28] *Arnould's Law of Marine Insurance*, *op. cit.*, p. 816.

[29] *Ibidem*.

5. THE WARRANTIES OF CLASS UNDER THE IHC 2003

The scope of the warranty provided under the "Classification clause", ITCH 1995, cl. 4.1 has been extended in the International Hull Clauses 2003 (hereinafter: the IHC 2003) in clause 13 (the so-called „*Classification and ISM clause*"). Despite the differences, the respective clause 13 of the IHC 2003 is generally similar to clause 4 of the ITCH 1995. Namely, the similarity is in the express warranty, although, instead of the traditional formulation referring to the insurer's release from liability from the moment of the breach, it introduces a single sanction of the automatic termination of insurance, subject to the right of return of the pro rata daily premium. [30] This clause provides for an automatic termination of insurance in the case of a breach of the obligation to class the ship with a classification society and to maintain the class throughout the insurance period (IHC 2003, cl. 13.1.1). Furthermore, the automatic termination operates also in the case of a change, discontinuance, suspension, withdrawal and expiry of class (IHC 2003, cl. 13.1.2). Finally, the automatic termination occurs in the case of a breach of the obligation to timely comply with all the recommendations, requirements and restrictions determined by the classification society relating to the ship's seaworthiness or its maintenance in the seaworthy condition (IHC 2003, cl. 13.1.3). If the application of the said provisions leads to an automatic termination occurring at the time when the ship is at sea, the automatic termination shall be postponed until the ship arrives to the next port of call (IHC 2003, cl. 13.2.1). Exceptionally, if the suspension, change, discontinuance, withdrawal or expiry of the ship's class occurs due to a damage to the ship otherwise covered by insurance, the

[30] *Ibid*, p. 815.

automatic termination of insurance shall operate only in the case that the ship in such a condition leaves the next port of call without the prior approval of the classification society (IHC 2003, cl. 13.2.2). In all the mentioned cases of the exceptional earlier termination of insurance, the insured is entitled to a return of the pro rata daily net premium, except in the case of a total loss occurring during the period of insurance (IHC 2003, cl. 13.2). The provisions on the automatic termination of insurance apply unless the insurer otherwise agrees in writing.

IHC 2003, cl. 14.4 imposes an obligation on the insured, the shipowner and the ship manager to comply with all the requirements of class relating to the reporting of all the incidents and defects in the ship to the classification society at the commencement and throughout the period of insurance. The insurer is not liable for the loss attributable to any incompliance with the said obligation (IHC 2003, cl. 14.4.2).

Therefore, one can notice that in the IHC 2003 the special clause on the automatic termination of insurance was dropped, whilst its provisions were respectively distributed in the two separate new clauses
– clause 13 "Classification and ISM" and clause 14 "Management". Both of these are paramount clauses, i.e. they have priority over any other provision of the insurance contract. The provision on the automatic termination of insurance in the case of a periodic class survey becoming overdue that was introduced in the ITCH 1995 has been dropped. A sanction has been defined for the breach of the obligation to report to the classification society any circumstance that might affect the ship's class, so that the losses attributable to the breach are excluded from insurance.

The described provisions on class are a product of the insurers' experience with the losses of the 80's when they realized that the statutory protection from the losses resulting from unseaworthiness and poor maintenance of ships was inadequate.

However, the impact of the said insurance clauses in practice is weak, since the revisions of 1995 and 2003 have never achieved a wide acceptance. Nevertheless, the respective new hull insurance clauses have nearly introduced an express warranty of seaworthiness as a continuous obligation applying throughout the period of insurance. [31]

6. CLASSIFICATION CLAUSES IN THE RULES OF THE P&I CLUBS

The rules of the P&I clubs regularly contain the usual provisions on the ship's class. The same requirement is contained in the Pooling Agreement of the International Group of P&I clubs. [32]

For example, Rule 5 (K) of the UK P&I Club imposes the following obligations on the members, i.e. the insured shipowners, regarding class: [33]
i. the ship must be and remain throughout the period of insurance classed with a classification society approved by the club;
ii. any incident or condition in respect of which the classification society might make recommendations as to repairs or other action to be taken by the insured must be

[31] *Ibidem*.

[32] The P&I clubs members of the International Group of P&I clubs regulate their rights and obligations within the Group by the International Group Agreement (IGA) and the Pooling Agreement. The Pooling Agreement is an annually renewed agreement between the clubs to mutually reinsure each other by sharing claims between themselves. There is no premium paid between the clubs under the agreement, and claims are simply shared in agreed proportions according to formulae. Because the Group clubs share their claims through the pooling system, they have a common interest in loss prevention and control, and in the maintenance of quality standards throughout the membership. See http://www.igpandi.org/Group+Agreements/The+Pooling+Agreement (14/2/2014).

[33] *UK P&I Club Rules 2014*, Rule 5 (K), available at http://www.ukpandi.com/fileadmin/uploads/uk-pi/Latest_Publications/2014_Correspondents/2014_Bermuda_Rules.pdf (14/2/2014).

promptly reported to the classification society;
iii. the insured must comply with all the rules, recommendations and requirements of the classification society relating to the insured ship within the time specified by the society;
iv. the insured authorises the club to inspect any information, relating to the maintenance of class of the ship, in the possession of any classification society with which that ship is or at any time has been classed, and will where necessary authorise such classification society or societies to disclose and make available that information to the club upon request;
v. the insured must immediately inform the club if, at any time during the period of insurance, the classification society with which the ship is classed is changed and advise the club of all outstanding recommendations, requirements or restrictions specified by any classification society relating to that ship as at the date of such change.
vi. the insured must comply with all statutory requirements of the ship's flag state relating to the construction, adaptation, condition, fitment, equipment and manning of the ship and must at all times maintain the validity of such statutory certificates as are issued by or on behalf of the flag state in relation to such requirements and in relation to the International Safety Management (ISM) Code and the International Ship and Port Facility Security (ISPS) Code.

The cited provisions are classed expressly as conditions, i.e. it means that the operation of the insurance contract depends on the fulfilment of those contract terms. Therefore, the insurance coverage is provided under the condition that the cited provisions are complied with. These provisions can in a concrete case be changed only if the club member (the insured) and the club expressly agree in writing. If the club member does not fulfil the said obligations, the insurance terminates automatically upon the expiry of the current insurance period and there is no renewal (UK P&I Club Rule 29 (B) vi.).

Furthermore, the insured shall not be entitled to any recovery from the club in respect of any claim arising during the period when he is not fulfilling or has not fulfilled those obligations, unless and to the extent that the club's directors otherwise decide (UK P&I Club Rule 5 (K)).

7. CLASSIFICATION CLAUSES UNDER THE NORDIC MARINE INSURANCE PLAN OF 2013 [34]

Regarding the ship's class in the context of the standard Nordic hull insurance clauses, the change of the classification society is always considered as an alteration of the risk (NMIP 2013, cl. 3-8., subcl. 2). Therefore in the case of a change of the classification society, the insurer is released from liability under the insurance contract, provided that it may be assumed that he would not have accepted the insurance if, at the time the contract was concluded, he had known that the alteration would take place. If it may be assumed that the insurer would have accepted the insurance, but on other conditions, he is only liable to the extent that the loss is proved not to be attributable to the alteration of the risk (NMIP 2013, cl. 3-9.). In any case, as soon as the insurer becomes aware of the change of the classification society, he may cancel the

[34] The basis for the Nordic Marine Insurance Plan of 2013 is the Agreement of 3 November 2010 between: The Nordic Association of Marine Insurers (Cefor) and the Danish Shipowners' Association, the Finnish Shipowners' Association, the Norwegian Shipowners' Association, and the Swedish Shipowners' Association.The Agreement states that the name of this document shall be "The Nordic Marine Insurance Plan of 2013" with the following subtitle; "Based on the Norwegian Marine Insurance Plan of 1996, Version 2010" (hereinafter: the NMIP 2013). The Agreement established a permanent Standing Revision Committee (SRC) for the purpose of drafting the NMIP 2013. The Parties to the Agreement may propose changes to the Plan. If the members agree that changes should be made, the SRC shall draft amendments to the Plan text and Commentary in English. See http://www.nordicplan.org (14/2/2014).

insurance by giving 14 days' notice (NMIP 2013, cl. 3-10.) . However, if the insurer becomes aware that such an alteration of the risk has taken place, he shall, without undue delay and in writing, notify the insured of the extent to which he intends to invoke his rights to cancel the contract or to exclude the respective losses from insurance. If he fails to do so, he forfeits those rights (NMIP 2013, cl. 3-13.) . A special case is when the ship looses the class or when there is a change of class. Namely, it is a condition that from the commencement of insurance the ship be classed with a classification society approved by the insurer (NMIP 2013, cl. 3-14., subcl. 1) . The insurance terminates in the event of loss of the class, unless the insurer explicitly consents to a continuation of the insurance contract. If the ship is under way when the class is lost, the insurance cover shall nevertheless continue until the ship arrives at the nearest safe port in accordance with the insurer's instructions (NMIP 2013, cl. 3-14., subcl. 2). Loss of the class occurs where the insured, or someone on his behalf, requests that the class be cancelled, or where the class is suspended or withdrawn for reasons other than a casualty (NMIP 2013, cl. 3-14., subcl. 3).

Furthermore, the insurer is released from liability for the losses resulting from the negligent breach of the safety regulations by the insured (NMIP 2013, cl. 3-25.). A safety regulation is defined as a rule concerning measures for the prevention of loss, issued by public authorities, stipulated in the insurance contract, prescribed by the insurer pursuant to the insurance contract, **or issued by the classification society** (NMIP 2013, cl. 3- 22., subcl. 1). **Periodic surveys required by** public authorities or **the classification society** also constitute a safety regulation. It is a condition that such surveys be carried out before expiry of the prescribed time-limit (NMIP 2013, cl. 3-22., subcl. 2). Finally, **the rules prescribed by the classification society regarding ice class** also constitute a safety regulation (NMIP 2013, cl. 3-22., subcl. 3).

It can be concluded that a change of classification society and the loss of class according to the NMIP 2013 have a similar legal effect as the insurance warranties under English law. [35]

8. CONCLUSIONS

The various standard marine insurance clauses are rather stringent in respect of the ship's class as a term of the insurance contract, in the sense that the ship's class is a condition affecting the validity of the hull and P&I insurance coverage. The fact that the insurers strictly insist on the maintenance of class is entirely justified. It is because the ship's class, for the purposes of the marine insurance contract, represents a proof of the ship's condition. The requirement is that the ship's condition as determined and approved by the classification society be maintained throughout the insurance period, because the insurer accepted to insure the ship under the agreed terms in consideration of a specified premium, relying on the ship's quality as evidenced by the class. [36] The insurance clauses relying on the ship's class are an additional legal protection of the insurers from the unjustified claims of the unconscientious shipowners disregarding their responsibilities in respect of the ship's maintenance, equipment, compliance with the internationally accepted standards of the safety of navigation and the protection of marine environment. The classification clauses complement the statutory protection of the insurers from the consequences of the unseaworthiness. The clauses on class are

[35] For a more detailed discussion see Lund, H. S.: "Comparative lessons derivable from the Norwegian Marine Insurance Plan 1996", *Marine Insurance: the Law in Transition*, Thomas, D. R. (Ed.), Informa, London 2006, pp. 188 – 189. See also NMIP 2013, Part I, Section 2 (Alteration of the risk) and 3 (Safety regulations) including the commentary.

[36] Jakaša, B.: *Pravo osiguranja*, 2nd Edition, Faculty of Law, Zagreb, 1984, p. 148; TERZIĆ, *op. cit.*, p. 25.

a product of the years of the hull insurers' and P&I clubs' experience and their means of a continuous control over the quality of the insured risks indirectly contributing to the loss prevention and the protection of marine environment. The provisions on class in the club rules are precisely and thoroughly elaborated and consistently implemented in practice. On the other hand, in the hull insurance practice the most commonly used standard clauses are the ITCH 1983 that do not contain such thorough provisions on class and consequently do not provide for an adequate protection. The subsequent revisions of the English hull insurance clauses, i.e. the ITCH 1995 and IHC 2003 introduce some important improvements regarding the ship's class and are more similar to the respective rules of the P&I clubs. However, till today the ITCH 1995 and IHC 2003 have not been widely accepted. The NMIP 2013 provides for some precise solutions adequately protecting the insurers from the unjustified claims of the substandard shipowners. In Croatia, however, the ships engaged in the international trade are predominantly insured under the ITCH 1983 since the Croatian insurers rely mostly on the London (re)insurance market. It is recommended that the insurers and the shipowners start considering a gradual introduction of the IHC 2003 in practice. These hull insurance clauses certainly represent an improvement compared to the 30 year old ITCH 1983, and they more clearly and precisely define the legal consequences of the unseaworthiness ensuring a higher legal security for all the contract parties.

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THE OVERVIEW OF SEA WATER QUALITY MONITORING REGULATIONS IN CROATIA

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ABSTRACT

In this paper, Croatian and International regulations for marine protection and water quality control together with the water quality parameters are analized. It brings the measures for water quality monitoring system. The water quality monitoring projects are also given. Croatian coast and sea are particularly valuable natural resources. Thereby, water quality is issue of special national interest, not only for tourism but also biodiversity preservation. Croatia continues with water quality control after joining the EU. Croatian administrative division to counties defines the management and the enforcement competences over confined geographical area. In different counties, management practice may slightly vary, but, in essence, they have to meet established criteria, as well as, existing regulations.

KEY WORDS

regulations, sea water quality, Croatia, EU.

1. INTRODUCTION

Protection of the marine environment, a separate legal disciplines relating to the study of the legal regime and the protection of the sea as part of the environment, must be a way of maintaining its natural ecological stability and quality of animate and inanimate nature.
The Adriatic Sea is one of the most important natural resources of the Republic of Croatia, so it is important to monitor the state of the sea and coastline and to act to preserve its quality and biodiversity.
In the framework of The national monitoring program along the Adriatic coast it is carried out systematically and continuously since 1989. The legal basis for the implementation and development of the bathing water quality program monitoring are following:

- International :

– Convention on the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona, 1976) (OG-IT 12/ 93, 17/98 , 11/04)
– The United Nations Convention on the Law of the Sea (Montego Bay , 1982) (OG-IT 11/95 , 9 / 00)
– Protocol on the Prevention of Pollution of the Mediterranean Sea by waste disposal from ships (Barcelona , 1975) (OG- International Treaties , No. 12/93)
– Protocol on the Protection of the Mediterranean Sea against pollution of land-based sources and activities (Syracuse , 1996) (OG-IT , 3 / 06)
– WHO / UNEP Guidelines for Health Related Monitoring of Coastal Water Quality - WHO Regional Office for Europe (Copenhagen , 1979) ,
– EU directive on bathing water (Directive of EEC Council concerning the Quality of bathing waters76/160/EEC , Official Journal of EEC But L281/47-52)

– EU Directive on the management of bathing water (Directive of the European Parliament and of the Council concerning the management of bathing water quality 2006/7/EC) .

- National :

– Environmental Protection Act (OG 80/13) - marine environment, the standard of environmental quality, state of the marine environment and protection the sea from pollution and coastal areas are defined,
– Law on Planning and Construction (OG 80/13) - sea beaches (Article 53) and protected coastal area (Article 49) ,
– National Environmental Strategy and National Environmental Action Plan (OG 46 /02)
– Strategy of Sustainable Development of the Republic of Croatia (OG 30/09)
– Regulation on sea bathing water quality (73/ 08). [1]

2. FIRST EVALUATION AND LOADS OF ENVIRONMENT OF CROATIAN ADRIATIC

Marine Strategy Framework Directive - MSFD of European Parliament and Council of 17th June 2008 (*Marine Strategy Framework Directive* 2008/56/EC) defines the legal framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment by 2020 at the latest. MSFD encourages the inclusion of environmental issues in other policies (fishing, agriculture, tourism, shipping etc.) and the harmonization of the measures which are to be taken on the basis of other laws and international treaties. MSFD orders to each member country development strategies for their marine waters, which will also be specific in terms of respecting the characteristics of waters and the general, expressing the perspective of the respective sea regions and sub-regions.

Aims to be achieved by the protection of the sea environment taking into account the sea sub-region are: protection, preserving, facilitating recovery, restoring the structure and function of sea and coastal ecosystems and the protection of biological diversity and the sustainable use; preserving of protected areas in the sea and ecologically important areas of the European Union NATURA 2000; reducing pollution in the sea and coastal environment to ensure that there are no significant negative impacts or risks to human health and/or health of ecosystems and/or use of the sea and coastline; preservation, improvement and re-establishing the balance between human activities and natural resources in the sea and on the shore and to reduce their vulnerability to risks as well.

The Republic of Croatia in addition to other obligations assumed the obligation of MSFD transposition, whose provisions are transferred through the *Regulation of establishing a framework for the activities of Croatian marine environmental protection* (NN 136/11). The Regulation defines the baseline and benchmarks for designing, developing, implementing and monitoring the implementation of the *Strategy to protect the marine environment,* including the adoption of:

- preparatory documents:

– evaluation of environmental waters,
– determination of good environmental condition by Set of features of good environmental status,
– establishing a Set of goals in environmental protection, an

- **action program**:

– *Monitoring and observation system* (deadline 15th July 2014) and
– *Program of measures* (deadline till 2015).

Initial evaluation of the situation and the load on the sea environment of the Croatian part of the Adriatic is the first step to preparing a program of measures to achieve and maintain good condition of the sea environment. It refers to coastal, transitional waters and territorial sea waters (the elements that are not covered by the relevant legislation in the domain of water management) which includes:

-analysis of the basic characteristics and features of the current state of the sea environment, which includes physical and chemical characteristics, habitat types, biological properties and hydromorphology,
– analysis of the main load and impact on the environmental status of sea waters, including human activities.

In the framework of the Strategy of the sea environment and the MSFD implementation, document *Initial evaluation of the state of the sea environment and load of the Croatian part of the Adriatic*, is the first step in the preparation of the program of measures to achieve and maintain good condition of the marine environment. For the Ministry of Environment and Nature Protection, the document was prepared by the Institute of Oceanography and Fisheries - Split and institutes, agencies and government bodies responsible for individual departments have contributed to the document preparing with their comments and materials.

3. SEA QUALITY MONITORING PROGRAM IN REPUBLIC OF CROATIA

The main aims of the Program for monitoring the quality of sea beaches in Croatia are:
protection of the health of bathers and health education of the public,
management of beaches in order to preserve their natural values and sustainable use,
monitoring the construction of sewage systems and the functioning of the them,
identification of pollution sources and their rehabilitation,
publication of results of the sea water quality for the purpose of tourism promotion of the Sea Environment of the Republic of Croatia,
informing the public through the media (magazines, brochures, maps) and websites.
In order to achieve the required standards, set of the management measures for sea bathing is determined. *Management measures for sea bathing* include establishing a timetable (calendar monitoring), monitoring, evaluating bathing water quality, identifying and assessing causes of pollution, preventing bathers' exposure to pollution, reducing the risk of pollution, the classification of the bathing water and the establishment and maintenance of bathing water profiles.
Monitoring activities of bathing water quality are conducted by legal persons authorized to monitoring activities in the field of environmental protection according to the *Environmental Protection law and the Water Law* (accredited laboratories), and to the decision of the county. The beneficiaries (county public health institutes of seven coastal counties) are conducting the chores: sampling, monitoring other parameters of sea quality, laboratory analysis of samples, evaluation of results obtained through sampling, generating reports and bathing water profile.
Resources for monitoring the sea quality on the beach, making cartographic schemes of the beach, development and updating bathing water profiles are provided by the county. In The program of testing the sea quality on the beach, in the part of financing the examination of individual points involved are also tourism companies, concessionaires and local governments. It is necessary to include new interested legal entities in the test program in order to increase the number of sampling points, or beaches by each county.

3.1 Browser of the Ministry of environment and nature protection

Data on the bathing water quality in the area of Croatia, can be followed on the billingual web browser of the *Ministry of environment and nature protection* www.mzoip.hr, or Institute for Oceanography and Fisheries www.izor.hr/kakvoca.
The base was established in 2007. Data are introduced from multiple network centers: *Institute of Oceanography and Fisheries in Split*, *Institute Ruđer Bošković - Center for Marine Research in Rovinj*, *Institute of Marine and Coast in Dubrovnik and Croatian Hydrographic Institute in Split*. *The Croatian Waters and Ministry of Environmental Protection, Planning and Construction - Department of the Sea and Ground Protection),* (now the Ministry of Environment and Nature Protection Department - *Department of Sea and Coast Protection*). Ratings are determined on the basis of criteria defined by the *Regulation on sea bathing water quality* (NN 73/08) and the *EU Directive on the management of bathing water quality* (2006/7/EC). By selecting the connections of RC or EU, review of bathing water quality score according to desired criteria is available. *The Environmental Protection Agency* uses the *Database for reporting to the European Commission* through the European Agency for the Environment , or WISE system (Water Information System for Europe).
The browser displays the assessment of bathing water quality in real time, and the time of sampling

to the announcement of the results is two to three days, depending on the length of the analysis. By selecting each test point, a preview of the final, year and individual assessment of bathing water quality on beaches in Croatia is available. Besides the rating the quality of the bathing water and basic hydro-meteorological data, the viewer can find information about the contents, properties and beach photos. The browser allows the public, tourists and swimmers in the first place making comments and suggesting new test points. In this way, the authorities responsible for the management of beaches and bathing water quality are given immediate and actual information about the satisfaction and public opinion. Official browser of MENP *Sea quality* has recorded permanent trend of increasing visits, which confirms that the public interest is increasing each year due to increased awareness of the importance of well-preserved sea environment and concern for personal safety and health.

In the summer months (the period from 1th June until 30th September), in terms of the quality of the coastal sea, there is a special pressure caused by the arrival of a large number of tourists and underdeveloped or inefficient municipal infrastructure.

3.2 Standards of the sea quality on the beaches

Since 1996 till 2009 the *Program for monitoring the sea quality of the beach in Croatia* was implemented on the basis of the Regulation on Sea Quality Standards on the beaches (OG No.33/96). Standards of Regulation were prescribed in accordance with the requirements of the *EU Directive on bathing water* (76/160/EEC, Official Journal of the EEC No L281/47-52), *Guidelines for bathing water quality in the Mediterranean*, the Mediterranean Action Plan of the United Nations Environment Program (UNEP/ MAP) and the World Health Organization (WHO).

The Regulation prescribes the determination of basic meteorological conditions, and sea visual inspection. (Table 1).

Table 1. *Methods of testing by the Regulation on sea bathing water quality (OG 73/08)* [1]

Indicator	Testing method
Meteorological conditions: wind (dirction/strength) rain (presence/absence) and strength on the day of cause and the day before the cause of the weather.	Observation and subjective evaluation based on Regulations criterion
Visible sea pollution (colour, stains, visible waste)	Observation and subjective evaluation based on Regulations criterion
Air and sea temperature	Hg termometar/ SM 2550
Salinity	ConductSM 2520B:1998
Escherichia coli	HRN ENI SO 9308-1:2000
Intestinal enterococci	HREN EN ISO 7899-2:2000

Microbiological parameters monitored in the sea are intestinal enterococci and Escherichia coli (Table 2).

Table 2. *Standards for sea quality evaluation after each test [1]*

Indicator	Sea quality			Test method
	excel lent	Good	satisfacto ry	
Intestinal enterococci (NoC*/100 ml)	< 60	61 – 100	101 - 200	HRN EN ISO 7899-1 ili HRN EN ISO 7889-2
Escherichia coli (Noc*/100 ml)	< 100	101 – 200	201 - 300	HRN EN ISO 9308-1 ili HRN EN ISO 9308-3

* NoC – number of colonies

At the point of sampling it is necessary to measure *sea temperature and pH*, and in the laboratory to determine the microbiological indicators. Microbiological parameters are determined by membrane filtration, a certain time of incubation on selective media, while for measurement of pH and temperature standard ISO methods were used.

Based on the results of sea quality monitoring, single, annual and final evaluation is determined, according to values of microbiological parameters. (Table 3).

Individual evaluation is determined after each test during the bathing season (every 15 days) to the values of microbiological parameters. Based on individual evaluation, sea is classified as excellent, good and satisfactory. The individual evaluation of sea quality, expressed by areas or by individual beach during the season, is the most interesting to the bathers, because it shows the current status of the sea in place of their destination or holiday place.

Table 3. *Standards for sea quality evaluation at the end of the season (eg) [1]*

Indicator	excellent	Good	Satisfactory	unsatisfactory
Intestinal enterococci (Noc/100ml)	*≤100**	*≤200**	*≤185***	*>185***
Escherichia coli(bNoc/100ml)	*≤150**	*≤300**	*≤300***	*>300***

* fundamental values of the 95th percentile
** fundamental values of the 90th percentile

The annual evaluation is determined after the end of the bathing season on the basis of data on sea bathing water quality for this season according to the values referred to in *Regulation.*

The final evaluation is determined by the completion of the last three previous bathing seasons according to the limit values of the *Regulation.*

Annual and final evaluation of bathing water quality are obtained by statistical calculation, based on the 90th, or 95th percent percentile measurement data during one season tests. It shows a large dependence on the range of measured values investigated bacteriological parameters. The larger the range of values of the tested bacteria is, it is, statistically speaking, the greater the uncertainty of maintaining the quality of the sea within the same customer and it presents greater risk and the likelihood of pollution. On the basis of annual and final evaluation, sea is classified as excellent, good, satisfactory and unsatisfactory.
(Table 3).

Sorted sea bathing is displayed on the map mode and on the information board on the beach by a circular symbol: excellent- blue, good-green, satisfactory-yellow and unsatisfactory-red.

3.3 Sudden and short-term pollution

In cases of sudden pollution of sea on beaches, the beneficiary (County Bureau of Public Health) by notification of pollution, must immediately carry out sea sampling, and submit the resulting data to the competent administrative body in the county and to environmental inspection. The resulting data are not taken into account (not included in the data set) in evaluation the sea quality.
When sampling microbiological parameters obtained exceed the limit values for evaluation satisfactory, it is believed that there is a short-term pollution. In these cases, the authorized person shall immediately notify the environmental inspection and other competent inspectors (integrated inspection) to determine the source of pollution. Till the termination of short-term pollution authorized person performs additional sampling. The samples obtained in the case of short-term pollution are not entered in the data set to determine the quality of the water. After termination of short-term pollution authorized person performs additional sampling within seven days, in order to check the short-term pollution. Subsequently, the obtained data are entered into the data set for the evaluation. [1]

3.4 Display of sea quality testing in Primorsko-goranska county for 2012

Testing the sea quality on beaches is carried out in all counties, and the paper gives an overview of the testing in Primorsko-goranska county.
Tests are made in the period from 15th May till 30th September, every 15 days at the following locations:

- from Voloskog till Mošćeničke Drage on 34 points,
- from Preluke till Scott cove on 34 points,
- from Crikvenice till Novi Vinodolski on 40 points,
- on island Krk, territory of Omišalj, Njivica and Malinska, Krka, Punta, Baška, Klimno cove, Vrbnik and Pinezići on 54 points,

– on island Cres, territory of Cres, Martinšćice, Miholašćice and Slatina cove on 20 points,
– on island Lošinj, territory of Osor, Nerezina, Čikata, Sunny cove, Veli Lošinj on 32 points,
– on island Rab, territory of St Eufemia, Barabat, Banjol, Suha Punte and Lopara on 20 points.

These sampling points are determined:
– on sandy or pebble beaches for each 100 m,
– the other beaches, one point for each 200 m,
– the estuary to the sea, coastal springs and springs at one point. [4]

The sea quality testing includes fieldwork and laboratory testing. Results of observations and individual testing after analysis, enter The data entry application for processing and data evaluation, and reporting and informing the public on bathing water quality of the Ministry of Environmental Protection, Planning and Construction. After analysis, reports on the sea quality are submitted to the Inspection of Environmental Protection - Administrative Department of Planning, Environment and Public Utilities of Primorsko-goranska county.

During 2012 *Program of testing the sea quality on beaches in the Primorsko-goranska county* was implemented on 224 points. Excellent quality is rated at 223 sea beaches, and only one beach had evaluation good. At 224 tested points there was no visible pollution, and there were no floating waste materials, mineral grease or suspended waste materials. The results compared to the ones of the previous year were better. In 2011 in the sixth quality testing one beach had unsatisfactory evaluation, but in the seventh testing it was evaluated with satisfactory. [4]

4. CONCLUSIONS

The bathing water quality monitoring program in the Republic of Croatia was always in coordination with EU Directives (Directive 76/160/EEC on bathing water quality and Directive 2006/07/EC on the management of bathing water quality), the Mediterranean Action Plan Guidelines and the Guidelines of the World Health Organization. In coordination with the development of technological capabilities, the awareness of the importance of protecting the environment, improving management policies, development of reporting on the quality of the bathing water and the inclusion of the public , *The bathing water quality monitoring program* has become modern, and its results available to the general and professional public. In accordance with the results of measurements, the number of sampling points on coastal and the island points is increased. Croatian Adriatic Sea is of excellent quality, it is not polluted with municipal wastewater and is suitable for tourism and recreation. Croatia is at the very top in terms of the bathing water quality in relation to other Mediterranean countries, which further favors the development of tourism. Results of testing the sea quality in the Primorsko-goranska county implemented by 2012, indicate that the sea is of excellent quality.

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THE IMPACT OF TECHNOLOGY ON SEAFARER'S WORK AND LEISURE

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ABSTRACT

Technological development has contributed to different possibilities of the seafarer leisure, as well as to providing connections with his family and friends. Furthermore, modern ships are technologically advanced systems that require constant investing in seafarers' knowledge, working abilities and willingness of decision-making at all levels of the crew for high-risk situations in which the ship can be found. In this sense, it is important to emphasize the need for conscious and conscientious labor, as the data shows that, despite the distinct technological advancement in marine systems, the majority of maritime accidents are caused by human error. Technology boosts the productivity and quality of products or services, but only if used duly, both during working and leisure time. A number of devices we utilize every day increases fatigue, occupies us and leads to an uncritical reliance on technology. The most conspicuous are tensions which occupy seafarer's minds during working hours such as the potentiality of virtual investments, gambling or participation in family activities in real time without physical presence, by using information technology. Due to fatigue that stems from work and leisure, as well as shifting of the initiative from human to machines, it is necessary to review the effects of technology on the successful performance of maritime profession.

KEY WORDS

ship, technology, seafarers, work, leisure, conscience

1. INTRODUCTION

From the social science perspective, the life of a seafarer is often considered within the concept of total institution set up by the American sociologist Goffman in 1961. Originally, the concept implies marginal social groups, separated from the outside world, often symbolized by clear physical barriers (high walls, barbed wire, metal doors, etc.). Such area includes, for instance, prisons, convents, orphanages, mental institutes and barracks. Individuals whose lives are determined by a formal organization, coercion and separation from family, friends and the wider society reside there. Their schedule of activities is determined by the leadership, food and items are limited and personal contacts are mainly superficial.[1]

Although living and working conditions of seafarers still differ considerably from human activities on land, they gradually move away from the conditions of total institution which is largely enabled by modern technology. Nowadays, the crew must constantly invest in knowledge to comply with its obligations, a system of promotion has been determined and organization structure gets flexible form based on greater dispersion of decision-making. Although frequent technological changes generate negative aspects of labor, which are conditioned by business profitability of shipping companies and seafarers in reaction to these circumstances (reducing crew number, excessive and monotonous work, uncritical reliance on the capabilities of technology, etc.), which increase the risk of maritime accidents and occupational injuries[2], duly adjusting to maritime activities on technological circumstances undoubtedly contributes to the business efficiency, as much as personal and social development.

Increase of the ship capacity and their speed of movement have allowed the development of a mass trade and specialization of occupations, while seafarers educate themselves for some of them in order to satisfy the demands of the work environment. Their education becomes permanent, in accordance with the required skills. Furthermore, modern technology increases the possibilities of seafarers during leisure. The organizational encouragement of the company and the ship's leadership is important by encouraging sport activities and events, maintaining a workout, watching movies together, etc., since the fulfillment of this period contributes significantly to the psychophysical condition, development of self-esteem and improvement of cooperation and understanding, which are important factors in navigation safety enlargement. As numerous studies have shown that the separation from the family is one of the most dominant factors of dissatisfaction at work, especially among the younger seafarers (Wall, 1980; Biličić, 1992; Cheng et al, 2008; Hake et al, 2011; etc.), the establishment of telecommunication structure has been recommended, including reasonable prices and access for the entire crew, the shorter duration of navigation, workshops organization on discussing common problems and providing pastoral, psychological and medical care on board and docks.[3]

Maritime industry is a social world determined by rules, customs and activities based on tradition, but open to contemporary changes. Although this activity has often been defined as conservative by nature due to the slow alignment with the capabilities of the organization of labor and leisure, speeding up the process becomes necessary. That is proven by the reduction of seafarer total number (especially in economically developed countries) due to the attractiveness of life on land.[4] An effective response to these requirements can additionally show many similarities and connections of life on land and sea, with multiple benefits for seafarers, shipping companies and the wider society.

2. POSITIVE AND NEGATIVE FEATURES OF TECHNOLOGICAL PROGRESS IN THE WORK PROCESS

As part of the material culture, technology always carries a socially established meaning. Hence, it is necessary to learn its usage, which involves changes in the perception of the environment such as changes of values and normative orientation of individuals. It irrevocably changes the lives, depending on the period of our adaptation.

Significant changes have been taking place within the maritime industry since the First Industrial Revolution. It is significant that they were not promptly obeyed. The example of introduction of the first engineers in the ship's collective could be presented, along with the appearance and maintenance of tension among deck and engine. In the early period of replacement of sailboats to steamships, the machine was completely unknown element of the ship. Engineers were not seafarers, they didn`t possess sailor skills, while the crew abusively named them "coal loader". Technical necessity intruded the acceptance of mechanics by traditional personnel, which was happening gradually, with difficulties and tensions in their relations. However, nowadays the seafarers on deck and in the engine room are aware that the machine is an integral part, moreover the core of the ship.[5]

Technological development of ships which quickly transfer a large amount of cargo has led to globalization and specialization of the market, extending the standard products at low cost. On the other hand, an economy based on mass production led to changes in the maritime industry being characterized by increasing automation, reduction of physical exertion of the crew, faster and monotonous work (shorter docking due to the speed of loading/unloading, faster voyage, etc.), the necessity to acquire new knowledge and outspread of culture of decision-making, the incidence of multinational crews due to the costs reduction, etc.[6]

Information technology has transformed maritime industry into a truly international maritime activity. The ship can be constructed in one country, the owner may be a citizen of another, and the crew of a third country, while the ship sails under the flag of the fourth. This phenomenon is called outsourcing, meaning the production and provision of services in different locations. In addition to the quality criteria, its financial background is based on the input price. Where the price is the lowest, the activity is established.[7]

Width of business has led to the necessity of changing relationships among shipping companies and crew, as well as to change of organizational relationships on the board. Former functional structure, determined by unilateral decisions taken by the shipping company, where the captain and officers represented mainly executive factors, has begun to change under the matrix structure, where decisions are based on more equal communication among the offices on the coast and the crew, under complementary appreciation of benefits. Likewise, crew members (especially officers) are being encouraged to participate in the decision-making process, while the error is trying to be understood, not punished. A typical example is the Navy of the United States, where the following principles have been established: 1. captain holds a meeting with officers before departure, explaining the rules and encourages them in providing remarks and seeking clarification; 2. officer of the watch manages the ship while the captain instructs him otherwise (he has full authority to make decisions and supervise the regularity of human behavior and technological systems); 3. crew is not obligated to examine how the captain will react in making conscientious decisions.[8]

With a ratio of cost-effectiveness and ability, the crew is selected precisely according to the tendency of decision making. The Western cultures are generally considered to have been individualistic, therefore prone to making decisions, while the Eastern are collectivist since their members more often expect a care from the community, including decision making and protection in case of distress.[9]

It is preferred to set the captain and officers who originate from developed countries with maritime tradition, while the crew has been selected from the East which includes the majority of sailors nowadays (particularly unskilled).

Maritime organization research suggests that participation in decision making is extremely important factor of satisfaction at work. If not compliant with the requirements of the crew, frustration is very likely to happen which would affect oversight during labor and endanger the safety of navigation.[10] Likewise, the dispersion of decision making prevents the arbitrariness of the company, the captain and/or officers in deciding which often causes maritime accidents due to passive acceptance of decisions understood as incorrect.[11]

In addition to its positive impact, negative effects of technology on operations that lead to injuries have been widespread. Although maritime accidents have been less numerous than before, they are still quite frequent, while the data show that most common cause are individual actions or errors in communication, organizational procedures and routines (over 50%).[12] Studies of the English, Danish and German seafarers, conducted in 1980s and 1990s, represent that seafarers more often die due to accidents than to natural causes, while the number of accidents among them is 11.5 times higher than among workers on land.[13]

The negative effects of technology may be indirect while the most common one is expressed through fatigue due to overwork, with shorter vacations than prescribed. Technological development of ship contributes to reducing the crew to excessive measures, while seafarers work more than required. *International Transport Worker's Federation* data show that more than 25% of seafarers work over 80 hours a week. This is favored by short voyages with numerous landing, often in late night and early morning hours, frequent inspections, etc. The fatigue caused by stress, monotonous and excessive work, lack and poor quality of sleep due to noise and vibration lead to reduced memory performance, assessment, decision making and response, including loss of physical power.[14] Mentioned factors are associated with the depression occurrence and reduced tolerance towards the crew, as well as unhealthy living habits such as excessive consumption of alcohol and narcotics and unbalanced eating (overeating), which increase the risk of accidents and occupational injuries.[15]

There are various measures to prevent fatigue, which implementation is affected by company, ship's captain and crew. The company should take care of the health of their employees and should not overload them with work, while the captain must respect the norms encouraging crew members in expressing the necessity for rest if they feel that fatigue impairs the quality of their work. Finally, seafarers should align the routine of their leisure (playing cards, surfing the Internet, watching movies, etc.) not disturbing the concentration, work capacity and efficiency.

The immediate technological impact on the distortion of workflow stems from inadequate or improper relationships of the crew towards technology. In the first case, the extensive and vague instructions for usage of the machines can confuse and lead to errors. Likewise, there are frequent oversight errors due to unfavorable audible and visual signal devices. Lots of manufacturers do not depart from the beneficiary needs and ship equipment with inappropriate usable design has been installed, which leads to mistake.[16] In the latter case, error occurs due to excessive reliance on technological capabilities. The machine development has always been leading to the reduction of manual labor, which sometimes unjustifiably implies a mental component. Machine possess certain features superior to people, such as short-term memorizing, precise action repetition, making simple decisions (yes/no), data processing and transmitting information, but the man is a dominant to machine in relation to long-term memorization of high-capacity, space observation, prediction, complex decision judgments and estimation, including improvisation and flexibility, i.e. changes of action with the aim of adaption to the environment.[17] Under conditions of dynamic work environment, being the case with maritime industry (the current unpredictability of environment, weather conditions, technological and human resources, etc.), the person who operates the machines should have priority without any other way around.

Technology should be utilized conscientiously, regardless of the hierarchical position of the employee. It makes the necessity for new knowledge and dispersion of decision making for an effective response to market demands. It is recommended to select the appropriate crew, which is aggravated by the dispersal of seafarers (particularly those highly educated) in other sectors due to dissatisfaction with life at sea encouraged by technological capabilities. Therefore, the organizational culture of crew should be dialogue process which optimizes the operating activities and leisure of seafarers.

3. POSSIBILITIES OF SEAFARER LEISURE DURING MODERN NAVIGATION

Maritime affairs have always been determined by the marginality. That is shown through numerous examples such as slaves who constituted the crew of Antiquity and the Middle Ages, fishermen all day dedicated to the sea, dockworkers and sailors without option of other financial existence, fishing villages significantly distant from the achievements of the (post)industrialization, etc. Although maritime has been specialized since the last century, requiring formal education while ensuring higher income and social prestige, life of the seafarer is quite different from the situation on land. This is proven by limited interaction, activities and supplies. In addition to the work organization, these factors create crew's dissatisfaction, damage the cooperation and contribute to disease (mental, cardiovascular, coronary, etc.), reducing the safety of navigation and contributing to abandonment of a large number of seafarers, which represents difficulty for shipping companies (in addition to growth of fleet from Asian countries) due to the current quality of their training and a high level of ability.

While it cannot completely eliminate the inconveniences of life on board, technology significantly contributes to their mitigation. Its effects depend again on the synergistic action of the shipping company, the captain, officers and the rest of crew. Examples of such practice, which are being clarified, include relationship with partners and family, leisure activities and crew's nutrition. In addition to establishing the matrix structure, improved living conditions on board are encouraged with the maintenance of workshops of critical thinking that contribute to cooperation in detecting and solving organizational difficulties/obstacles.[18]

Marginality of life at sea is recognized through the distance of the partner and family. Seafarers often do not recognize their children when they return home and complain that they cannot take them to school, shows, sporting events, etc. They miss life periods within their family, which can be very distressing. Return to the land may further undermine relations with beloved ones. Partners are not accustomed to their presence in the house, they have more household obligations that contribute to fatigue and irritability, while relationships can be deteriorated with unfulfilled expectations on the upbringing of children who do not accept the authority of a parent not involved in their lives most of the time. In such circumstances, seafarer actually awaits a return on ship, got used to such specific routine.[19] However, many succeed to maintain a stable relationship with family on the basis of understanding and common conversation. Furthermore, shipping company support may be valuable in developing a climate of trust, allowing spouses to navigate in certain circumstances or providing services to family members in case of necessity. Certainly, importance of information technology is undisputed due to cheap and frequent communication. Seafarers are more involved in family activities now, at least virtually, with spatiotemporal distance.[20]

Leisure on board has been encouraged organizationally due to the improvement of crew's cooperation, maintenance of capabilities and struggle against boredom, loneliness and harmful appearances (use of opiates and narcotics, gambling, etc.) that contribute to numerous accidents being widespread among seafarers. This probably stems from dissatisfaction at work, wherein difficulties in developing friendships should be highlighted due to constant change of ships during seafarer's career and the presence of international crew with very different values, norms and customs. Seafarers drink more in the ports, especially when they go out with several colleagues for entertainment and to reduce the fear of danger and the unknown.[21] However, it should be emphasized that leisure should not jeopardize the efficiency of the work process. The preoccupation with activities that are not related to work is often the case, such as using a cell phone or computers, surfing the Internet, communication via *Skype*, etc.), which impair the ability to reasoning, along with the possibility of making quality decisions.[22]

When numerous aspects of life on board are unfavorable, it is also the case with the nutrition. There is no standardization of the seafarer nutrition. Furthermore, the fact that an increasing number of seafarers have excess body weight shows negligence of company for the crew due to unhealthy food increases the possibility of developing diseases.[23] A better nutrition is also facilitated by marine technology through advanced possibilities of food storage and multiple opportunities of the food supply in port and during the voyage. As in the preceding examples, the denial at the expense of the crew on an economic basis harms even the company due to higher risk of navigation. So, it is necessary to consider the crew circumstances in formulating business policies. Long-term success is based on interaction among satisfaction and the crew's abilities at which it is often not given enough importance.

4. CONCLUSIONS

Current technology makes similar the life features of seafarers with land routine. That is obvious due to the growing necessity for crew education in changing conditions of life and work, development of more flexible organization, a larger range of leisure activities, use of information technology, etc. As a social construct, the technology has ascribed meaning and therefore requires conscious use. Unlike human beings, it cannot make decision. Therefore, it is not appropriate to denounce technology for operating errors. Such an error may be considered in the case of not utilizing its capabilities that enhance whole seafaring through an individual well-being of the crew during the voyage.

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THE IMPACT OF THE LAW OF THE SEA TOWARDS GLOBAL OCEAN POLICY ISSUES: MARITIME ADMINISTRATION PERSPECTIVE

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ABSTRACT

The implementation of the appropriate maritime policies, legal norms and the main principles of the international law of the sea, represented mainly by the Law of the Sea Convention (1982), for ensuring the quality of global shipping industry and seafarers, maritime environment protection, maritime safety and security, along with an effective economic management of maritime functional areas, are considered the main responsibilities of the maritime administration in nowadays. Nevertheless, the sustainable development of ocean resources and space at international level, as well as the management of the integrated maritime management practices are becoming currently an imperative task for the maritime administration, which based on the international law of the sea and domestic legislation, must play more active role towards these important matters for the international community. In this respect, the focal point of this study is to analyse the possible role and impact of this administration towards international ocean policy issues such as living marine resources, exploitation of oceanic mineral and energy resources, and ocean environmental protection, as crucial matters for the national interests of a coastal state as well as considered important key factors for the international system and for the international relations in general. The authors agree that the maritime administrations worldwide need to strictly implement the international law of the sea in order to cope with these recent changes global in nature in order to fulfil its main objectives.

KEY WORDS

Maritime administration, international law of the sea, Law of the Sea Convention, ocean policy, maritime security, maritime safety, maritime environmental protection, ocean natural resources, living marine resources.

1. INTRODUCTION

Whosoever commands the sea commands the trade: whosoever commands the trade of the world commands the riches of the world and consequently the world itself. This 17th century famous policy statement declared by Sir Walter Raleigh emphasizes the great importance of an effective administration of the ocean activities and resources, achieved through a comprehensive national ocean policy and the implementation of the international law of the sea. In light of these considerations, Maritime Administration is concerned with the policy making, regulatory and service provision functions of the government, as well as the effective implementation of the law of the sea that contribute to ensure that national maritime interests and are effectively protected, and international relations between the appropriate

state and other international actors are implemented in a way that ocean resources and exploitation is implemented according to international law. Therefore, its main responsibility is the implementation of the political, social and economic philosophies and policies of the national Government, as well as the requirements of the international maritime conventions and the law of the sea towards an effective administration of the national and global maritime affairs.
The significance of the Maritime Administration and the implementation of the law of the sea is paramount because it promotes the progress and prosperity of the shipping industry and seafarers, and also the sustainable use, development and optimization of the ocean policy issues such as; living marine resources, exploitation of mineral and energy resources, and environmental protection. In this respect, an analytical discussion will be provided regarding the role and impact of Maritime Administration and the law of the sea in ocean policy issues; by analyzing firstly the concept of Maritime Administration, secondly its approach toward international ocean policy issues, and finally discussing the legal framework which enables this organization to accomplish its national objectives.

2. THE LEGAL CONCEPT OF THE MARITIME ADMINISTRATION AND OCEAN POLICY

The concept of the Maritime Administration is a substantial matter to comprehend, therefore is essential first to recognize its position within Public Administration, then its definition, tasks, its maritime policy, and finally its structure. The Maritime Administration of a country with maritime interests is an integral component of its Public Administration, that although might be considered part of the executive division of the government, is considered as a "fourth power" due to the permanent specialized civil service that maintains and to autonomous authority in the policy-making process (Plant, 1998. p, 2). In this regard, Maritime Administration is the maritime administrative side of the government, and its power lies upon the administrators as well as the politicians, indicating their ability to influence and make decisions. At the same time, the Maritime Administration implements the policies and the decisions made by the political system, and also the requirements of the international maritime legislation regarding maritime affairs. Hence, Maritime Administration, within the framework of the Public Administration, effectively exercises the legislative and executive functions of the Government pertaining to the maritime realm.
National maritime administration means any authority which is established by a State in accordance with its legislation and which is responsible, inter alia, for the implementation of national and international laws concerning maritime transport and the standards of its flag ships (UNCCRS, 1986). Within the agenda of a country's overall maritime activities, the purpose of Maritime Administration is to provide the government with machinery which would permit it to perform satisfactory and efficiently those tasks pertaining to maritime shipping legislation, national maritime law and international maritime conventions (Vanchiswar, 1996). As such, the Maritime Administration might be defined as a governmental body which involves decision making, strategic planning, governmental consultancy, formulating objectives and goals, directing and supervising employees, exercising controls and enforcing the maritime jurisdiction (Plant, 1998). Consequently, it may be said that Maritime Administration is the *action plan* of the government which ensures that the national maritime interests are successfully protected.
With an increase focus on the sustainable development of ocean resources and space, as well as in the integrated maritime management practices, Maritime Administration`s main task is the implementation of appropriate maritime policies for ensuring the quality of shipping industry and seafarers, maritime environment protection, maritime safety and security, along with an effective economic management of maritime functional areas. In this respect, the Maritime Administration implements maritime strategies covering its purpose and duties prescribed by the national maritime legislation, which are as follows: 1) Registration of ships. 2) Inspections and Certification of ships. 3) Manning of ships. 4) Prevention and combat of marine pollution. 5) Detention of unsafe ships. 6) Port state control. 7) Investigation into shipping casualties. 8) Registration of seamen. 10) Maritime

training and education. 11) Issuance of the Certificates of Competency. 12) The adoption and implementation of International Maritime Conventions. 13) Advice to government on maritime matters. 14) Wrecks. 15) Crew matters (Vanchiswar, 1996, Cicin-Sain. & Knecht 1998).

Establishing an appropriate ocean policy is extremely important for the Maritime Administration because of its regulatory and enforcement functions, as well as its activities and responsibilities. Bearing in mind the common objective that a Government and its Administration has towards the protection of the national maritime interests is obvious that the development of Maritime Administration policies will derive from a Government's overall national philosophies. Thereby, the policies of a Maritime Administration will mirror the aims consistent with those of the Government for the shipping policy as a "totality of economic, legal and administrative affairs by which the state influences its fleet's position in the national and international economy", and with the overall maritime policy which includes approaches such as; international obligations, safety standards of national ships, safety of navigation, development of human resources, protection of marine environment, regional and international co-operation, development of shipbuilding and port development (Vanchiswar, 1996, p 49).

The organizational structure of the Maritime Administration may vary in different countries as a result of the nature and extend of the responsibilities of this Administration and from the maritime development stage in the country. Hence, Maritime Administration`s infrastructure is not automatically planned from the beginning but has developed as a result of circumstantial progress. In many countries, Maritime Administration is under the Ministry of Transportation's responsibility, but in other States, might be an independent authority. An example of what has been previously stated is the organizational structure of the Swedish Maritime Administration. The Maritime Transportation Directorate as an integral part of the Ministry of Transportation and Communication, is the highest authority of the Swedish Maritime Administration, and is directed by the Minister in relation to the administrative, legal, financial, technical and social matters pertaining to the National Constitutional Law and to the Maritime Law of Sweden. Under the responsibility of the Directorate of the Maritime Transport are the following departments: 1- Maritime Transportation (maritime traffic, aids to navigation, manning of ships, and pollution prevention). 2- Maritime Registry (registration and classification of ships, registration of seafarers, and ship license). 3- Port Authority (port security, port activities, and port pollution prevention). 4- Vessel Survey and Inspection (inspection of ships, safety of ships and certifications of seafarers). 5- Maritime Transportation Studies (transportation strategy, infrastructure planning and international projects). 6- Legal Affairs (legal and policy consultancy).

3. THE LEGAL APPROACH TOWARDS INTERNATIONAL OCEAN POLICY ISSUES

Maritime Administration`s approach towards ocean policy issues can best analyzed by identifying first the ocean issues, afterwards to discuss its main role in these issues, and finally to examine the groups and industries interested. Developing an ocean policy is essential for any state in order to manage national ocean interests in a coherent way to ensure the best satisfaction of the state's interests. In this respect, the setting of objectives for the effective utilization of marine resources, the assessment of obtainable capabilities, and the identification of the instruments for enhancing capabilities required to reach the objectives within the overall national development perspectives will constitute a rational ocean policy (UN Resolution A/46/722, 1991). According to UNCLOSS 1982, the national ocean space adjacent to the coast involves the Territorial Sea, Contiguous Zone, Exclusive Economic Zone, and Continental Shelf upon which Coastal States have rights, jurisdiction and obligations over their space and resources. It is the Maritime Administration`s task to protect these rights and to enforce jurisdiction over these maritime zones regarding the protection of the ocean areas, as well as to promote rational use and development of their living resources. The main ocean policy issues of a coastal country stand on matters with great economic interests, which are, *inter alia*:

Living Marine Resources, including activities such as; fishing, aquaculture, collection of marine mammals and gathering of other marine creatures, are a vital source of protein, vitamins and minerals for human consumption, accounting thus for about 20% of the total world food supply (Churchill & Lowe, 1999). Since these essential resources are considered natural common property, Maritime Administration is facing a big challenge to preserve these resources and prevent the over-fishing based on sustainable development policy.

Exploitation of Mineral and Energy Resources, such as oil, gas, gold and minerals, is another substantial issue with essential economic interest. Due to the high technological capabilities for exploration and exploitation "half of natural output produced by environment system is being utilized by humans, and the margin for error in economical activities that can inflict irreversible changes on the natural resource base will narrow" (Ma, 2007, p.128). In this regard, the role of Maritime Administration in promoting and implementing policies for the improvement and optimal use of the sea-bed resources is more than crucial.

Ocean Environment Protection which can be defined as the introduction by man of substances or energy into the marine environment, which results in the harmful effect of ocean living resources, hazard to human life, and hindrance to marine activities, is another issue of a great concern to Maritime Administration (Churchill & Lowe, 1999). The four main sources of marine pollution are shipping, dumping, seabed activities and land activities. For this reason, it is the duty of Maritime Administration to implement appropriate policies to prevent marine pollution and protect the marine environment. The optimization of resources and the ocean governance are also essential ocean policy issues.

In view of the exhaustibility of resources and environmental concerns caused by the human impact on the oceans, Maritime Administration`s main strategy to tackle these issues is to promote a sustainable use and development policy, aiming to protect national maritime interests in the ocean resources and space. In light of these considerations, the role of Maritime Administration is to participate, consult and contribute in the national maritime policy-making process regarding the adoption of appropriate rules, regulation and procedures in the protection of maritime interests. In addition, the implementation of national maritime laws and, the adoption and execution of international maritime conventions with regard to the sustainable use of ocean areas, protection of maritime environment and optimization of ocean resources, is another task of the Maritime Administration. Furthermore, considering the jurisdiction and sovereignty rights over the space and resources of the national maritime zones it is the responsibility of Maritime Administration to enforce the law against any unlawful act committed within these areas regarding ocean policy issues.

Another task of Maritime Administration is to adopt and implement Integrated Coastal and Ocean Management and Integrated Maritime Management Systems to address concerns regarding the preservation, sustainability, development, and the protection of the ocean resources and space, as well as to find a balance between human's impacts on one hand, and the need for the protection of the ecosystem on the other (Cicin-Sain & Knecht 1998). In the fulfilment of its objectives is very important that Maritime Administration maintains close link with interested parties in the national ocean policy, such as; the Ministry of Economy. Ministry of Transportation, Ministry of Tourism, Ministry of Defence, Ministry of Foreign Affairs, Ministry of Communications, Ministry of Food and Agriculture, and Port Authorities. In this regard, the role of Maritime Administration is to operate as a coordination centre among these institutions, aiming toward an integrated national ocean policy for the protection of maritime interests (Walsh, D. 1977).

A further important matter regarding Maritime Administration's approach toward ocean policy issues is the influence of interested groups or industries upon Governmental law-making bodies regarding maritime affairs. In this respect, is essential first to identify the orientation of a Government toward ocean policy issues in order to understand its priorities. Countries such as U.S.A and Canada have clearly defined the significant position that ocean policy issues are representing to their national interests. In the maritime policy-making process of these countries an essential role are playing the interested industries in ocean affairs, such as Fishing, Oil, Mineral and Tourism Industries. All these important dimensions are playing an active role in the national ocean policy-making process by exercising influence upon

Governmental law-making bodies in the adoption and implementation of the national maritime laws consistent with their interests regarding the exploitation of fishing resources, ocean environmental protection, and effective exploration of the sea-bed resources.

4. THE IMPLEMENTATION OF THE INTERNATIONAL LAW OF THE SEA

The legal framework within which Maritime Administration operates is based on the constitutional law, and on the international maritime conventions adopted by the United Nations and the International Maritime Organization (IMO). The legal authority of Maritime Administration is characterized the most, as regulatory power to control certain activities by setting conditions, constraints, and limitations with regard to the sustainable use and development of the maritime property (Cicin-Sain & Knecht, 1998). The constitutional law and international maritime legislation are the main legal platforms of Maritime Administration in performing its tasks. In the case of U.S.A, the Maritime Administration of this country in achieving its objectives, implements national maritime laws such as Merchant Shipping Act 1936, which stipulates the US policy on the encouragement and sustainable development of merchant marine; Maritime Transportation Security Act 2002, which imposes security and safety requirement on the maritime industry and; the Environment Maritime System 2008, aiming the protection of ocean and marine environment (U.S Department of Transportation, 2003).

With regard to international maritime legislation, the Maritime Administration`s ocean policy derives mainly from the doctrine of the United Nation Convention on the Law of the Sea 1982 (UNCLOS), which is considered the constitution of the oceans that has managed to establish the fundamental jurisdictional principles for the ocean resource management. The main principles behind UNCLOS are as follows: 1) Accommodating peacefully all users of the sea. 2) Protection and preservation of the Oceans. 3) Optimal use of the living and non-living resources of the oceans, and 4) Respect for freedoms in oceans. These principles are the main pillars by which the maritime policy of the Maritime Administration is founded. An additional essential international instrument with regard to the Maritime Administration’s ocean policy, is the United Nations Convention on Conditions for Registration of Ships 1986, which highlights that, “a State shall have a competent and adequate national Maritime Administration which shall implement applicable rules and standards concerning, the safety of ships and persons on board, and the prevention of pollution of the marine environment” (Article 5, UNCCRS).

The relevant international instruments of IMO for the improvement of maritime safety and pollution prevention are a significant contributor for the Maritime Administration`s national policy toward ocean issues. The most substantial instruments are as follows: 1) The International Convention for the Safety of Life at Sea (SOLAS) 1974, as a significant instrument to ensure the safety at sea with regard to the seaworthiness of ships. 2) The International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, aiming the complete elimination of intentional pollution of marine environment, and preserving and protecting the ocean environment. 3) The International Convention on Standard of Training, Certification and Watch Keeping for Seafarers (STCW) 1978, with the purpose to promote safety at sea and protection of the marine environment by establishing international standards for the manning of ships, labour conditions and, training and certification of seafarers. 4) The International Convention on Load Lines (LL) 1966. 5) The International Convention on Oil Pollution, Preparedness and Co-operation (OPRC) 1990. 6) The Intervention Convention 1969 and 7) Collision Regulation (COLREG) 1972.

Within the legal framework of Maritime Administration, the United Nation Environment Program Conventions are also essential legal sources. The most significant legal instruments are: 1) Agenda 21, which is a comprehensive plan of action for the protection, rational use and development of ocean space and their living resources. 2) Convention on International Trade in Endangered Species (CITES), aiming to ensure that international trade of wild animals and species does not threaten their survival. 3) Convention on Migratory Species (MSC), in which all the migratory species threatened with extension are listed. It is on the purpose of these legal instruments, that the Governments and their respective Maritime Administration should take all measures to implement and enforce the rules and regulations of all the above international conventions.

5. CONCLUSIONS

In conclusion, analyzing the concept of Maritime Administration, its approach toward ocean policy issues and its legal framework, is perhaps an efficient method in defining the role of Maritime Administration in the ocean policy issues. In this respect, the principal role of the Maritime Administration is the implementation of appropriate maritime strategies for ensuring the quality of shipping industry and seafarers, maritime environment protection, maritime safety and security, along with an effective economic management of maritime resources. Therefore, the purpose of Maritime Administration is to provide the government with a mechanism in order to perform satisfactory and effectively those tasks pertaining to National and International Maritime Legislation.

Moreover, the consultation and contribution in the national maritime policy-making process to protect the national maritime interests, the implementation and enforcement of the national and international maritime laws with regard to the optimization of the ocean resources and environmental protection, the adoption and execution of the ICOM and IMM systems for a sustainable use and development of the ocean space and resources, and finally to provide cross-sector coordination among interested institution in maritime affairs are the main tasks of Maritime Administration toward ocean policy issues. In order to perform all the above responsibilities, Maritime Administration is based on National Maritime Laws and International Maritime Conventions, as the main instruments in setting principles, rules and regulation regarding the ocean resource management, safety at sea, and protection of marine environment. In light of these considerations, the role of Maritime Administration toward maritime affairs and particularly in the ocean policy issues is crucial, irreplaceable and very important.

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THE ROLE AND IMPORTANCE OF SAFETY IN MARITIME TRANSPORTATION

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ABSTRACT

Today, safety is a very important factor that affects all elements of maritime industry. However, safety management and its implementation in the maritime industry are more important than ever. International legislation and regulations in shipping were rather scarce at the time of the Titanic tragedy. Present-day maritime industry has a number of codes, conventions and guidelines that set the boundaries of safety and efficiency in shipping. The development of maritime industry has resulted in the great development of technology, design, size, propulsion and safety of ships. Consequently, the development of new technologies in the maritime industry has brought changes in the education systems over the last few decades. After the Second World War the maritime education system has been evolving proportionally to the demands of the industry. Despite great breakthroughs in technology and safety at the workplace, the marine industry is still a relatively dangerous place to work. This paper presents the flow and the analysis of the development of technologies that have been major milestones in shipping with regard to their contribution to maritime safety. The paper also discusses important factors that adversely affect the safety of navigation today and points out the dangers affecting the future of maritime safety, with the aim of minimising the dangers, i.e. material and human losses, and maximising the environment preservation.

KEY WORDS

maritime safety, development of ships, professional training, international regulations and standards, competent authorities for safety.

1. INTRODUCTION

Maritime safety is one of the imperatives of the maritime industry. Sea accidents occur under a set of circumstances in an area where each of the factors affecting these circumstances may, at a moment of time, alter its initial state and turn into another state that can be more or less predictable. A danger is a state of imminent distress, whereas a risk is a danger that can be predicted, but only to a certain extent. It should be borne in mind that the risk always implies the probability that an undesirable event may occur and that the only thing a man can do is to assess it. Risks in maritime shipping are mostly related to accidents at sea that can be, according to their causes, be divided as follows [4]:

- accidents caused by unintentional human error,
- accidents caused intentionally by man,
- accidents due to technical failures,
- accidents due to poor weather (wind, waves, lightning, etc.)

In the context of safety of traffic in maritime shipping, it may be assumed that a system or its sub-system is likely to function properly within the set limits. Hence the goal is to reduce or to eliminate the causes of adverse events that threaten the safety of navigation with the purpose of achieving absolute reliability in maritime transportation. In a wider sense, the safety of maritime transportation may be defined as a set of measures that are taken to protect human life, but also as a set of measures that are taken to protect material and non-material assets that are directly or indirectly related to maritime transportation. There are a large number of factors affecting the safety at sea, including shippers, ports and port authorities, coastal countries, international community, etc.

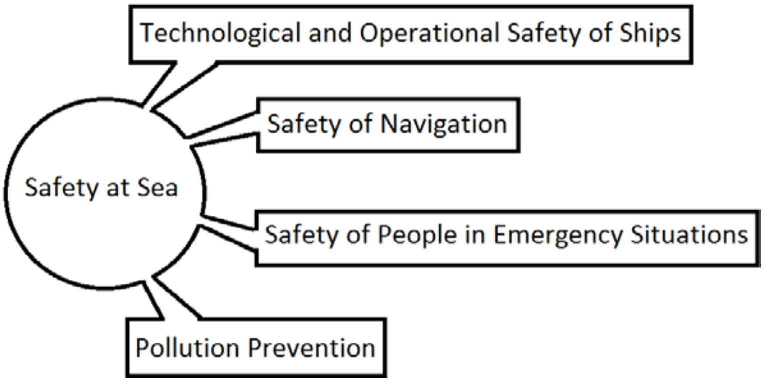


Figure 1. Safety at sea
Source: Kopacz; 2001; 201 [4].

In a narrower sense, the safety of maritime transportation implies the measures aiming at performing the carriage of cargo by sea without harmful effects on human life, cargo, vessel and environment. In order to obtain an adequate level of safety, a system of safety has to exist at the international level which will be capable of bringing adequate necessary measures and which will monitor the implementation of these measures by means of various instruments and through various institutions. The maritime system of safety at sea can be divided into the following components [4]:

- institutions bringing legal regulations (international conferences, International Maritime Organization and its institutions, etc.),
- institutions in charge of the implementation and monitoring of security measures and standards,
- international maritime conventions and other legal instruments related to safety at sea, and
- users at sea.

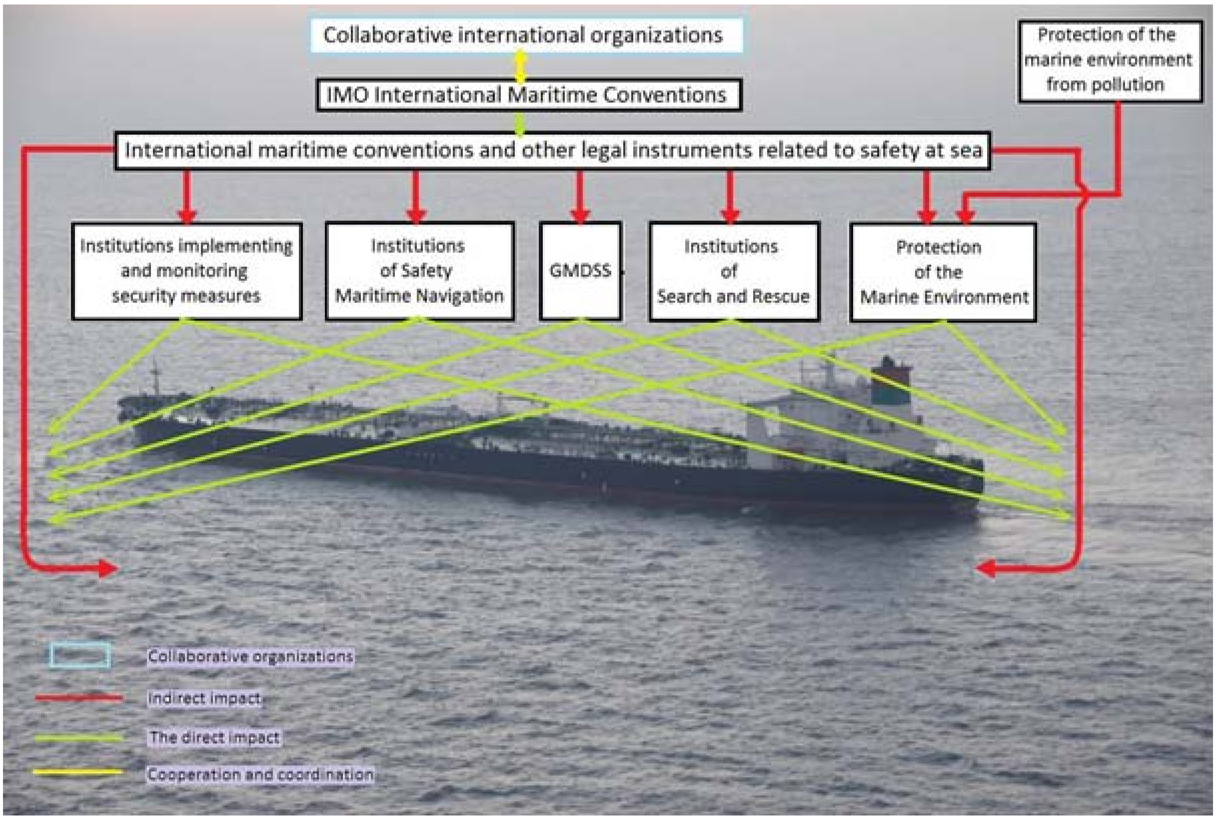


Figure 2. The system of maritime safety
Source: Kopacz et al.; 2004; 24 [3]

2. ANALYSIS OF SAFETY FROM THE STANDPOINT OF TECHNOLOGICAL DEVELOPMENT OF MARITIME INDUSTRY

Since the 1970s, world seaborne trade has been growing due to the market globalisation (Figure 3). Generally speaking, from the ancient times up to present days, the transportation of goods by sea has remained one of the cheapest ways of shipping and the world seaborne trade has been growing steadily, particularly after the World War II. The number and size of merchant ships have increased due to major technological breakthroughs, yet maritime industry has remained a dangerous workplace. Today's world fleet consists of more than 100,000 vessels with the total tonnage of almost 1 billion GT. [8]
Since the 1912 RMS Titanic disaster that claimed 1513 lives [9], there have been many changes with regard to safety of navigation in terms of regulations and technology. The new technologies that have considerably affected the safety in maritime industry include the introduction of gyro-compass, RADAR, followed by ARPA RADAR for improved safety in maritime traffic, mandatory use of electronic charts (ECDIS) since 2012, Global Positioning System (GPS), Automatic Identification System (AIS) for identifying and locating vessels, vessel traffic service (VTS) for traffic control and monitoring, etc. However, it should be underlined that some research results show that the dependence on certain technologies may lead to accidents.
Over the years, the progress in design and construction of ships has resulted in the improved safety at sea. The progress has been achieved not only in design, but also in the strength and the size of the vessels which have become increasingly larger

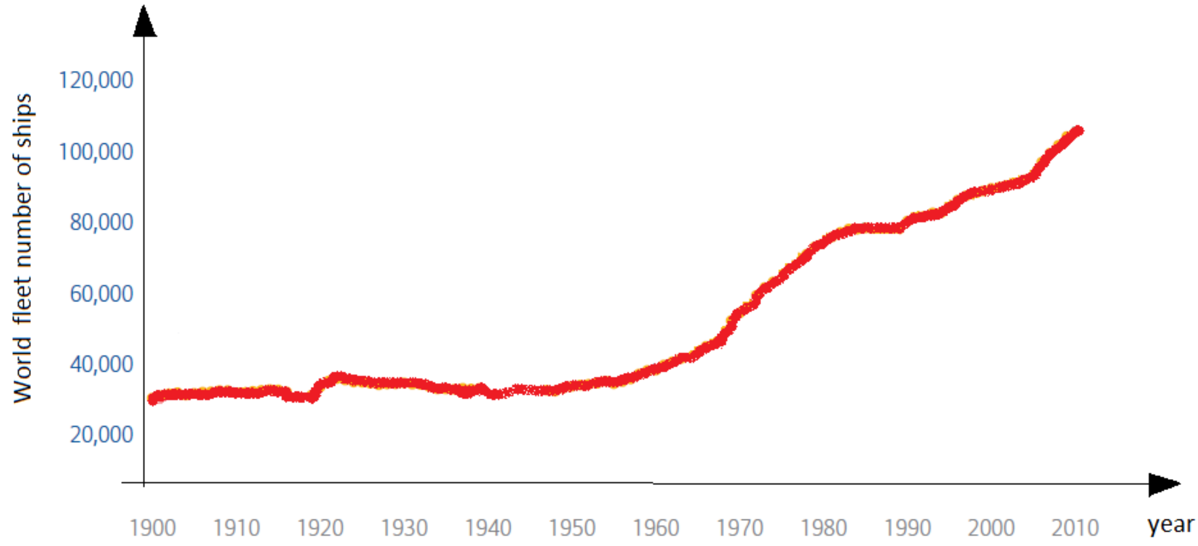


Figure 3. Each year the world fleet size is increased by a number of ships
Source: Lloyd's Register Fairplay, World Fleet Statistics 1900-2010

(Figure 4). The construction techniques have progressed to such an extent that they have very little in common with the techniques used in the times when the Titanic was built. That vessel, which represented a high-tech marvel of shipbuilding technology at her time, appears rather small when compared to modern container ships, VLCCs and FPSO (floating production, storage and offloading) units (Figure 4). In early 20th century Europe was the centre of shipbuilding, the vessels were designed by small teams and constructed in relatively small shipyards. Today, just a hundred years later, the situation is entirely different.

The centres of ship design and construction have moved to the countries in the Far East (China, South Korea and Japan). Forty years ago (in 1979) the world market share in shipbuilding between Japan and Europe was 1:1, whereas by 2012 this ratio dramatically changed: China 45%, South Korea 29%, Japan 18%, the EU 1%, the rest of the world 7% [10].

Computer-supported modelling has replaced difficult and time-consuming calculations of ship's stability, structure and hydrodynamics. In addition to hull design, there have been other technological changes in the past hundred years, e.g. regarding the bridge arrangement and appliances.

At the time of the Titanic the navigation bridge featured few navigational appliances. The standard equipment used to include Nautical Almanac, sextant, chronometer and magnetic compass. On the other hand, modern bridges are equipped with computers and high-tech appliances such as autopilot, VHF radio, depth finder, Automatic Identification System (AIS), ARPA Radar, Global Positioning System (GPS), Electronic Chart Display and Information System (ECDIS) etc., and the magnetic compass has been superseded by gyro-compass. These appliances have ensured a safer and easier navigation.

Furthermore, major breakthroughs in weather forecasting have also improved the safety at sea. Monitoring weather conditions and selecting optimal routes with regard to fuel consumption, vessel's characteristics and reduction of voyage time have become standard procedures. The purpose of selecting the optimal route using modern technologies, including meteorological service, is not to avoid poor weather but to find the balance between the length of the journey and fuel consumption, with due attention paid to safety of the crew, passengers, cargo and the ship when meeting bad weather.

During all these years the maritime industry has attempted to enhance safety implementation and control. However, despite all efforts, the recent disaster of the cruiser Costa Concordia has proved that, in modern times, the safety at sea is the result of a set of initiatives, research, regulations and innovations.

Maritime shipping has become considerably safer over the past decades and navigation appears to be safer than ever, but further development of technologies will bring new challenges that the shipping industry will have to deal with and that will require solutions for future problems.

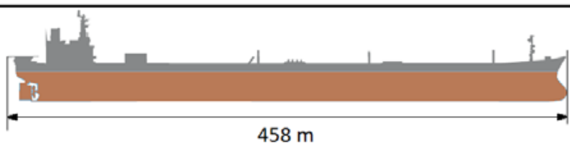
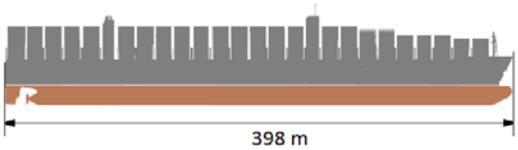
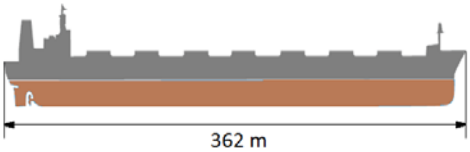
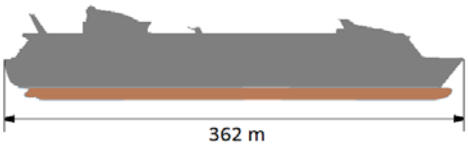
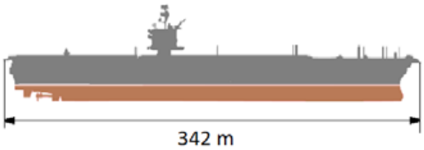
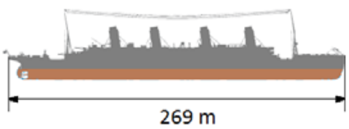
SHIP SIZE COMPARSION	NAME	TYPE	YEAR
 488 m	Prelude	FLNG	2017
 458 m	Knock Newis	Oil Tanker	1979
 398 m	Mærsk Mc-Kinney Møller	Container Ship	2013
 362 m	Valemax	Bulk Carrier	2011
 362 m	Alure Of The Seas	Cruise Ship	2009
 342 m	USS Enterprise	Aircraft Carrier	1961
 269 m	Titanic	Ocean Liner	1912

Figure 4. Size of modern ships compared with the size of the Titanic, the vessel that was the most advanced shipbuilding achievement of her era
Source: author

3. ANALYSIS OF SAFETY FROM THE STANDPOINT OF MARITIME LEGISLATION

The technological development of the maritime industry has increased the need for new conventions and guidelines that would define new boundaries of safety and efficiency. Safety and security management and implementation are very important aspects of modern shipping. The Port State Control (PSC), established on the basis of STCW convention in 1978, has greatly contributed to the safety and security in maritime shipping. The PSC is entitled to check any vessel at any port and prevent a vessel's departure if she does not meet safety requirements. The PSC encourages vessels to respect international safety and security standards, to prevent environmental pollution, and to observe other operational regulations. The performed inspections of vessels are uniform in order to ensure equal standards of safety and avoid the obstruction of fair market competition. There are more and more inspections worldwide, in accordance with the increase in maritime traffic. Classification societies also contribute to the safety at sea through applying international standards in designing and construction of vessels. The states whose ensigns the vessels are flying are the ones observing the IMO regulations. However, the "flags of convenience" appeared in the 1950s and some of them have been criticised for being loose in observing regulations and control, by failing to ratify international standards in national parliaments or by failing to implement ratified laws and regulations.

Figure 5 shows the development of safety through the introduction and amendments of regulations over the years. It can be noticed that significant changes came into effect after the Titanic disaster in 1912 by adopting the SOLAS convention and its amendments.

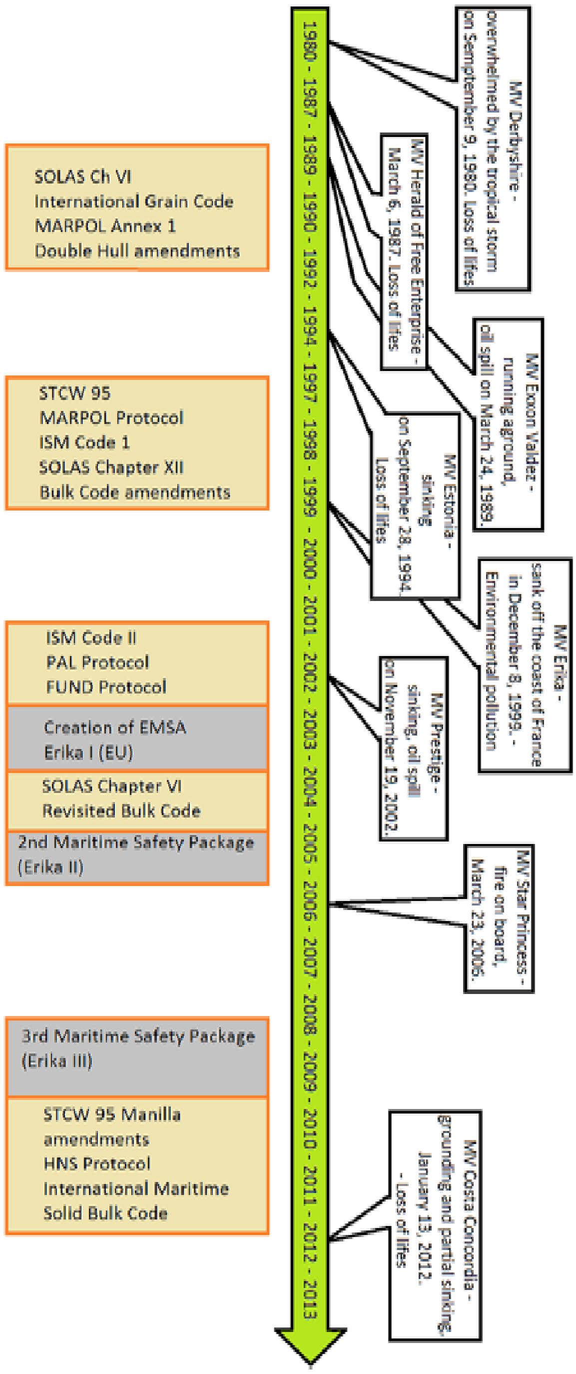


Figure 5. Time flow chart presenting the changes in safety regulations over the years
Source: 15 Years of Shipping Accidents: A review for WWF

Similar changes were introduced by the regulations governing the transport of dangerous cargo (tankers, bulk carriers, etc.), e.g. Bulk Code, amendments to MARPOL Annex I, and the US regulations such as the Oil Pollution Act 1990 (OPA '90). Sadly, some of the changes regarding the improved safety of navigation were introduced only as a response to maritime disasters that had already occurred. For instance, it was only after the calamitous fire on the cruise ship Star Princess in 2006 that fire regulations, i.e. amendments to SOLAS chapter II-2 and to the International Code for Fire Safety Systems (FSS Code) were adopted. In this context, it remains to be seen what safety regulation changes will take place, in the near future, following the disaster of the cruise ship Costa Concordia.

4. THE MOST COMMON CAUSES OF SHIP LOSSES IN MARITIME INDUSTRY

Despite the fact that maritime transport has been ranked as one of the safest means of transportation (e.g. compared to road traffic), seafaring remains a very dangerous profession. According to the data covering the period 1996-2005, there were 84 fatalities per 100,000 seafarers in Poland each year, 96 fatalities per 100,000 seafarers in Hong Kong, 90 fatalities per 100,000 seafarers in Denmark and 11 fatalities per 100,000 seafarers in the United Kingdom. When studying the data referring to the UK, it can be concluded that the safety at sea has improved over the last two decades: fatal accident rate per 100,000 seafarers per year amounted to 53 from 1976 to 1985, 39 from 1986 to 1995, and 11 fatalities from 1996 to 2005. [8]

When observing Table 1, it can be noted that, over the last several years, most of human lives have been lost onboard passenger / Ro-Ro ships and general cargo ships. In 2012 there were 610 persons reported killed or missing (lives lost) as a result of total losses during the year.
Human errors and fatigue figure prominently in these accidents. Most of the casualty situations are caused by [7]:

- sinking (49%)
- grounding / stranding (18%)
- fire / explosion (15%)
- engine failure / hull fracture (2%)

Figure 6 shows the world fleet total losses over the past 100 years. Although the data clearly indicate a downward trend in marine accidents, there is still a risk of collision, explosion and other events that can result in the loss of vessel. The losses are also affected by the type, age and sailing area of a vessel.
Sinking is the most common cause of ship losses, resulting in 50% of all ship losses per year. [8] The losses are also related to geographical areas where they took place, most frequently in the South China Sea and the Black Sea (Figure 7). Sinking is followed by grounding as the second most common cause of ship loss.

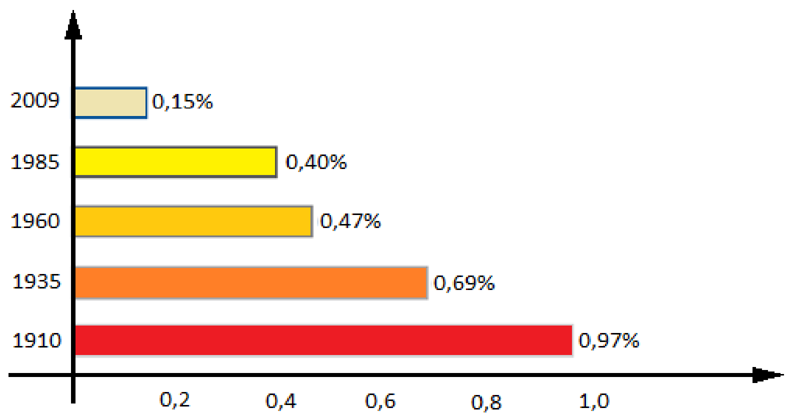


Figure 6. Total losses - % of the world fleet
Source: Calculated from Lloyd's Register World Casualty Statistics 1900-2010

Table 1: Lives lost (as a result of total losses) for the period 2007-2012

Ship Type	2007	2008	2009	2010	2011	2012
Anchor Handling Tug Supply	16					
Asphalt/Bitumen Tanker			3			
Bucket Dredger		3				
Bulk Carrier	39	15	55	48	39	8
Bunkering Tanker						
Cement Carrier	2		1			
Chemical Tanker	14				2	
Chemical/Products Tanker						17
Container Ship (Fully Cellular)			12			
Crane Ship						
Crude Oil Tanker					5	
Deck Cargo Ship	5	4				
Diving Support Vessel		1			13	
Factory Stern Trawler	11	5	2		1	
Fish Carrier						
Fishery Research Vessel						
Fishing Vessel	4	39	18	41	17	26
General Cargo Ship	199	156	327	144	72	86
Grab Dredger						
Heavy Load Carrier			1			
Hopper, Motor	1					
Landing Craft	1	1				
Livestock Carrier			43			
LPG Tanker		10				
Offshore Tug/Supply Ship				10		
Ore Carrier						
Passenger Ship	2		143		12	293
Passenger/Cruise	2					32
Passenger/Ro-Ro Ship (Vehicles)	22	831	62		3013	103
Passenger/Ro-Ro Ship (Vehicles)/Rail			5			8
Pipe Carrier						
Platform Supply Ship	1					
Products Tanker		1				10
Pusher Tug	3		5		5	
Refrigerated Cargo Ship				2		2
Research Survey Vessel	2				7	
Ro-Ro Cargo Ship	10	7	1			2
Standby Safety Vessel						1
Stern Trawler	10	27	9	6	28	9
Tanker (unspecified)	1	14	3			
Trailing Suction Hopper Dredger						
Trawler	4	4	3	1		
Tug	7	1	1	1		2
Vegetable Oil Tanker	7					
Vehicles Carrier						11
Grand Total	**363**	**1,119**	**694**	**253**	**3,214**	**610**

Source: IHS Fairplay - World casualty statistics 2012

Figure 7. Total losses by region from 26 November 2011 to 25 November 2012
Source: Lloyd's List Intelligence Casualty Statistics. Analysis: AGCS.

When studying the statistical data (Table 2) by the type of the vessel, it can be noticed that cargo ships and fishing vessels have most losses (48%). Among large merchant ships, bulk carriers have more losses than tankers, container ships and cruisers – around 7%, although they make only 20% of the world merchant fleet. It can be also noted that vessels conveying liquid cargo and containerised cargo have a lower loss rate.

Table 2. Ship losses by type (2001–2012)

Period	**Barge**	**Bulk**	**Cargo**	**Chemical/Product**	**Container**	**Dredger**	**Fishery**	**LPG/LNG**	**Other**	**Passanger**	**Ro Ro**	**Supply/Offshore**	**Tanker**	**Tug**	**Unknown**	
2001-2002	4	9	70	6	1	4	43	2	13	11	5	1	2	6		177
2002-2003	3	11	68	9	1	1	31		9	14	7		4	8	3	169
2003-2004	2	6	65	9	1	4	30		4	10	9	3	3	9	1	156
2004-2005	5	8	58	7	2	3	38	2	3	13	7	3		5		154
2005-2006	7	8	56	10	5	2	23		2	12	10	3	2	8	1	149
2006-2007	5	10	76	5	3	4	34		7	7	5	5	1	9	1	172
2007-2008	4	8	55	9	1	3	36	1	4	5	8	1	3	9	1	148
2008-2009		12	49	8	5	1	30		6	5	5	3	2	5		131
2009-2010	1	10	57	4	4	1	20		3	2	1	1	3	3		110
2010-2011		12	35	4	2	2	17	1	2	8	2	2	1	3		91
2011-2012		7	51	7	4	1	12	1	6	3	4	2	2	6		106
Total	31	101	640	78	29	26	314	7	59	90	63	24	23	71	7	1563

Source: Lloyd's List Intelligence Casualty Statistics. Analysis: AGCS

Table 3. Causes of loss statistics (2001–2012)

Period	**Collision**	**Contact**	**Foundered**	**Fire / Explosion**	**Hull Damage**	**Missing / overdue**	**Machinery damage / failure**	**Piracy**	**Wrecked / stranded (aground)**	**Miscellaneous**	**Total**
2001-2002	20	2	51	35	24		15		22	8	177
2002-2003	21	1	59	22	12		13		34	7	169
2003-2004	13	3	72	21	7	1	9	1	28	1	156
2004-2005	24	4	62	18	7	3	10	1	23	2	154
2005-2006	25	4	61	18	5	1	7		26	2	149
2006-2007	16	2	68	15	11	1	17	1	39	2	172
2007-2008	11	1	74	17	3		8		33	1	148
2008-2009	13		62	14	8		7	1	24	2	131
2009-2010	10	1	58	12	3	1	3	2	18	2	110
2010-2011	3		50	6	3		5		24		91
2011-2012	6	2	52	11	5		6		23	1	28
Total	162	20	669	189	88	7	100	6	294	28	1563

Source: Lloyd's List Intelligence Casualty Statistics. Analysis: AGCS

According to the type of accident, most of the vessels were lost over the last decade due to sinking and grounding. Many researches and studies have proven that the highest risks include collision, sinking and hull fracture [11]. Fire / explosion also represents a considerable risk onboard ships, threatening general safety and resulting in human casualties and material losses. Fire remains a major threat particularly onboard Ro-Ro vessels and large cruise ships.

5. MAJOR FACTORS AFFECTING THE SAFETY OF MODERN NAVIGATION

5.1. Professional competence

Due to the progress in technology, vessels have become increasingly larger over the past 100 years. Modern ships (VLCC tankers, large cruisers and container ships) feature cutting edge design and represent a challenge to insurance instruments because of their added value. Large passenger ships intended for cruising are designed and built with special attention paid to the safety of passengers. Their design represents additional challenge in the areas of safety, security and risk management, particularly with regard to evacuation and rescue operations at remote locations. Because of high costs of maintenance, insurance, and additional professional training, many shippers seek cheaper workforce in the developing countries where standards of living are lower. This trend challenges the safety of modern maritime shipping because some of these countries do not have sufficiently developed infrastructure that would meet the requirements of professional education and training, and ensure future competence of the seafaring personnel.

Despite IMO regulations and guidelines for introducing international standards in professional education of seafarers, education policies and grading standards are not consistent across the world, which may lead to differences in professional competency. It is clear that some

countries fail to fully implement IMO educational and training standards. Varying standards and policies on professional education, as well as different methods of training and assessing the seafarers' proficiency and competence, result in an internationally inconsistent system of certification where a certificate issued by one flag state does not have the same value as the certificate issued by another flag state. [2]
Such differences in standards result in differences in seafarers' skills and competency, which may have adverse consequences and lead to jeopardised safety at sea.

5.2. Insufficient manning

Insufficient manning is another frequent safety problem in modern maritime industry. In spite of advanced technologies, insufficient number of crew members dealing with a growing scope of tasks and duties may result in risk and danger induced by human factor (fatigue being the most common), especially in important operations lasting 24 hours or more. A tired or exhausted worker is less productive and is more prone to accidents and injuries. Fatigue is a common problem partly due to maritime legislative which in most segments appeases the shippers allowing them to use minimum crew onboard ships. Such practice should be changed and the excessive scope of work per person should be reduced in order to reduce various elements (e.g. fatigue, sleep deprivation) that may lead to dangers caused by human factor.

5.3. Piracy

Piracy remains one of the major issues affecting the safety in maritime shipping. Pirate activities have been particularly prominent in the region of the Gulf of Aden. Maritime industry has been insufficiently successful in fighting the piracy and is still seeking ways and methods to eliminate it completely. Statistics show that the situation has changed recently (Figure 8) but it still remains a serious threat to safety of navigation. The problem is most prominent in the West Indian Ocean region and the Gulf of Aden, mainly due to low standard of living and failure to restore effective governance in Somalia. According to 2011 statistical data provided by ICC International Maritime Bureau (IMB), 28 ships were hijacked by pirates off the Somali coast and fifteen people were killed in those attacks. [12]
Another problem lies in the fact that pirates operate across vast ocean areas which are difficult to monitor and control efficiently, particularly in view of the limited assets that are allocated for fighting piracy. IMO has been encouraging national governments to provide military aid to achieve greater safety at sea.
Given the fact that the piracy-related costs amounted to almost 7 billion US dollars in 2011 [8], it should be noted that it is very important to raise global public awareness of the dangers and risks of piracy in maritime affairs and to encourage the governments to respond more resourcefully to the situation.
Figure 9 shows the areas of pirate attacks reported to IMB Piracy Reporting Centre during 2014. It can be noticed that frequent pirate attacks threatening the safety at sea were reported along eastern and western coasts of Africa and in the region of Indonesia (in the area of the Malacca and Singapore Straits).

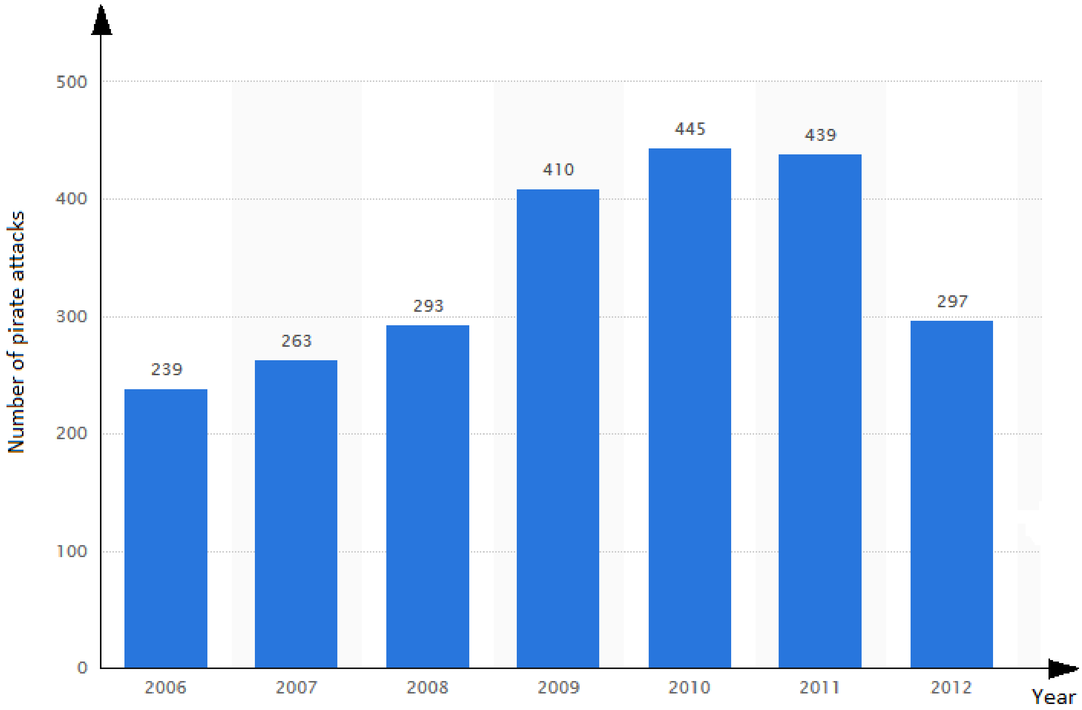


Figure 8. Number of pirate attacks against ships worldwide from 2006 to 2012

Source: http://www.statista.com/statistics/266292/number-of-pirate-attacks-worldwide-since-2006/

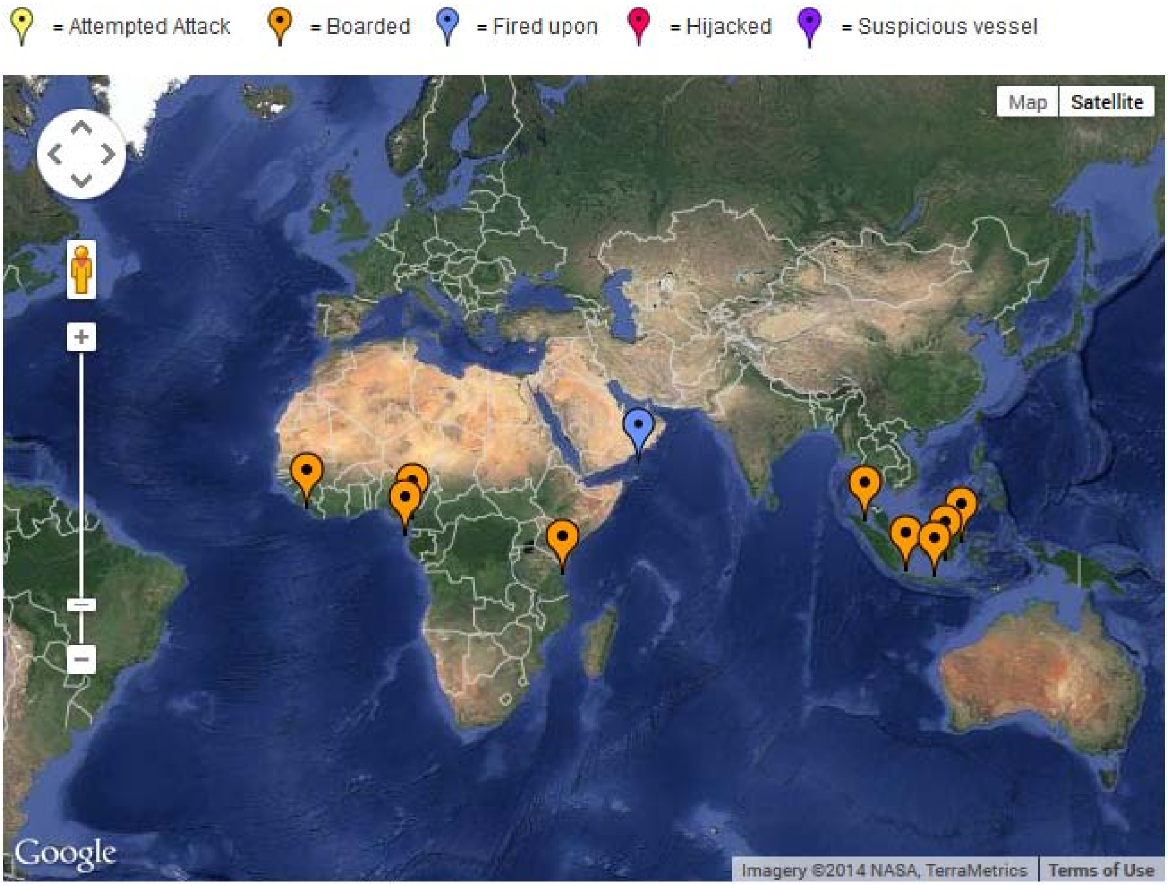


Figure 9. IMB Piracy and Armed Robbery Map 2014

Source: http://www.icc-ccs.org/piracy-reporting-centre/live-piracy-map

5.4. Language barrier

The language barrier represents a serious safety issue onboard ships. Since the dawn of times, people have tried to communicate with each other and to develop languages as the means of communication. This inherent human need resulted in thousands of languages, which naturally resulted in efforts to find common languages that would enhance communication among various populations who do not share a common language. In modern times, English language has become a *lingua franca*, i.e. the bridge or unifying language, in global economy and international maritime affairs. Language barriers have always affected the safety onboard ships with multi-national crew. As most of modern large vessels carry multi-national crews, English language has become, in most cases, the principal means of communication. However, problems often arise in communication during routine operations or even in emergencies when people react impulsively while they are supposed to respond effectively. It sometimes occurs that crew members under pressure start panicking and using their national languages. Language barriers onboard ships are not only about understanding orders but are involving other important issues such as social and cross-cultural aspects. Language as a means of communication is not the only factor that can cause misunderstanding and other problems that jeopardise the safety of the ship – the safety can be at risk due to conflicts arising from different social, cultural, even religious backgrounds. After adopting the criteria regarding the ships flying the flags of convenience, multi-language crews have become common, and so have the problems related to onboard communication and cross-cultural behaviour of the crew members. Tragic examples include the disasters of the Ro-Ro ships Scandinavian Star and Estonia, and the tanker Sea Empress, where huge loss of lives or environmental disaster took place due to misunderstanding, unfamiliarity with the language, or errors in communication among the crew. [14]

As multi-national crews are here to stay onboard vessels, it is strongly recommended that they adopt English language as their bridge language, a lingua franca, and that the satisfactory proficiency in English is achieved by every crew member in order to improve onboard safety and avoid accidents and tragedies. Finally, English language is the language of the maritime industry and is widely used and applied by maritime shipping community.

6. FUTURE CHALLENGES TO THE SAFETY IN MARITIME INDUSTRY

The development of technologies has been followed by new problems and challenges that the maritime industry has to face. The distressing fact is that the important changes related to the improved safety at sea were introduced only as a response to maritime disasters that either claimed many human lives or caused extensive and long-lasting environmental damage. Such situations should be avoided by proactive analyses of potential threats and challenges in maritime navigation and, based on the obtained results and conclusions, by designing measures for improved safety of seaborne transport without harmful effects on people, cargo, ship and environment.

A serious problem threatening the safety in the field of maritime industry lies in the sluggish and complicated maritime legal regulations that tend to appease the shippers. For example, flags of convenience allow shippers to place economic criteria above safety criteria. This is directly related to the issue of additional costs associated with supplementary education and training of the workforce, which encourages most of the shippers to recruit cheaper labour from the developing countries. Many of these countries do not have sufficiently developed educational infrastructure to ensure the implementation of IMO standards and to meet international requirements regarding the levels of proficiency and competence of seafarers. Despite the efforts of the IMO and the international maritime community, the educational policies, grading standards and certificate-awarding criteria are not consistent in all countries. Some of the drawbacks of this inconsistency and recruitment of cheaper workforce are related to the insufficient proficiency in foreign language skills, in particular English language, which in crisis situations may put the safety of navigation at risk. The problem of multi-national manning does not only involve language barriers but also social and cross-cultural hurdles.

Piracy represents another serious threat to safety at sea. The efforts that have been made by the IMO and national governments are insufficient because statistical data show (Figure 8) that no major progress has been made in dealing with this issue over the past several years. Therefore it can be expected that piracy will remain one of the major threats to the safety of navigation and will likely continue to result in further loss of human lives, ships and cargo. It is undisputable that maritime shipping and the safety in maritime shipping have greatly benefited from the development of technologies but, given the above discussed problems, maritime industry has to put more effort into the enhancement of risk management and into minimising the above mentioned threats, dangers and risks.

7. CONCLUSIONS

It is certain that safety represents a crucial factor that affects all components of the maritime industry and that the safety of modern maritime shipping is the result of a set of initiatives, research, regulations and innovations. Despite great breakthroughs in technology and safety at the workplace, the marine industry is still a relatively dangerous place to work. It is true that the progress in construction, design, electronic appliances and helpful navigational devices fitted onto the bridge has resulted in the increased safety at sea. However, other safety issues have emerged, such as piracy or legislative regulations that allow shippers to reduce operation costs at the expense of safety. Furthermore, insufficient manning leads to increased scope of work and, subsequently, fatigue and sleep deprivation of seafarers who are, consequently, less productive and more prone to accidents and injuries. Another issue arising from cutting operational costs is connected with hiring cheaper workforce from the countries which are unable to implement the adopted international standards in the professional education and training of seafarers. Global public awareness should be raised, the above discussed factors that jeopardise the safety of modern navigation should be analysed and adequate measures should be taken across the maritime community in order to minimise the factors that put the safety of maritime shipping and safety of navigation at risk.

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THE IMPLEMENTATION OF THE CONVENTION ON BIOLOGICAL DIVERSITY

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ABSTRACT

The Convention on Biological Diversity is the key global instrument on the conservation and sustainable use of biological diversity and the fair and equitable sharing of the benefits from the use of genetic resources. In 1992, the Convention on Biological Diversity was mentioned for the first time on the United Nations Conference on Environment and Development. The Convention promotes the maintenance of healthy ecosystems, the protection of threatened species and the conservation of the genetic material that underpins populations of wild and domesticated species. Recent studies have shown that biological diversity decreased due to habitat destruction. Therefore, the protection of nature is imperative precondition for the survival of the diversity of living components, ecosystems and landscapes. The aim of this paper is to present current state of biodiversity in the world, and future strategic plans for conservation of biodiversity and preventing further destruction of biological systems.

KEY WORDS

Biodiversity, Convention, Protocol, Biological Security Strategy.

1. INTRODUCTION

Biodiversity is the totality of all living organisms, which are the integral parts of ecosystems and includes diversity within species, between species, habitats, and diversity of ecosystems. Although the approximate extent of biodiversity, is not known, scientists have until now described and classified the 1,063,000 species of animals, 344,300 species of plants and 11,200 microorganisms. The assumption is that the total number of species ranges from 10 to 30 million; however, each year 40,000 species disappears, which greatly reduces the overall ecological balance and stability.

The Red List of the International Union for Nature Conservation (International Union for Conservation of Nature, IUCN) has demonstrated that among the species studied, 38% are threatened with extinction, with 22% of all known mammals, 30% of amphibians, 12% of all known birds, and 28% of reptiles, 37% of freshwater fish, 70% of plants and 35% of invertebrates are endangered or facing extinction.

Research indicates that biodiversity has decreased due to the destruction of habitats, destruction of natural biological systems, the overly intense exploitation of land, pollution of water, air and soil, including other inappropriate processes in nature. Every year, biodiversity losses cost the global economy billion of euros, undermining economies, business prospects and opportunities to combat poverty. Therefore, the protection of nature is a prerequisite for the survival of humans and biodiversity is an essential factor in the quality of life on earth.

2. CONVENTION OF BIOLOGICAL DIVERSITY

The Convention on Biological Diversity (CBD) is a globally accepted fundamental document for the protection of biodiversity, which establishes the conservation of biological diversity as a fundamental principle of international nature protection and humanity's common commitment. The Convention on Biological Diversity (CBD) entered into force on 29 December 1993.

This convention is the fundamental international treaty that deals with biodiversity issues. It provides member countries with a comprehensive and holistic approach to the conservation of biological diversity, the sustainable use of natural resources and provides a fair and uniform distribution of benefits resulting from the exploitation of genetic resources.

The term biosafety refers to the need to protect the environment and human health from the possible harmful effects of modern biotechnological products. Safety is the main objective of the Convention and is achieved by reducing all potential threats to biological diversity, and takes into account the risk to human health. The *Convention on Biological Diversity* recognises the dual aspect of modern biotechnology and allows for the transfer of technology, but seeks to develop procedures that boost security in the use of biotechnology.

In 1995 a working group was formed under the Convention, which drafted the Protocol on Biosafety (Cartagena Protocol). The Cartagena Protocol on Biosafety (CPB) is an international agreement that legally binds its signatories and regulates inter-country or cross-border movement of living modified organisms (LMO).

Foods derived from GMOs are subject to the Protocol only if containing LMO, which are capable of transmitting genetic material and reproducing. The Protocol promotes biosafety in determining the rules and procedures for the safe movement, transit, handling and use of living modified organisms, with special emphasis on cross-border transfer and transit of LMOs, and also determines the timescale in which decisions must be made.

It also defines a series of procedures, depending on the intended use of LMOs, hence special procedures for LMO exist which are to be intentionally introduced into the environment, especially those LMOs that are to be used directly for food, animal feed or production, and especially for LMO used in closed systems.

Protocol signatory countries are required to ensure safe handling, packaging and transportation of LMOs, while LMO shipments across borders must be accompanied by appropriate documentation in which, among other data, specifies the type of LMO and a contact person from whom additional information can be obtained when necessary. These procedures and requirements are designed to enable importing countries to obtain the necessary information used to make a final decision on permitting or banning the import of a specific LMO and based on facts and safe handling of the organism.

To facilitate implementation of the Protocol, the international mechanism for exchanging biological safety information (Biosafety Clearing House - BCH) was established for country signatories of the Protocol, through which information is exchanged.

The Protocol brings the following benefits to signatory countries:

– The opportunity to participate in the harmonisation of rules, procedures and enforcement, trans-boundary transfer of living modified organisms,
– The establishment of systems whereby the governments of signatory countries can cooperate with governments of other countries, the private sector and civil society to strengthen biosafety,
– Improved access to relevant technologies and data, and benefits from exchanging information and knowledge to demonstrate commitment to the conservation and sustainable use of biological diversity by implementing biosecurity measures.

2.1. The Nagoya-Kuala Lumpur protocol

The Nagoya-Kuala Lumpur supplementary protocol on liability and compensation for damage is a supplementary protocol within the framework of the Protocol on Biosafety (Cartagena Protocol). After several years of negotiations, the Parties to the Cartagena Protocol on Biosafety adopted this protocol on 15th October 2010 in Nagoya, Japan.

The objective of the Supplementary Protocol is to contribute to the conservation and sustainable use of biological diversity by establishing international rules and procedures for determining liability and damages arising from the use of living genetically modified organisms (LMOs). The Supplementary Protocol assumes an administrative access which requires undertaking appropriate measures in response to operators (natural or legal persons carrying out control of LMO's) or by a competent authority in the case of where an operator is unable to take such measures.

This approach covers situations in which damage to biodiversity has already occurred or when there is a high probability that damage will occur if failing to take adequate measures. The Supplementary Protocol is the second agreement on liability and compensation, in the context of multilateral environmental agreements, along with the *Protocol on Liability and Compensation for Damage Resulting from the Transboundary Movements of Hazardous Wastes and Their Disposal*, adopted in 1999 along with the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*.

2.2. Strategic plan for the implementation of the Convention on Biological Diversity

At the tenth meeting of the Conference of Parties to the Convention on Biological Diversity (CBD/COP-10), held in October 2010 in Nagoya, Japan, a new, ten-year Strategic Plan of the Convention for the Period 2011-2020 was adopted, as a fundamental document for guiding national and international activities in order to conserve biodiversity and contribute to the achievement of the three objectives of the fundamental conventions. The CBD's new Strategic Plan has 20 goals for the mitigating losses and pressures biodiversity, conservation of biological diversity at all levels, improving and maintaining the benefits acquired from biodiversity.

The United Nations General Assembly at its 10th session in December 2010, declared the 2011-2010 decade as the decade of biodiversity (Resolution 65/161). Some of the most important goals that Parties to the Convention committed themselves to strive for a complete halt of the loss of natural habitat (at least halving the loss), including forests, protecting 17 % of terrestrial and inland water, and 10% of sea and coastal ecosystems.

The Strategic Plan, as a comprehensive framework for the conservation of biological diversity, was accepted by the Parties for transposing and implementing national strategies and action plans for biodiversity conservation within two years. The third edition of the Global Biodiversity Outlook (GBO 3), which is based on national reports of the country signatories was prepared by the CBD Secretariat, and shows that the international community has failed to achieve the goals set by the Convention to mitigate the loss of biodiversity by 2010, with all indicators show an increase on pressures placed on nature.

The Republic of Croatia regularly prepares national reports on the implementation of the Convention and the measures for achieving the three objectives of the Convention. During 2009, the fourth national report for the Convention on Biological Diversity was prepared. In accordance with the decision taken at the CBD/COP 10, the fifth national report is to be prepared by 31 March 2014.

3. BIODIVERSITY IN EU

In the EU, about 25% of animal species, including mammals, amphibians, reptiles, birds and butterflies are in danger of extinction, while even 88% of fish stocks are overexploited or significantly spent. The the loss of biological diversity is caused mainly due to land use, pollution, overexploitation of resources, the uncontrolled spread of non-native species and climate change. These pressures are increasing in intensity, and only 17% of assessed habitats and species indicate a favourable status.

The European Union has adopted a strategy for the conservation of biodiversity. The strategy adopted has six priority targets and accompanying actions aimed at greatly mitigating the threats to biodiversity. The actions include:

- The full implementation of existing legislation for the protection of nature and a network of natural reserves, to ensure significant improvement of the conservation status of habitats and species;

- Improving and restoring ecosystems and ecosystem services, particularly through the increased use of green infrastructure;
- Ensuring the sustainability of activities in agriculture and forestry;
- The preservation and protection of fish populations in the EU;
- The control of invasive species,
- Strengthening contribution by the EU to common global actions for preventing the loss of biodiversity.

The strategy is in line with two major obligations that EU leaders assumed in March 2010: halting the loss of biodiversity in the EU by 2020 and the protection, valuation and restoration of biodiversity in ecosystem services in the EU by 2050.
The strategy is also in line with global commitments that the EU decided to commit to in Nagoya in October 2010, under the Convention on Biological Diversity.
As an integral part of the 2020 European strategy, the biodiversity strategy will contribute to EU goals for efficiency in the use of resources by ensuring sustainable management of Europe's natural capital, as well as mitigating climate change and goals for adapting to them by improving the resilience of ecosystems and the services they provide.

4. CONCLUSIONS

The amount and rate at which we currently use our planet's natural resources exceeds sustainability by as much as 25%. The direct effect of this relationship on natural resources is the strong pressure and causing of danger to species, habitats and communities.
Conventions, protocols, strategies and studies on sustainable development and conservation of biodiversity, are all efforts that are being made for the conservation of biodiversity.
The Convention on Biological Diversity (CBD) is a globally accepted basic document for the protection of biodiversity, establishing the conservation of biological diversity as a fundamental principle of international nature protection and shared commitment by humanity.
The Cartagena Protocol on Biosafety (CPB) is an international agreement that legally binds its signatories and regulates inter-country or cross-border movement of living modified organisms (LMO).
The Nagoya-Kuala Lumpur Supplementary Protocol on Liability and Redress is a supplementary protocol under the Protocol on Biosafety (Cartagena Protocol).
The Republic of Croatia regularly prepares national reports on the implementation of the Convention.

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ANALYSIS OF INVESTMENT IN EMPLOYEES IN MICRO AND SMALL MARITIME COMPANIES AND THEIR IMPACT ON BUSINESS RESULTS

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ABSTRACT

Knowledge and high technology, education, expertise and innovation of employees are becoming key elements of mastering change and competitive advantage of organizations, and societies as a whole. Therefore, the requirements for training and development of employees are constantly growing, and in their knowledge and skills become more invested in, both on the macro-economic, national and at the microeconomic, level of organization. The revenue and costs per employee per some maritime companies, such as Split Ship Management, Jadroplov Splitska plovidba, Linijska nacionalna plovidba, will be observed in the period since 2008. by 2010. year. Because of the relationship that exists between revenues and expenses per employee in this paper will be the access to quantify and determine the correlation between them. The subject of this paper is to examine and determine whether there is a strong positive or negative relationship between income and the cost per employee, based on a sample of shipping companies. The comparison of revenue per employee and changes in cost per employee will demonstrate the importance of our employees and the importance of investing in our employees have for the entire business. Research that will be conducted in the accession work will contribute to giving more importance to investing in employees. Also the contribution of businesses in pointing to the employees, their work and investing in training and education of employees may affect the operating results and lead to a weakening, but on the other hand to extraordinary results. Acknowledges businesses to focus increased attention on investing in employees through various types of motivators.

KEY WORDS

human resources, micro and small shipping company, employee training, revenue per employee, the cost of education.

1. INTRODUCTION

Due to their specific characteristics micro and small-sized companies are studied and observed separately from large enterprises. Small-sized enterprises in Croatia account for productivity which is below average and for profit share which is above average. About 80% of employment increase in the enterprise sector takes place in small and middle-sized companies. In reality, it is a sector which is extremely important for the employment rate, but also a sector which is exceedingly burdened with risks. Knowledge and high technology, education, expertise and innovation of employees are becoming key elements in mastering changes and competitive advantages of organizations, and societies as a whole. Since the requirements for the employee training and upgrading are constantly growing, more investments are being made in employee knowledge and skills, both at macroeconomic, national level, as well as at the microeconomic level of organizations. This paper deals with six micro and small-sized shipping companies, namely

Split Ship Management, Jadroplov, Splitska plovidba, Linijska nacionalna plovidba, Alba brodarstvo and Privez-odvez. The circulation of income and expenditure per employee of the selected companies will be observed in the period from 2008 to 2010. For each of them, the analysis of the mutual correlation will be made in order to facilitate understanding and to reach conclusion. Due to the correlation which exists between income and expenditure per employee, this paper will quantify and determine their mutual relation. The mutual correlation of education and income per employee will be analyzed. The research that will be carried out in this paper will contribute to emphasizing the importance of the investments in employees. This paper will also draw attention to how employees, their work and the investments in their education and training can influence business results and lead either to their decline, or to extraordinary results. The aim is to draw companies' attention to investments in their employees by means of different motivators. The final contribution of this paper is the apprehension of the importance of investments in employees and the course of its influence on company's income.

2. ANALYSIS OF INVESTMENTS IN EMPLOYEES IN MICRO AND SMALL-SIZED COMPANIES IN CROATIA

Small and middle-sized companies comprise 99.4% of all the registered entrepreneurs, 64.7% of the employed, 44% of the share in gross domestic product and 40.5% of the share in the total exportation of the Republic of Croatia.[1] Many studies and analyses, both in Croatia and in the area of EU, show the importance of the development of small and middle-sized enterprises in the economy of a country and their contribution to the potential of economic growth. According to the official classification in the Accounting Act, in the class of small enterprises there were 87 807 of total 89 656 entrepreneurs registered in Croatia in 2008, which represents 97.94% of their total number.[2] In these enterprises there were 460 856 workers or 48% of the total number of the employed in enterprises.[3] Small-sized companies, in this case, include micro companies as well.

The main obstacles to the enterprise development in Croatia are:[4]

- Administrative obstacles;
- Inefficient juridical system;
- Assets registration;
- *Education system which is not focused on enterprises nor on issues relative to SME;*
- Obtaining loans (collateral expenses, rights of lender and loan user, availability of loan information)

Table 1. Perception on education quality which supports the development of small and middle-sized enterprises in 2010

	Mark 5 shows:	Average	Croatia
Education and training – (primary and secondary level of education)	Primary and secondary level of education stimulates creativity, independence, proactivity, provides information on market	1,97	2,11 (in 2008 2.17)
Education and training (tertiary level of education)	There are sufficient university courses on entrepreneurship, business education is at global level; expert, professional and continuous education provides good preparation for self-employment	2,83	2,76 (in 2008 2.79)

Source: http://cepor.hr/SME%20godisnjak_final.pdf (14th Feb 2013)

[1] http://www.e4e.com.hr/pdf/60_sjednica_vlade_rh_1.1_strategija.pdf (13th Feb 2013)

[2] http://www.hub.hr/Default.aspx?art=1952&sec=508 (13th Feb 2013)

[3] http://www.hub.hr/Default.aspx?art=1952&sec=508 (13th Feb 2013)

[4] http://www.westernbalkans.info/upload/docs/Croatia_SME_finalcro.pdf (13th Feb 2013)

Apart from the formal system of education, there are a number of institutions which provide education to entrepreneurship beginners and/or enterprises already set up, such as centers for entrepreneurship, Croatian Chamber of Commerce, Croatian Bank for Reconstruction and Development, Croatian Association of Employers and private companies active in the sector of adult education. Entrepreneurial education is insufficiently represented at all formal levels of education. At the primary level it is still not recognized as knowledge and skill necessary for acquiring entrepreneurial competency, with minimal presence in curriculum. In high-school education, entrepreneurship is recognized as a sum of knowledge and skills only in vocational schools and it was introduced as an obligatory subject in the curriculum of secondary schools of economics. At university level – entrepreneurship is present at least at one course level at six or seven universities in Croatia, but it is present only at one level at two universities. In associate degree colleges and academies in Croatia, entrepreneurship is present as a study course. Informal education for entrepreneurship is mainly carried out by institutions that support entrepreneurship, and it is mainly focused on issues which are suggested and co-financed by the Ministry of Economy, Labour and Entrepreneurship through the project Education for entrepreneurship. There is an emphasized tendency of European Union and member states to promote skills upgrading in small and middle-sized companies, and all forms of innovations, because an analysis discovered that more than 60% of companies deem that schools do not provide competencies required for entrepreneurs and their personnel.[5] Human potentials are a competitive advantage of a company only when they are wisely conducted, i.e. when the management of human potentials in organization is of good quality. In the same way, the value of human potentials of an organization can increase, remain at the same level, or decrease depending on the way they are managed. Continuous education and constant improvements of individual and organizational knowledge and skills have become inevitable within the companies that wish to subsist in extremely competitive global market which surrounds us. Since the knowledge embedded in human capital, education and improvement is crucial for the success of contemporary organizations and associations, the activities for propagation of total knowledge, skills and abilities of people who train the future employees for independent decision making and acting in various situations are becoming the key organizational activities (Bahtijarević-Šiber, 1999). As emphasized by Fey, Björkman and Pavlovskaya (2000), employees considerably contribute to the success of their organizations if they possess a high level of skills and knowledge, which makes the importance of investments in education and development of employees indubitable. Investments in education and development of employees increase the value in the chain of values, through greater efficiency, better product/service quality, increased buyer/user contentment, finally leading to greater success and competitiveness of the organization. Continuous education and the system of constant improvement is the most effective way of achieving competitive advantage. Application of organizational strategies is possible only if employees possess skills and knowledge necessary for the implementation of these strategies, therefore education and development become the strategic imperative of contemporary organizations. It follows that in contemporary organizations the investments made in employees to improve their knowledge and skills and to apply the acquired skills and knowledge are effective at more levels. This was proven by many empiric researches. Education is a serious

5 http://www.e4e.com.hr/pdf/60_sjednica_vlade_rh_1.1_strategija.pdf (13th Feb 2013)

problem when it comes to the functioning of Croatian organizations, which probably deem that there are far more important things than education. It was to be expected, since in many organizations there are no resources, nor real needs for organizing a special sector for education and development, or for a person who deals exclusively with these activities. In bigger organizations, additionally educated employees spent more hours working on programs for education and development than those coming from smaller organizations, and that is most probably the consequence of the restricted number of human resources in smaller organizations, which cannot afford long-term absence of their personnel. The organizations in Croatia improve their practice of education and development, but that is still far from the level and importance that is given to the education and improvement in successful world organizations. Funds for education have been cut because most of the organizations are oriented towards cutting the costs, mostly affecting the expenses of education and marketing. This leads to the temporary balance improvement, however it is not good on long-term basis because organization's competitiveness on market falls. The crises encouraged organizations to approach the employee education more profoundly, to approve only of those trainings that improve the target competitiveness of employees and to find specialized companies proven to provide the best service in that area. The maintenance intensity of internal education has been reduced, as well as financing, i.e. co-financing of post-graduate programs, although the need for education remained the same. The expenses relating to employees represent an important item of expenditure in most contemporary companies. Employers have different opinions related to human potentials. Although they understand their strategic role, they often do not have resources or they do not know how to operate with the resources. Lately, the attitude that investments in more efficient management of human resources are a valuable investment which result in greater reimbursement of the invested funds than does the investment in research and development has become more widespread. Small companies relatively rarely use human potential management as a strategic activity in enterprise management. Human management is restored through the increase in profitability and market value of the company. The research has shown that the refund of these investments is six times greater with regard to the increased efficiency of the employees, and therefore of the company. This paper will try to prove it.

3. ANALYSIS OF CONNECTION BETWEEN INCOME PER EMPLOYEE AND EXPENSE ON EMPLOYEE EDUCATION IN THE RELATIVE COMPANIES

Investments in employees can create competitive advantage, and this includes human and intellectual capital, which is returned to organization through efficiency and income increase, profit. Formal education, gained mainly in the earlier period of life, is not sufficient in order to keep the required expertise because constant changes in the area of technology impose the need of continuous education and development. Knowledge that company has at its disposition today, and this relates equally to technique, sale, marketing or human resources, will not be sufficient tomorrow. The thesis arises that the increase of employee education expenses should influence the increase of income per employee as well as the overall income. The better quality personnel should contribute to the better business result. The aim of the paper is to point out the importance of the investments in employee education which will provide multiple returns to the company through the increase in income per employee and total income. This will be analyzed in this paper and either proven or rejected.

Table 2. Mutual dependence between income per employee and employee education expenses

	SPLIT SHIP MANAGEMENT d.o.o			JADROPLOV d.d.		
	2008	2009	2010	2008	2009	2010
Number of employees	47	25	25	49	48	48
Change %	-	-47.00 %	0.00 %	-	-2.00 %	0.00 %
Income per employee (in €)	74.598,00	83.205,00	55.212,00	72.387,00	716.095,00	1.027.628,00
Change %	-	12.00 %	-34.00 %	-	889.00 %	44.00 %
Expenses of professiona l training	6.520,80	4.020,00	1.350,00	26.234,93	21.331,33	10.265,02
Change %	-	-39.00%	-67.00%	-	-19.00%	-52.00%
Total income (in €)	3.506.077,00	2.080.135,00	1.380.292,00	3.546.954,00	34.372.563,00	49.326.122,00
Change %	-	-41.00%	-34.00%	-	869.00%	44.00%

Source: Made by author

Table 3. Mutual dependence between income per employee and employee education expenses

	SPLITSKA PLOVIDBA d.d.			LINIJSKA NACIONALNA PLOVIDBA d.d.		
	2008	2009	2010	2008	2009	2010
Number of employees	25	42	42	52	42	42
Change %	-	68.00 %	0.00 %	-	- 19.00 %	0.00 %
Income per employee (in €)	397.382,00	156.562,00	163.047,00	103.653,00	85.240,00	84.551,00
Change %	-	- 61.00 %	4.00 %	-	- 18.00 %	- 1.00 %
Expenses of professional training	6.465,73	5.539,29	5.032,06	17.201,50	16.837,33	14.301,77
Change %	-	- 15.00%	- 10.00%	-	- 3.00%	- 16.00%
Total income (in€)	9.934.541,00	6.575.621,00	6.847.978,00	5.597.286,00	3.580.076,00	3.551.141,00
Change %	-	- 66.00%	4.00%	-	-26.00%	- 1.00%

Source: Made by author

The first company to be analyzed is Split Ship Management, the indicators of which show that although the expenses of professional training of the employees decreased by 39% in 2009 in comparison to 2008, the income per employee increased by 12%. In 2010 the further decrease of investments in employee education is evident by 67%, and also the decrease of income per employee by 34%. The other analyzed company is Jadroplov which in spite of the decrease in expenses of professional training for employees by 19% in 2009, had the increase in income per employee even by 889%. Not even the further reduction of expenses of professional training did impede the further increase in income per employee by 2010. On basis of the first two analyzed companies, it cannot be concluded that the expenses of investments in employee education have strong influence on income per employee as well as on total income. In order to bring the final conclusion, four additional companies will be analyzed.

The next company taken into account is Splitska plovidba. In 2009 Splitska plovidba reduced the expenses of professional training for employees by 15%. It also reduced income per employee by 61% and total income by 66%. In 2010 Splitska plovidba continued to reduce the expenses of professional training for employees by 10%, but the income per employee increased by 4% as well as the total income. Therefore it can be concluded that Splitska plovidba can partially confirm the given thesis. Analyzing further Linijska nacionalna plovidba it can be seen that the expenses of professional education for employees reduced by 3% in 2009, whereas its income was also reduced by 18% and the total income reduced by 26%. The year 2006 was characterized by further drop of the income per employee and total income. The analysis of Linijska nacionalna plovidba proved that there is a positive connection between the expenses of professional education and income per employee i.e. the drop of expenses for education causes the drop of income per employee. However, this conclusion is made only on basis of one company, partly on basis of Splitska plovidba, whereas SSM and Jadroplov reject that thesis.

Table 4. Mutual dependence between income per employee and employee education expenses

	ALBA BRODARSTVO d.o.o.			PRIVEZ-ODVEZ d.o.o.		
	2008	2009	2010	2008	2009	2010
Number of employees	5	6	6	9	9	9
Change %	-	20.00 %	0.00 %	-	0.00 %	0.00 %
Income per employee (in €)	50.455,00	52.682,00	37.145,00	38.248,00	38.455,00	30.028,00
Change %	-	4.00 %	- 29.00 %	-	1.00 %	- 22.00 %
Expenses of professional training	604,66	811,57	617,2	1.866,67	900,33	687,2
Change %	-	34.00%	- 24.00%	-	- 52.00%	- 24.00%
Total income (in €)	252.279,00	316.095,00	222.870,00	344.232,00	346.094,00	270.251,00
Change %	-	25.00%	-29.00%	-	1.00%	- 22.00%

Source: Made by author

The final two companies which were analysed are Alba brodarstvo and Privez-odvez. Alba brodarstvo increased the expenses of professional training by 34% in 2009 in comparison to 2008, and the income per employee got increased by 4% and total income by 25%. In 2010, the company Alba brodarstvo reduced the expenses of professional education by 24% and so was the income per employee by 29% and total income as well. On the basis of the analysed indications in Alba brodarstvo it can be derived that there is a positive connection between the income per employee and the expenses for professional education, i.e. the increase in expenses for professional education influences the increase in income per employee, still not in the percentage higher than the percentage of the increase in expenses for professional education. Finally, the last company to be analysed is Privez-odvez, the indicators of which show that in 2009 the expenses of professional education were reduced but the income per employee was increased by 1% as well as the total revenue. On the other hand, in 2010 there was a further decrease in expenses for professional education by 24% and also the decrease of income per employee and of total income by 22%. It can be said that this company as well as the company Splitska plovidba partly confirm the set up thesis.

By looking at the analysis of all companies, a conclusion arises that two companies reject the thesis that the increase in the expenses for professional education would be profitable on multiple levels and affect the increase in income per employee and in total revenue, or conversely that the reduction of expenses for professional education affected the decrease in income per employee and total income. Two enterprises partially prove the set up thesis, whereas the other two enterprises confirm the thesis. Therefore, a clear and certain conclusion cannot be brought.

It cannot be said that it is not necessary to invest in education and further upgrading of employees, however from the financial indicators and the results, the positive or negative effect of decrease or increase in investments in employee education on business results cannot be seen. Maybe the results would be different if the analysis was made on bigger enterprises because the expenses of professional education would be higher and they would have more influence on total revenue and overall business results. Since the evidence was not found to prove whether the expenses of professional education have strong effect on the drive of income per employee, the effect of increase or decrease in expenses on personnel, with special emphasis on expenses on net wages, on income per employee and total income, will be analysed. Maybe precisely because of the situation in Croatia, the wage increase would be greater motivator for the employees to work more efficiently and productively, which would result in total income and income per employee increase. The period analysed in this paper is precisely the period of recession, i.e. economic and financial crisis present not only in Croatia, but in the whole world. Motivation, precisely, is the key to the working success. The product of motivation is better quality work, greater creativity, and finally, the objective of each employer – better efficiency of entire organisation. Today, most of the employees, under the influence of an evidently bad current situation, mostly get contented by the height of their wages. In these difficult times, most of them will opt for money, which is gaining in importance, because new knowledge, compliments or sense of contentment cannot pay for the basic needs in life. Therefore, this paper analyses the interdependence between the expenses of education and income per employee as well as between personnel expenses (net wages) and income per employee. Efficiency, i.e. the relation between the invested resources and the achieved results is the present issue. Is it worth for an employer to invest in professional education of the employees or is it more efficient to increase their net wages?! The conclusion will be reached upon the end of the analysis on relation between income per employee and personnel expenses. The analysis could suggest to the entrepreneurs, owners of the micro and small-sized companies that if they do not have enough funds for education and upgrading of their employees to look for state aids or to join trusts. Although it cannot be seen from this paper exactly what the influence of investments in employee education on business results is, on the long-term basis it is worthwhile and it brings to the better and greater business operations and business results. It would be advisable to the micro and small companies to make long-term plans and to try to make the most use of government incentives for upgrading and education of their employees in case they do not have enough funds, because the increase in wages ensures motivation and satisfaction of employees only for a short period of time. First of all, they should use the human potential management as a strategic activity in enterprise management; they should apply the same set of activities as the big companies, but in a more simple way. From the efficient management of human potential they should deduce which motivators influence the employee contentment and productivity. Needs and aims of an individual are constantly developing and changing, as well as the sense of contentment, and finally the contentment is reflected through the productivity of the success/failure of the whole organization's business. Employees are the most valuable potential which ought to be improved and perfected by motivation and innovation of their knowledge and skills, and which ought to be turned into capital by means of which an organization achieves competitive advantage. The management of human potential and emphasis on value of human factor in organization business is a direction that will in due time lead to the positive steps in companies and in progress of economy.

4. CONCLUSIONS

Croatian companies, which aspire to achieve better financial results, must value and invest much more into employees and activities. They have to be more mobile in their policy of human potentials, pay their employees well and stimulatingly, identify key employees, have educated workforce which will be trained and improved constantly, measure the quality of human potential management and monitor work efficiency of the employed. The growing number of contemporary managers recognizes that the investments in people are the key to the future success. The main cause of weak productivity of the employed in the Croatian economy is not the insufficiency of knowledge and skills, but inadequate way of managing the employees and the lack of investments in professional training for certain jobs, because the need to invest in production technology requires continuous investments in education and professional training of employees. Due to their financial restrictions small companies do not have the possibility to invest in employee education if they have to invest in technology. Even though significant changes in educational upgrading of small companies cannot be expected in short period, it is important to investigate the reasons of rare use of government incentives for the employee development. Human management gets recompensed through the increase in profitability and the market value of company. Although they consider human management to be important, they rarely decide to change the way they manage human potentials. The analysis made in this paper brings to the conclusion that micro and small enterprises make little investment in professional education and upgrading of their employees, therefore the obtained results could not explain in what way the change of the educational expenses influence the income per employee and total income. If big enterprises were analyzed, the influence of educational expenses on business results could be seen because those expenses are by far higher than the expenses of micro and small-sized enterprise.

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SUSTAINABLE MARITIME TRANSPORT IN BALTIC AND THE MEDITERRANEAN REGION: POLICIES AND CHALLENGES

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ABSTRACT

The paper describes a research into the sustainable maritime transport policies and challenges related to achievement of sustainable maritime transport systems in the Mediterranean and the Baltic Sea Regions. Sustainable development being a global objective, has found reflection in European Union legislation on regional and local levels and has resulted in a number of strategies for development - for maritime transport as well. Maritime transport, being an important part of the economies of the regions, provider of work places is also a controbutor to gloabl warming through the exhaust gases and is a potential source of pollution. Thus it is a challenge when it comes to achievement of sustainable development and protection of the environment of the region. Being both European Union regions, the Baltic and the Mediterranean are part of strategies for sustainable development and the purpose of the paper is to make a comparative analysis of the approaches towards sustainable maritime transport in both regions, policies, similarities and challenges. Despite the differences in the geography and governance, lessons learned from both regions could be benificial for achievement of the sustainable maritime transport system and protection of the seas.

KEY WORDS

sustainable development, maritime transport, Baltic Sea, Mediterranean Sea.

1. INTRODUCTION

In recent years sustainable development has become an integral part of European Union policies and legislation. The notion is being implemented in different spheres, aiming at an overall balanced development of the economic, social and the environmental spheres. Maritime transport sector has not been an exception for that. Sustainable development of the maritime transport systems has been a topic for discussion and debate in the European Union. As per statistics, 80% of world trade is carried by sea and in Europe short-sea shipping carries 40% of intra-European freight. With more than 400 million sea passengers passing through European ports each year, maritime transport has also a direct impact on the quality of life of citizens, both as tourists and inhabitants of islands and peripheral regions (COM(2009 8 final). With that maritime transport also provides workplaces for a large portion of population and carries a large threat of pollution and death in case of accidents.

In 2009 Commission of European Communities issued "Strategic goals and recommendations for the EU's maritime transport policy until 2018" (COM(2009 8 final). The document covered important goals for the development of the maritime transport, including "the ability of the maritime transport sector to provide cost-efficient maritime transport services adapted to the needs of sustainable economic growth of the EU and world economies" and issues that lay ahead in improvement of safety and care for the environment without reduction of the economic growth.

Though maritime transport is important for the European Union, it is not so easy to implement the balanced way forward towards sustainable development. European Union has a lot of different sea basins – Baltic Sea, North Sea, Mediterranean Sea, as well as the Celtic Sea next to the British Isles and the Bay of Biscay between Spain and France. Each one has its own history of formation, history, current use and future development. The aim of the paper is to make a comparative analysis of the approaches towards sustainable maritime transport in Baltic Sea and the Mediterranean regions, policies, similarities and challenges. Having one policy and legislation is usually not enough to reach the goal – "think global, act local" approach is needed for such situations as well.

2. THE BALTIC AND MEDITERRANEAN SEAS – PHYSICAL DATA

Both Baltic and Mediterranean and Baltic Seas are almost entirely-enclosed. With that Baltic Sea waters change entirely only once every 50 years, as the sea has connection with the North Sea only through narrow straights, while for the Mediterranean the only connection with other bodies of water used to be through the Strait of Gibraltar until in 1869 Suez Canal was opened to connect the Mediterranean with the Red Sea.

Baltic Sea measuring 400 000 km² lies in the colder latitudes and its northern and north-eastern parts freeze in winter. Salinity is low, which makes the environment very vulnerable to eutrophication. Mediterranean Sea with a surface area of 2.5 million km² instead lies in the latitudes with warm and dry climate. Water is highly saline and while it is poor in nutrients, it is rich in biodiversity.

85 mln inhabitants live on the coast of the Baltic Sea, while Mediterranean is home to around 150 mln people. Due to good climate Mediterranean region is visited by about 250 mln people each year, while Baltic Sea Region has become an attraction only recently and due to its climate cannot boast that many visitors.

When it comes to governance both seas are not fully controlled by European Union. Baltic Sea Region is bordered by 9 countries, one of which is not a member of the European Union. Mediterranean is surrounded by 21 countries, only 8 of which are members of the EU.

There is heavy passenger traffic however, in the Mediterranean not only connected with tourism, but with the movement of inhabitants between the islands and to the islands from the mainland. In the Baltic Sea Region the passenger ferry traffic is done on a smaller scale and more frequently connects to the other countries in the region as opposed to smaller islands.

When it comes to maritime transport, the Mediterranean plays an important role as a key world maritime route with 30% of worldwide traffic, 25% of oil transport, and 450 ports and terminals. There is heavy traffic in the region and as the Suez canal is the gateway to the Red Sea and the Indian Ocean, a lot of traffic is transit. The Baltic Sea Region also has heavy traffic with around 60 000 vessels entering the region every year, but the traffic is also related to the fact, that half of inter-region trade happens with the help of maritime transport – import of goods is a vital part of the economy of the region.

3. THE BALTIC AND MEDITERRANEAN SEAS – GOVERNING CONVENTIONS AND POLICIES

While it is easy to place borders on land and divide the responsibilities among countries, the issues become more complicated when it comes to sea. The dispute as to who owns the seas and oceans has been on the agenda probably since there were the first boats navigating the bodies of water. Over the years there had been different decisions as to how different seas and oceans were divided, but as of 17th century the concept of "mare liberum" was introduced – waters beyond national boundaries were free for all to navigate. Territorial waters were determined by so-called "cannon shot" rule, which meant that the coastal states were to exercise dominion over their territorial seas as far as projectiles could be fired from a cannon based on the shore. In 1956 United nations held the first conference on the Law of the Sea (UNCLOS, 1956), where it confirmed that the international law does not consider territorial waters to extend beyond 12 nautical miles. Countries however do provide "safe passage" through their territorial waters if it is feasible for the ship to take a shorter route. While there are the laws regarding the international and the territorial waters, in case of seas and oceans it is not so easy to divide the territories. While we can make divisions based on the coordinates, in case of oil spills for example the damage is not done in one specific country, but could be done in the whole region. Water will not honor the coordinates and the winds and currents will not care for the political divisions. This is why protecting the region cannot be an effort of one specific country – all those involved should participate.

In case of both regions – Baltic and the Mediterranean – there are countries parties to the European Union and those not. While European Union would have the directives related to the protection of the regions and the transport policies, it would by no means assume that other countries would have the same attitude. And in case of lack of co-operation, one side being prepared for the accidents and the having readiness to introduce stricter measures for the benefit of the environment might not lead to any results, as the damaged caused will influence the life in the whole region. Fortunately in case of both Baltic and the Mediterranean the countries in the regions care for the environment.

In 1976 Barcelona Convention for Protection against Pollution in the Mediterranean Sea was signed (Barcelona Convention, 1976). The convention is a regional convention to prevent and abate pollution from ships, aircraft and land based sources in the Mediterranean Sea. Mediterranean Action Plan was part of the United Nations Environment programme and was first aimed at the marine pollution control, over the years, its mandate gradually widened to include integrated coastal zone planning and management. In 1995, the Action Plan for the Protection of the Marine Environment and the Sustainable Development of the Coastal Areas of the Mediterranean. The Convention's main objectives include assessment and control of marine pollution, sustainable management of natural marine and coastal resources; integration of the environment in social and economic development; protection of the marine environment and coastal zones through prevention and reduction of pollution, and as far as possible, elimination of pollution, whether land or sea-based; protection of the natural and cultural heritage; strengthening solidarity among Mediterranean coastal States and contribution to improvement of the quality of life.

Baltic Sea Region also has its convention - Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 (Helsinki Convention) is an international convention encompassing various measures for the prevention and elimination of pollution of the Baltic Sea. First convention was signed in 1974 and entered into force in 1980. After the collapse of the Soviet Union, the independent states signed the convention in 1992 and it entered into force in 2000 (Helsinki convention, 1992). Nowadays there is a Helsinki Commission that is •an environmental policy maker for the Baltic Sea area by developing common environmental objectives and actions, it provides information about the state and the trends in the marine environment, it ensures that HELCOM environmental standards are fully implemented by all parties throughout the Baltic Sea and its catchment area. It also coordinates multilateral response in case of major maritime incidents.

From this point of view, Mediterranean region does not have its own commission that supervises the fulfillment of rules in the region. Helsinki Commission has additionally collected data related to the marine environment, has kept the AIS data, as well as participated in the creation of so-called "places of refuge" that can be used by ships in distress.

4. SUSTAINABLE MARITIME TRANSPORT SYSTEM

In 2012 the United Nations Conference on Sustainable Development issued a document (A/CONF.216/L.1*) called "The Future We Want", which renewed political commitment to sustainable development and the Rio 1992 principles. With that, one of the points of the document is dedicated to sustainable transport:

We note that transportation and mobility are central to sustainable development. Sustainable transportation can enhance economic growth and improve accessibility. Sustainable transport achieves better integration of the economy while respecting the environment. We recognize the importance of the efficient movement of people and goods, and access to environmentally sound, safe and affordable transportation as a means to improve social equity, health, resilience of cities, urban-rural linkages and productivity of rural areas.

What makes the maritime transport sector so important and yet difficult from point of view of sustainable development? Maritime transport is what has historically bound the planet into one and gave possibility for far-off regions to connect among each other. It is what nowadays connects the world, transporting raw materials and natural resources to factories, ready made goods and also people from one place to another. It is a comfortable and a relatively environmentally friendly way to transport tonnes of goods, generating profits for all regions. But for that, maritime transport sector employs thousands of people and provides a social service – connecting and moving people between regions. Despite its relative environmental friendliness, maritime transport still uses the fossil fuel to move and is a source of different exhaust gases. Additionally, in case of accidents, the damage to the environment might be catastrophic.

With this we can see achievement of sustainable development in the sphere is an important issue – it would make sure that the system functions generating profits and providing employment, but is environmentally and socially safe.

In 2013 International Maritime Organization had introduced the concept of a Sustainable Maritime Transportation System (IMO, 2013) which mainly focused on the following items:

- Safety Culture and Environmental Stewardship (promotion of safe and minimization of environmental impact of shipping)
- Education and training in maritime professions, and support for seafarers (proper education and training for both sea/ and non-sea-going employees, improvement of quality of life of seafarers)
- Energy efficiency and ship-port interface (improvement of efficiency beyond the ship including paperwork, operations and logistics infrastructure)
- Energy supply for ships (fuel provision for ships and access to clean energy)
- Maritime traffic support and advisory systems (development of optimal systems for navigation)
- Maritime Security (protection of seafarers, ships and shipping lanes by local communities)
- Technical co-operation (development of programmes of technical assistance, as well as development and maintenance of oceanographic, hydrographic and meteorological information and aids to navigation)
- New technology and innovation (promotion of a unified platform for innovation and research)
- Finance, liability and insurance mechanisms (financial instruments to ensure that costs are kept at reasonable levels, while those suffering loss or damage are assured prompt compensation)
- Ocean Governance (harmonization of initiatives, and there should be a thorough discussion of the effects of envisaged measures and regulations on the Maritime Transportation System in order to ensure that it is sustainable and can continue to provide its services effectively).

5. MARITIME SPATIAL PLANNING IN BALTIC AND MEDITERRANEAN SEAS

Achieving sustainable development in maritime transport sector is a goal hard to reach. While there are more and more participants of the international conventions for the protection of the marine environment, the change is happening at a slow pace. As maritime activities are very diverse and cover different geographies, not all actions can be treated as straight-forward and not all decisions taken have a direct effect.
On 10 October 2007, the European Commission adopted the Blue Paper proposing an Integrated Maritime Policy (IMP) for the EU (COM(2008) 791 final). Maritime Spatial Planning is a key instrument for the Integrated Maritime Policy - it helps public authorities and stakeholders to coordinate their action and optimizes the use of marine space to benefit economic development and the marine environment.

One of the difficulties in achieving sustainable development in maritime transport is the fact that the sea is home to a number of different activities. Seas and oceans are home for fish, they accommodate the cargo traffic, leisure boats, pipelines, oil platforms. But for that there are various shore-line activities that become an integrated part of the region. How it looks in reality is that there is are a lot of different stakeholders using the same resource and their point of view on the matter is directly related to what their activity is. In most cases stakeholders lack knowledge and perspective of other uses of the seas and oceans.

Maritime spatial planning helps reduce the conflicts between sectors, encourages investment by providing transparency, increases coordination between administrations, increases cross-border co-operation and helps protect the through early identification of impact and opportunities for multiple use of space (COM(2010) 771, 2010).

Now maritime spatial planning is not yet sustainable development – however, it is a stepping stone in the right direction. Providing correct planning for the region can be crucial in achieving sustainable development. If we plan accordingly and take into consideration all stakeholders, this would be the ground for us to move forward towards sustainable development.

With that it is important to mention, that for now maritime spatial planning is implemented on European Union level only. While the member states are responsible for implementation, non-EU countries do not have the pressure to implement the maritime spatial planning. However, it is understandable that the whole system works if all participate, so promotion of the benefits and support for the non-EU countries could increase their involvement in research and implementation of the same principles as are created for the EU countries.

How does the situation look like for the Baltic and the Mediterranean regions? In the Baltic Sea Region maritime spatial planning has become quite popular. The € 3,7 m project BaltSeaPlan (2009-2012) for integrated maritime spatial planning and preparation of national maritime strategies within Baltic Sea Region resulted also in demonstration of MSP in 8 pilot areas: Danish Straights (Denmark), Pomeranian Bight (Germany/Denmark/Sweden/Poland), Western Gulf of Gdansk (Poland), Middle Bank (Sweden/Poland), Lithuanian Coast (Lithuania), Western Coast of Latvia (Latvia), Pärnu Bay (Estonia), Hiiumaa and Saaremaa Islands (Estonia). Additionally, a preparatory action plan for Gulf of Bothnia, a part of northern Baltic Sea situated between Åland Islands and the Quark (Umeå-Vasa) was issued in 2012. In the project the future of a wide variety of issues like maritime traffic, fisheries, wind power and nature protection are planned together, instead of considering them one at a time.

Pilot projects gave an opportunity of agencies from different member states to work together and discuss the plans they have for specific cross-border regions (which are the most sensitive ones) and come up with joint solutions that could benefit all parties.

When it comes to the Mediterranean region, there have been cost and benefit studies for the introduction of the maritime spatial planning in the region (most notable FISH/2007/04 and MARE/2010/05), however, no specific plans have been developed so far, and calls for proposals have been sent, so new research in the matter should be available soon.

What makes it more difficult to implement the maritime spatial planning in the Mediterranean? It is partly the larger size of the area and more stakeholders coming from different backgrounds. Baltic Sea Region has only 1 country non-EU, which is anyway a member of the Helsinki convention and follows the rules imposed in the region. Baltic Sea is additionally a sulphur emission control area and ships entering have to comply with certain standards. Due to its vulnerability Baltic Sea Region had imposed more stringent regulations on all participants, which in the end helped to promote the co-operation between countries. Mediterranean region, partly due to its size, but also due to its use faces different issues. Being a transit region with thousands of ships going through it yearly, it is different in nature from Baltic Sea Region, where goods are transported by transit, but it is a semi-closed region, where ships have to enter and then leave through the same location. Mediterranean region also does not have a commission governing over the environmental issues that would be promoting the co-operation in the region and enforcing the regulations. True, Mediterranean sea is less sensitive to eutrophication, as the Baltic, but constant exposure to pollution would reduce its biodiversity considerably.

6. CONCLUSIONS

For European Union sustainable development is an important issue. It is included in all strategy documents and has become an integral part of all development goals. Transport sector is of course no exception to that. Maritime transport being the economic artery of the Union is at the center of the plans as well. Sustainable development goals are usually very broad, and it is not always possible to easily provide a solution for a better way forward. Nor is it possible to implement the same solution everywhere – no regions or spheres are exactly alike, so a local approach has to be provided – a development is sustainable if it is a balanced way forward for all parties.

When it comes to the maritime transport sector, European Union has an abundant access to seas and oceans. Maritime transport is an important part of the economic development, but despite being united by the same governance, regions are still very different.

The purpose of the article was to provide comparison between the Baltic and the Mediterranean Seas and to see which policies govern the move towards sustainable development of the maritime transport and which challenges lie ahead for the two regions united by same legislation but separated by geography, history and current use.

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PASSENGER LINER SHIPPING INFORMATIZATION MODEL

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ABSTRACT

Passenger liner shipping system includes passenger and vehicle transport on lines which are under concession approved by the authorised institutions. Services providing process within the passenger liner shipping involves many areas of activity, while activities are related to the reception of vessels, passengers and vehicles at the port, transport services, reservation services and ticket sales. Bearers of those activities are port authorities, operators, shipping companies and travel agencies. Such a complex whole can be efficiently handled only by appropriately designed information databases, integrated information systems and well-developed governance mechanisms. The purpose of the functioning of the system, to whose accomplishing all the elements and their activities should be directed, is related to the optimization of the process according to market principles, and optimizing public benefits. The need to increase the efficiency of the management liner shipping traffic, results from the features of the environment, i.e. the wider economic entity. The globalization and internationalization trend is becoming more relevant environment moderator, driven primarily by involvement of Croatia in the European integration processes. Coping successfully with market principles and the rapidly changing dynamic of business conditions, is becoming a necessity for all operating entities of the system and the criteria of the management process. Implementation of modern management and value-oriented concept involves establishing principles of feedback control and continuous improvement through a high level of integration of the system and taking into account the requirements of all stakeholders, as well as internal and external factors in the function of on-going market positioning and maintaining the level of competitiveness. Information technology and appropriate designed information system in combination with standardized system elements are the foundation and the basis of functionality of these principles.

KEY WORDS

passenger liner shipping, information system, management system, process-based management, continuous improvement.

1. INTRODUCTION

In order to ensure regular connection of islands with the mainland, passenger liner shipping system was established in Croatia. This system includes passenger and vehicle transport on lines which are under concession approved by the authorized institutions. Services providing process within the passenger liner shipping involve many areas of activity, and the bearers of those activities are port authorities, operators, shipping companies and travel agencies. All those activities and their elements should be managed and directed to the realization of the purpose of this system, i.e.

optimization of the process according to market principles, and optimizing public benefits. Such a complex whole can be efficiently handled only by appropriately designed information databases, integrated information systems and well-developed managing mechanisms.

2. COASTAL LINER SERVICES SYSTEM

Coastal liner service system was established by the Act on Liner Shipping and Seasonal Coastal Maritime Transport (hereinafter referred to as the Act). The purpose of the system is to ensure regular connection of islands with the mainland and each other, and resorts on the mainland, with the appropriate number of daily connections in both directions in order to create better conditions for life on the islands and to encourage their development.[1]
The establishment of the public transport system is based on the principles of:

- Stimulating the economic development of the islands,
- Transport continuity and regularity with ships of certain capacities and types, and ensuring the proper quality of transportation,
- Transport services with predetermined prices and other conditions, particularly for certain categories of travelers and for a specific lines,
- Providing support to shippers, without which it is not possible to ensure continuity and regularity of public transport on certain lines,
- Adapting public transport to real requirements,
- Provide additional transportation services.

As a part coastal liner service system, the following groups of processes are allocated:

- Management process
- Core process (the passengers transportation process)
- Support process to the core process (reservation and ticket sales, the ship movement record).

2.1. Managing process

The holder of the management process is the Agency for Coastal Line Traffic. Its activity is defined by the Act through following activities:

1. performing all operations in connection with the granting of concessions for state lines: a public tender procedure, making decisions about granting and revoking of the concession, the concession contract, cancel the tender, transfer the concession to another shipping company, giving permission for a replacement vessel in the event of force majeure or ineligible, the extension of the concession in the event of a repeat tender, approval of the price list, approval of the timetables,
2. giving preliminary approval to the decision of the regional, interregional and local lines,
3. determining the seasonal and off seasonal of navigation
4. unifying the line schedule
5. supervision the implementation of the provisions of the Act, and the decision and the concession agreement implementation, in relation to subsidies and concession fees to the state line,
6. other activities that are assigned by Act to the Agency.

[11] Act on Liner Shipping and Seasonal Coastal Maritime Transport, National gazzette no. 33, 2006, actl. 3.

2.1.1. Mechanisms of management as part of the management process

From the legal definition of activities management system mechanisms (ways) are derived:

- Establishing national lines:
  - The minimum frequency of trips,
  - The type and capacity of ship,
  - Type of transportation,
- Concessions:
  - The conditions of the tender,
  - The terms of the contract,
  - The criteria for selection
- State aid:
  - the definition of criteria for determining state aid
  - the approval and control of funds allocation from of state aid
  - the establishment and management of the allocation and use of the right to subsidized tariffs
  - the establishment and managements of the allocation system and the usage of the right to subsidized tariffs,
- Identification of the season and post-season,
- Timetable:
  - of participation in decision making and alterations,
  - the consolidation and updating.

In order to effectively implement the above mentioned control mechanisms, it is necessary to establish a mechanism for feedback between planned and actual value as a part of the control system. Organizational base is establishing the functions of planning and controlling, and the structure of the hierarchy of measureable objectives and accordingly, the planned values. Intensification of the relations among the functions in the direction of the planning-implementation-control-intervention in terms of improving is necessary in order to implement the process approach to management, which is the premise of efficiency of this system. The process approach provides a recognition and valorization of the role of information in place of their creation in the context of the functioning of the system and its individual components, and the design and positioning information as inputs in accordance with the access to the broader context, objectives and purpose. Process is defined as set of interrelated or interacting activities which transforms inputs into outputs.[2] The advantage of the process approach is the continuous control that it provides over the link between the individual processes within the system of processes, as well as over their combination and interaction. Process approach bridges the boundaries between processes and this is the basis for the integration and coordination of system elements, as well as for the construction of a functional management information system. Allowing directly overview the relationship between input - output, process organization is the foundation of continuous operation and continuous improvement as a fundamental principle.

The flow of information designed in accordance with the above principle is actually establishing the sequence of converting the output size of the input to the pre-defined stages of the process.

Due to mass operational data that are inherent to this system, and consequently, to demand for more dynamic feedback, information technology and integrated information systems are becoming a necessity in terms of data processing and the formation of appropriate control and reporting background.

2.1.2. Instruments (tools, resources) management as part of the management process

Management instruments of coastal liner services system, which are developing within the

[2]HRN EN ISO 9000:2008; Quality management Systems – Fundamentals and vocabulary

informatization system belong into two basic categories:

- reporting and control management support,
- integration of all elements of the system, by providing their interaction threw their default mutual relations by using IT technology.

The required reporting and control basis for the establishment and more dynamic connection between the feedback and the planned values of the control level consists of the following reporting groups:

- The number of passengers and vehicles per line / per travel periods;
- Occupancy per line / travel / season,
- The amount of grants on behalf of usage the right to subsidized tariffs - the automatic creation of orders for invoicing,
- Lines as incoming centers, income by categories, travels, lines, vessels, shipping companies,
- Statistic on traffic and revenue.

Development and implementation of technology and information base is focused on:

- Ensuring the implementation of unambiguously defined flow of information,
- Ensuring the transfer of regulations form managing to operational elements of the system.

Standardization and implementation of the regulations on this level is requirement for uniformed way of functioning, and centralization of realization processes services network. This network is consist of core process, ie passenger and vehicle transport service process, and support process, ie reservation, sales and records of movement of vessels. Appropriately structured information system is a prerequisite for functionality of joint management level. In doing so flow of information must comply with the responsibilities and decision-making centers.

2.1.3. Required adaptations of elements of the coastal liner services system in order to increase system functionality

Centralization and integration of the system supported with IT technology have specified organizational preconditions, which are related to:

- introduction of element of a "journey" as the basic organizational and documentation system unit,
- organizing an application process that precedes embarking,
- introduction of the attributes “booking option” as mandatory features of the line/travel,
- a unique sailing schedule (for all shipping companies) available via web service,
- proving the right to use subsidized tariffs by identification cards,
- issuance of identification cards for the use of the subsidy, in accordance with strict rules within the system for awarding and usage of privileged tariffs,
- terms of concession agreements as a basis for managing and the use of information system.

2.2. The core process –passenger transport service process

The core process – passenger transport service process comprising the following stages:

- a trip plan
- buying a ticket
- registration – check-in
- preparation for embarking
- embarking
- navigation
- disembarking

The performance of the core processes of transport of passengers, as well as its level of efficiency, are based on management instruments designed as part of the management process. Transportation service performance combines activities of several stakeholders who take turns at stages of the process, namely:

- agencies for booking and ticketing,
- sipping companies
- port operators

The possibility of planning a trip is associated with the possibility of booking the ticket. System informatization enables simplification of booking and ticket sales, by increasing the number of selling points, introducing new ways of purchasing (by web, slots, mobile phones, prepaid cards), and new means of payment, while ticket, depending on the purchase, can be in different formats.

Log in, registration or check-in procedure, embarking procedure (preparing and embarking) is performed as needed and it is usually caused by high traffic intensity and a larger number of lines in different ports, and it is dependent on the spatial and organizational capabilities of the certain port. Information system enables that the ticket becomes the basis for this procedure.

By using appropriate technical equipment it is possible to access the database, to control the ticket as well as changing the ticket status during check-in procedure.

Check-in and embarking procedures organized in this way and supported by information system enable reporting operational data in real time. Those reports may relate to the list of tickets sold in relation to the tickets which have changed status after check-in. One has access to embarking process data, etc. These data may also have an important role in the context of security issues. Ticket checking at check-in and embarking means dual control, which reduces the possibility of abuse and deliberate enabling passenger passing-through.

Disembarking is a final phase of passenger transport process.

2.3. Port Authorities and port systems in the function of vessel and passengers in port

Administration, construction and utilization of ports open to public transport operate through the port authority. Decision on the establishment of the port authority determinates the port area over which extends the jurisdiction of the port authority, and establishes port operations and infrastructure and superstructure facilities in the area. In the Republic of Croatia it was formed six port authorities in ports of special (international) economic importance for Croatia and 22 port authorities for ports of county importance[3].

The way of managing the port, as well as organizing and the structure of port authorities, depend on their importance in the traffic and port system of the Republic of Croatia, which is influenced by the port traffic, conditions and size of port capacities, and port connections with the hinterland. The role of the port authority is managing the strategic development of the port, port utilization management, ensuring the smooth flow of traffic through the coordination of entities operating in the port area, maintenance of port infrastructure, managing investments in port capacities, and control and management of activities of the private sector through the issuance of concessions for particular activities[4].

Besides Port Authority, other public institutions perform their functions within port system. Harbor Master is responsible for maritime safety and there is an obligation of port authority to issue consent of the harbor master for berthing ships on a certain location within the process of reservation and acceptance of the vessels. Other authorities also perform operations related to each ship call of the port within their responsibility. Since these are

[3] Order on classification of ports open to public traffic in the county of Dubrovnik - Neretva, op.

[4] Law on Maritime Domain and Seaports, op., Art. 76

daily operative processes they have to be dynamic and well-coordinated and this is where the importance of information system takes place.

2.4. Management of the port system

Management of the port system refers to:

- Management of the private sector(work of the concessionaire)
- Management of the concessionaire,
- Management of users of the port area,
- Management of the maintenance and development of port infrastructure and superstructure,
- Management of the vessels accommodation procedures,
- Management of the safety standards,
- Management of strategic development plans and marketing plans of the port.

Although not directly responsible in the process of provision of services within the public system liner, port authorities have an important regulatory role in this process, which takes place due to the dynamic interaction between public liner shipping and port operations management, ie port management system. There are two areas within which the interaction takes place:
- Organization of the port area,
- Vessel and passenger accommodation in the port.
The Port Authority is coordinator and organizer of the activities in the port area, and determines the purpose and method of use of a specific part of space within the port area. This relates issues of the registration process and preparing for embarking. The issue of disposing of space which is in the function of performance of these activities, as well as the holders of the activities, is under the jurisdiction of the port authority. The role of the port authority is to ensure availability and functioning of this activity, as well as designing standards, conditions and rules for the performance of the activity, and supervision and control over them. Rules and standards must include a precise definition of the responsibilities of shipping company, port operator and port authority during embarking and disembarking.
Vessel and passenger accommodation, except previous described operational level, refers to the administrative management and coordination level. Accommodation of the ship and passengers / cargo / vehicles in the port is an integrated procedure which involves several entities, holders of various activities and functions, and an information system which supports this process must ensure communication among all holders of the functions and activities, according to defined rules and documents and information flow. The ability of the vessel acceptance process to access and interact with a part of the coastal liner information system, which refers to the movement of ships, represents a significant improvement in terms of organization and documentation, in a way that gets a unique, controlled, accurate and timely source of information for all those functions within the port system, i.e. vessel accommodation system within the port.

3. AN INFORMATION SYSTEM FOR SUPPORTING PUBLIC PASSENGER TRANSPORT MANAGEMENT SYSTEM

Information system for support transport management system is an integrated, process-oriented business information system that contains all the elements necessary for business process management organization (Figure 1)

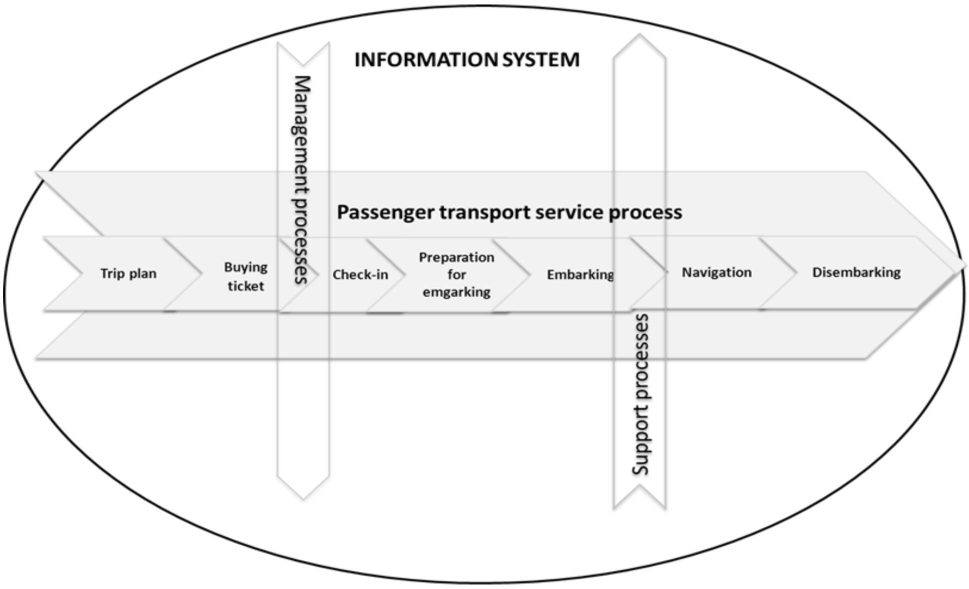

Figure 1: An information system for supporting public passenger transport management system

The basis of the information system is to manage the business process by monitoring the flow of documents and processing the information they contain.
Basic features of the system are:

- Process approach,
- Documentation system,
- Context,
- Safety,
- Administration.

The system is based on the principle of centralized control, where all data is stored in a central database and data access is achieved partly through the client program, and partly through a web interface. Storing all data in a central database provides records, processing and access to information in real time.
The information system integrates three administrative and managing levels related to management of information system elements:

1. operational part of the system - reservations and sales
2. administrative part of the system - timetable, managing reservations, services,
3. system administration – standard implementation, common rules of procedure

3.1. Control level of the system

The most general and the highest level of information system refers to setting up basic rules of functioning. Instruments of this level of management, which are prerequisites for the transfer of rules on the functioning of the operating system level, as part of an information system are:

A) as part of the system administration:

- Granting permission to access and work,
- Organization of links between documents,
- Organization of communication channels / information flow.

B) as part of the application of common rules and standardization - the rules that are set at the highest and middle management level:

- Forming sailing list,
- Forming of lines,
- Forming a trip,
- Operationalization of the trip,
- Forming announcements,
- Determination of the season and post-season
- Determination of the rules for the use of subsidized tariffs.

3.2. Information system as a support to the services performance process

Lower managing levels of the systems support services implementation process network. It is a management of the core process, i.e. execution services process, and support processes; reservations and ticket sales as well as records of ship movement.

The need for information - reporting base within the services realization system includes:

- Operational characteristics of travel, the time, the ship, capacity,
- Sold and reserved tickets, the number of remaining places,
- Number of embarked / disembarked passengers and vehicles / canceled tickets.

Information support to service realization processes consists of the control activities and support to operational activities.

The control part is related to managing reservations and ticket sales and announcements, as well as the records of the ships.

Support to operational activities is related to reservations and sales processes, and service realization process.

All phases of the service realization processes in terms of information, are conditioned by a link to a document - ticket, depending on which stage of the process, are changing statuses.

3.3. Using RFID cards within the information system

One of the opportunities provided by the coastal liner services system is the use of RFID system (Radio Frequency Identification).

The system of issuing and use of RFID card consists of:

- Issuance of cards,
- The use right , which is realized through the card,
- Control of proper use.

Issuance of cards is one of the system's management mechanisms which centralize the right regulation, the basis of use right, as well as control over the implementation of the regulation.

Following activities are linked for issuing cards:

- Determining the rights and conditions of use preferential tariffs,
- Determining other terms, conditions and ways of use,
- parameters input for specific groups and types of cards in the information system module - administrative levels of the system,
- Entry of master data for each user in a single document with a unique user identification,
- Data entry for each card with a link to the user, and group type, and unique identification.

In terms of information and documentation, activities are implemented by creating and updating the four documents in the information system;

- A group of cards,
- Type of card,
- Master data about the user,
- Cards.

By updating these documents, and administration of information system in terms of determining the relation between documents, terms and content control, the rules are specified within the system rules, and the conditions for the application of the rules to all lower-level documents are creating. In that way established information system ensures that the content of the card which is given as the final output procedure for issuing cards, is formed in accordance with the rules set.

3.4. Contributions of coastal liner informatization system to stakeholders.

Contributions to the holders of the management process:

- Sturdy and unique, integrated management system designed to support centralized management principles to all aspects of the system,
- Developed mechanisms and tools of operational and strategic management,
- Access to and use of data in real time,
- Management of the allocation and use rights to subsidized tariffs system,
- Increasing the quality of services,
- Statistics on traffic and revenue,
- Increasing the efficiency of business processes

Contributions to the shipping companies:

- Developed mechanisms and tools for business management,
- The information necessary for the management of the services realization process,
- More efficient and cheaper process of booking and ticket sales,
- Increasing the quality of services,
- Easier communication, exchange of information and documentation from the business environment (port authorities, port operators),
- Increased ability to control tickets,
- Increased ability to control the use of subsidized tariffs

Contributions to the users

- Increasing service quality, reliability, accuracy, predictability,
- The ability to plan a trip (ticket reservations)
- Availability of the necessary information about holidays,
- Easy booking procedure and purchasing cards, a large number of retail places, the availability of all modes of purchase, the possibility of using all valid means of payment,
- Standardized services,
- Transparent rules of using services

Contributions to the port authority

- Automatic calculation of the amount of port dues,
- Easy exchange of data and documents within the vessel and passengers record in port
- Data on the movement of ships in real time

Contributions to the other public institutions:

- Base of statistical reports furnished by different categories and criteria
- Information base for operative business processes for Harbor Master, Custom, Maritime Police and others.

Contributions to the national economic system and the community:

- Efficient and controlled traffic subsystem as an important factor in the efficiency of the national economy,
- Efficient and reliable transport system,
- The ability to monitor development trends and the use of performance indicators as instruments of strategic management.

4. CONCLUSIONS

From the complexities of coastal liner services, as well as the involvement of a large number of interested parties that appear in the roles of stakeholders, users and regulators and coordinators at different levels of management, arising multiple opportunities to increase its efficiency and its contribution to all interested parties. In addition to adequate information base, efficient process management requires an active approach to establishing and making more dynamic relationships among the management functions of planning and control at all levels.

The need to increase the efficiency of the coastal liner services management system arises from the characteristics of the environment, i.e. wider economic whole. The trend of globalization and internationalization is becoming more relevant moderator of the environment, driven primarily by the inclusion of Croatia in the European integration processes. Successfully coping with a accentuated market principles and the rapidly changing dynamics of business conditions is becoming a necessity for all operating system entities and the criteria of the management process. Implementation of modern leadership and value oriented concept, involves establishing feedback principles and continuous improvement through a high level of integration of the system, and taking into account the requirements of all stakeholders, as well as internal and external factors in the function of the permanent market positioning and maintaining the level of competitiveness. Information Technology and appropriately designed information system in combination with standardized system elements are functionality basis and core of implementing such principle.

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IMPROVING THE EFFICIENCY OF CUSTOMS PROCEDURES IN THE MEDITERRANEAN SEA PORTS AS A FUNCTION OF DEVELOPMENT OF PORT TRANSPORT NETWORKS

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ABSTRACT

It is well known that European ports encourage reevaluation of their management strategies in order to attract investments in the field of transport. In addition to the infrastructure needed to develop new, reliable and cost-effective transport network, there is a need for the enhancement of port services and customs procedures through the simplification and harmonization of procedures using the information-technology systems. Currently, there is an obvious progressive shift toward electronic access to the implementation of various port procedures where customs administration plays a key role. Project MEDNET-Mediterranean Network for Custom Procedures and Simplification of Clearance in Ports, was recently accepted by the MED program and will be co-financed by the European Regional Development Fund (IPA MED). The main objective of the project is to establish and manage a network port authorities and traffic experts in the Mediterranean, and the long-term goal is to focus on the exchange of experiences in the field of port and customs procedures and simplification of customs procedures for vessels and cargo. Expected result is an increase in mutual understanding of the procedures and promotion of the introduction of information systems in ports as well as the possible introduction of these systems in other intermodal hubs.

KEY WORDS

customs procedures, MEDNET project, port systems, transport policy

1. INTRODUCTION

The improvement of the efficiency of customs procedures in the Mediterranean sea ports can be establish and operate through network of port authorities and transport experts of the Mediterranean, on a long-term basis, focusing on the exchange of experiences concerning custom procedures and the simplification of clearance for vessels and cargoes. This is expected to enhance the common understanding of such procedures and promote the introduction of information systems to ports and potentially other intermodal nodes.

The main objectives are:

- Record of current and past EU and other activities, studies and projects, which have a relevance to the simplification of clearance of vessels and cargo procedures in the Mediterranean ports.

- Presentation of existing practices of port authorities in terms of pre-arrival processing, risk assessment, fraud control, evasion control, tax and duty collection.
- Identification of "weak links" and bottlenecks of current practices in clearance processing and related documentation proceedings.
- Identification of best international practices of Mediterranean ports related to the clearance of vessels and goods with the use of appropriate information systems.
- Presentation of good practices related to custom procedures and in particular the application of ASYCUDA[1] in the Mediterranean.
- Promotion of cooperation between port authorities of the Mediterranean with the introduction of harmonisation procedures focusing on the alignment of proceedings, operations and documents with conventions, norms and international practices.
- Production of an inventory of existing bi-lateral, multi-lateral and international agreements for the Mediterranean region related to normalisation of procedures, thus the adoption of international formats for proceedings and information.
- Production of a Strategic Action Plan focusing on measures of harmonisation and normalization of procedures among ports to create an open market with the use of information systems and simplified procedures.
- Raise of awareness and enhancement of exchange of views amongst port authorities on a regional, national and EU basis.

In the framework of thus defined objectives, the aim of the research in this paper is presentation, definition and analysis of pilot actions whose conduct in certain Mediterranean ports will improve of the efficiency of customs procedures in the Mediterranean ports. The mention pilot actions are:

- Simplification of the procedures associated with customs,
- Promotion of the single market: introduction of the electronic T2L to justify the community status of goods,
- Improvement of sanitary, phytosanitary and veterinary controls: introduction of electronic tools,
- Improvement of Ro-Ro traffic: parking management and customs procedures,
- Improvement of Ro-Ro and cruise ship calls: ship supplies and berth allocation,
- Facilitating the implementation of single windows and port community systems.

2. SIMPLIFICATION OF THE PROCEDURES ASSOCIATED WITH CUSTOMS

2.1 Implementation of Single Window system for Summary Declaration for Temporary Storage (SDTS)

The proposed initiative is aimed at application of the current computer systems and tools for submitting declarations. The proposed method implies lodging declarations once only and the information can be used by all authorities involved. Integration with National Customs System is a key entry point to the Customs paperless clearance system. So, this Action will be incorporated into port system because of functionality and benefits that provides:

Functionality

- Establishes a single administrative window for loading and discharge manifests and single administrative documents for customs declarations,
- Import and export paperless clearance,
- EU New Control Transit System (NCTS).

Benefits/Aims

- Simplification and costs reduction in customs formalities,

[1] Automated system for customs data (detailed: http://www.asycuda.org/).

- Improves customs controls (security, taxes, ...),
- Electronic data interchanges among customs for any procedure,
- Single desk and unique recognition among Member States.

Those actions should be developed and enhanced because of two main perspectives:

The business perspective: to enhance the capability to model the business cooperation processes, based on the need of creating a common understanding of electronic business messages and workflow - implement the more suitable electronic transmission system which avoids the appearance of cumbersome situations. The main focus is also, dealing with the definition of appropriate business models and how to establish that all (port) players work together, using state of the art technology.

The technological perspective: to adopt and enhance the procedures for lodging the Summary Declaration for Temporary Storage with capabilities to cooperatively support multimodal transport chains. Specifically, to build solutions upon the recommendations of international standardization bodies (EU) and with all the functionalities capable to support well defined business models.

Also, that entirely electronic procedure will be established for the application of important safety and security formalities. Namely, the bottlenecks associated with the transmission of summary declarations for temporary storage and customs manifests will be identified and the reasons that hinder the efficient flow of information will be evaluated. Current administrative, regulatory and technical barriers will be also analyzed. In addition, the action will identify the opportunities and recommendations in view of simplifying and speeding up the procedures associated with the summary declaration for temporary storage and the customs manifests. Also, it is important to note that exit or entry summary declaration must be provided by the person that manages with transport mode and which intends to enter / bring in / out the goods of the customs territory of the EU. The document that indicates the status of Community goods must be prepared by a person that transport (consign) the goods i.e. a person who clearly knows their customs status and thus it declares.

2.2. Updating Single Window system for Summary Declaration for Temporary Storage and Cargo Manifest

The proposed initiative is aimed at updating the current computer systems and tools for submitting these declarations to Mediterranean ports which already have implemented SDTS. The proposed method implies lodging these declarations once only and the information can be used by all authorities involved. This solution avoids any discrepancy between the information lodged at the different authorities involved and permits the introduction of advanced measures in regulatory compliance and risk management.

The MEDNET project intends to make a significant contribution towards customs procedures and simplification of clearance for vessels and cargoes in the Mediterranean area through a set of activities. The analysis, improves and recommendations regarding the procedures for lodging the SDTS contribute to this goal. The proposed pilot prepares the port systems for future Community Customs Code requirements allowing the agents involved to share information and interoperate in the different systems established in the Mediterranean area.

3. PROMOTION OF THE SINGLE MARKET: INTRODUCTION OF THE ELECTRONIC T2L TO JUSTIFY THE COMMUNITY STATUS OF GOODS

A full implementation of the electronic T2L solution by all economic operators in all Member States will provide exponential benefits in the Mediterranean area allowing a seamless flow of goods by sea in the region. The European Single Market is based on a Customs Union offering free movement of goods, services, people and capital. Although there is freedom for trade between the EU countries, ports represent the line between EU and non-EU Customs territory and Customs controls are required in order to determine the status of goods. Although simplified procedures exist, in most cases the mechanisms for the transport operators to prove the Community status of goods to Customs are still manual and paper-based. These procedures involve costly use of office resources and paperwork which results in additional expenses, errors and delays in intra-Community sea transport due to manual processing time.

The T2L, as it is referred to, is one single document, which once presented to and sealed in customs, should be delivered to the shipping company's premises within the port of loading. The shipping company arranges the unloading of the goods into the previously assigned vessel and sends the document to the client in the destination country. In this context, the electronic T2L is oriented to facilitate and simplify the compliance with Customs regulations by proving the Community status of the goods transported by sea through electronic means, contributing also to the start-up of other innovative integrated transport solutions. In an optimal scenario, the mechanisms that allow the presentation of the required documentation in an electronic way should be provided. Intra-Community sea freight flows would be more reliable and simpler to control if Customs Authorities, at the origin and destination of these flows, could share information. For this to happen the same principles used in exit and entry summary declarations will be applied.

4. IMPROVEMENT OF SANITARY, PHYTOSANITARY AND VETERINARY CONTROLS: INTRODUCTION OF ELECTRONIC TOOLS

This action includes incorporation of tools that carry out an effective control of the entry of goods into the country in order to comply with the Community declarations required related for sanitary or veterinary controls. In order to define methods that use electronic sources, such as summary declarations, cargo manifests and any other source for road, rail or maritime traders at the ports so as to ensure that goods of animal origin entering the European Union are subject to veterinary controls pursuant to current legislation. This control should be extended to the non-animal goods subject to sanitary controls required on arrival in the country. A tool should be built to consult the relevant information sources. Enquiries can be made at any time by the competent authority and official veterinarians. Specific enquiries can be made about goods subject to monitoring according to specific regulations and different criteria: by ship or scale; by consignment number; by container number; by type of operation (loading or unloading); by Customs destination (import or transshipment); by date range; by time spent at the terminal; by location (at port or retired), etc.

The enquiry can be viewed on screen with different classification, ranking and selection options, which are available with the following entry criteria: competent authorities and official veterinarians will have access to the consignments and data recorded; maritime operators will have access to those containers and goods that have been submitted by them in the summary declarations of temporary storage, loading or unloading lists and cargo manifests; freight forwarders, logistics operators and cargo receivers will have access to the consignments registered in the summary declaration for temporary storage. The results obtained should be exportable to an Excel file or PDF report for their management and/or filing.

5. IMPROVEMENT OF RO-RO TRAFFIC: PARKING MANAGEMENT AND CUSTOMS PROCEDURES

5.1 Parking management as a function of improvements of Customs procedures

The efficient management of parking areas enables the improvement of the transport chain, reduces parking time, reduces queues and improves the environmental impact since less emission are spread not only in the ports, but also in the surrounding area.

In order to improve the Ro-Ro traffic, it is important to simplify maneuvers and excessive movements. A better management of parking, will enable the improvement of the transport chain, reduce loading and unloading time, reduce the time of the parking in appropriate areas, minimize excessive movements providing a safe Ro-Ro traffic with minimal costs. The information of the quantity and type of vehicles to be loaded or unloaded shall be taken by the operator (transport agency). The full list will contain, number of vehicles and their classification as:

- Car vehicles
- Trucks, Semi Trailers, Trailers
- Bus
- Vans

The Ferry Agent should receive informations 8 hours before arriving at berth. The officer of the ferry makes the distribution of the vehicles, according to parking spaces. Parking management plan should be entered into the ITS (Intelligent transport system), which will be clearly legible on a screen within the space ferry and parking areas of the port. Street parking in the area of the port should be set according to the parking management plan that is displayed in the electronic monitor. This plan should take into consideration other issues such as the buses go down first or specific problems that can occur etc. Direction of vehicles for loading/unloading will be showed by the electronic monitors, showing the plate number of the vehicle. Also, each driver must be equipped with a number which indicates the queue for loading or unloading. The implementation of such an electronic system requires a strong collaboration between carriers and operators (agencies).

5.2 Automatic exit of trucks from port areas

Since exits of cargo in lots of Mediterranean ports are not automatized, custom officers must check manually the documentation that is accompanying the cargo loaded onto trucks and validating if the cargo is customs cleared or/and all customs procedures closed, which is a time consuming process and is sometimes includes human mistakes. Although lodging of customs declaration is electronic and the Custom Administration is supporting a paperless communication, the exits from the port remain a bottleneck. A solution to the problem would be to introduce an electronic and automatic exit validation procedure for trucks helping the Customs to be more efficient on the gate.

The announcements of trucks arrival has to be computerized to enable planning of work on terminals as well as support traceability of trucks inside the port area. The proposed action will therefore support the simplification of exits by speeding up in particular custom related procedures. The proposed action will enable an improvement in data quality in port records. The analysis about the problem will be prepared with the participation of Custom Officers and prototype of the intelligent transport solutions will be designed and then piloted.

6. IMPROVEMENT OF RO-RO AND CRUISE SHIP CALLS: SHIP SUPPLIES AND BERTH ALLOCATION

Ship supplies procedures and formalities affect to all the types of ships and ports, which is particularly relevant for cruise traffic. In this case, large quantities of catering, fuel and accessories must be loaded and unloaded in a short time. Due to their nature, cruises call into port frequently so is necessary to streamline these processes and procedures in order to keep them coming back to a port.

The ship supplies provider or his representative has the authorization of simplification that avoids the need to introduce export SADs (Single Administrative Document) to authorize loading, but requires that exported goods are registered in the accounting documents and export operations are notified periodically after goods have left the Customs territory of the Community. This option requires that the provider supplies vessels or their representative is an AEO (Authorized Economic Operator).This method allows loading of supplies in operations requiring an export SAD by simply presenting the sales invoice accompanying the goods, without requiring any Customs declaration prior the loading of supplies.

The shipping agent has the capacity to generate electronic messages, which allow it to notify the arrival of AED (Advance Export Document) or to receive transit and subsequent loading. Include the possibility that these messages can be resent "remotely". A laptop with an internet connection would suffice plus a digital certificate for signing electronic Customs declarations with the applications required generating these messages. Additionally, if the shipping agent meets the conditions to be a declarer it could present export SADs using the Customs web services. In automatic transshipment, the operation is finalized with the cargo manifest by the shipping agent, an electronic re-export notification is not necessary. Additional possibility that must be reviewed and authorized by the Customs is the implementation of an automatic paperless supplies clearance system to avoid printing the documents.

In this paperless process, the fiscal receipt could perform the export SADs or AEDs authorizations, transit receptions with subsequent loading and automatic transshipment using the references on these documents, without needing submit any Customs paper to justify them. This possibility requires define and authorize these Customs procedures and the fiscal receipt. In fact, the electronic tools should be installed in ports for this check. This method will help to eliminate unnecessary movements to print and obtain release of goods papers.

7. FACILITATING THE IMPLEMENTATION OF SINGLE WINDOWS AND PORT COMMUNITY SYSTEMS

7.1 Electronic procedures related to container consolidated cargoes

The action is aimed at creating a procedure to manage maritime departures for container goods consolidation covered by different Customs documents. The objective is to cover by means a consolidation message of container goods the lack of information in Customs documents prior to their consolidation which hampers the right processing of these departures by electronic systems. In this way, the NVOCC[2] would be able associate a particular container to the loaded SADs in the container. This would continue with the development of the goods exit procedures through the implementation of automatic paperless export clearance system to include the container in the messages of traceability between the Customs and ports.

The method is based on relate the loaded SADs and its associated consignments with a specific container number by an electronic document. The proposed solution includes the following functionalities:

- A module for submission of consolidation warehouse working orders with EDI (electronic data interchange). The communication and integration with the consolidation warehouse plays an important role to organize and improve the overall process. The smooth integration of the working orders allows the linkage between “consignments and container”. The multiple LCL[3] bookings will be automatically linked inside a single container, which will be associated to the FCL[4] Booking.
- Introduction of track & trace capabilities for consolidated cargo: The track & trace of the shipment will be managed taking into account consolidation/deconsolidation operations in an intermediary warehouse. The goal of this pilot will be to achieve a complete trace of the unique consignment across the supply chain. The unique identification of the consignment, the use of multiple references, and the consolidation/deconsolidation in

[2] Non vessel operating common carrier; A shipment consolidator or freight forwarder who does not own any vessel, but functions as a carrier by issuing its own bills of lading and assuming responsibility for the shipments.

[3] Less than Container Load; A term used to describe the transportation of small ocean freight shipments not requiring the full capacity of an ocean container – Usually less than 20 cubic meters.

[4] Full container load; A standard (twenty or forty-foot) container that is loaded and unloaded under the risk and account of the shipper or consignee.

different containers are some of the challenges that will be faced in this pilot. The track & trace information will be delivered by Port Community System as the result of the previous message interchanges.

- Customs Automation: Customs procedures in consolidated cargo represent a high volume of administrative tasks for the NVOCC. Different aspects should be analyzed to present an option that allows the automation of the process. Import, export or transit operations require to follow different processes and documentation where the origin of the goods, the value and the AEO distinction are factors that should be taken into consideration. The automation and integration with Port Community System will contribute to speed up the process and reduce these administrative tasks.

7.2 Setting up of an integrated, user-friendly and computerized procedure to improve maritime Single Window

The proposal for this Directive applies to ships arriving in and departing from ports situated in Member States. It aims to simplify and harmonize the administrative procedures, and to use information and communication technology to increase efficiency. It also aims to reduce the amount of information to be repeatedly provided to the various port authorities. Transmitting of information is encoded digitally, using a revisable structured format which can be used directly for storage and processing by computers. The national authorities will have fewer checks to carry out, and the used of computerized communication methods will enable checks not covered by the proposal to be better organized, whilst improving their efficiency. The Directive will considerably reduce the cost and duration of time in port and will be beneficial to maritime transport, thus contributing to an adjustment in the balance between various modes of transport. The objective of this concept is to remove or simplify the documentary and physical checks conducted on ships and goods moving between ports situated in the European Union. The other main objectives of this concept are:

- facilitate import and export procedures
- reduce compliance and administrative costs and to improve clearance times
- coordinate a common approach to the control of goods
- help ensure proper collection of all customs duties and other charges
- ensure rapid provision and receipt of relevant information with regard to the international supply chain
- To enable the seamless flow of data between the administrations of exporting and importing countries, as well as between customs authorities and economic operators, allowing data entered in the system to be re-used.

8. CONCLUSIONS

The MEDNET project, through the presented implementation of pilot actions, will intended to make a significant contribution towards custom procedures and simplification of clearance for vessels and cargoes in Mediterranean ports. The main project output will be a Strategic Action Plan and a Ports Operation Observatory, focusing on best practices and measures of harmonization and normalization of procedures among ports of the Mediterranean to create an open market with the use of information systems and simplified procedures. This in itself will have obvious strategic implications to the facilitation of transport by removing non-physical barriers and will enable a more rigorous push towards seamless maritime traffic across borders. The underlying expected impact of the above is to reduce or even break the borders between the players and the transport public and private bodies and to establish solid basis for the future of the project, as well as its long-lasting effect. By giving the players opportunities to meet and debate upon the project activities and results, the MEDNET project aims at installing the necessary basis for a strong commitment of public and private sectors. One such event is the organization of a public Workshop in the mid-term of MEDNET project and the Open Conference at the end of project, where all relevant target groups will be invited to contribute to the validation of presented pilot actions, best practices and the normalization of selected simplification procedures and proposed recommendations.

ACKNOWLEGMENT

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ANALYSIS OF SWITCHING OVERVOLTAGES IN SHIPS ELECTRIC POWER SYSTEM

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ABSTRACT

Ships electric power systems can work in different regimes. They usually works in normal work regime in which needs of all customers are fulfilled with values of frequency, voltages and other characteristic variables deviations in ranges defined by regulations. Transitions of regimes can be spontaneous (as consequence of some unpredictable events such as failures, environment influences and so on) or by purpose (as consequence of dispatching operations). They cause transient processes because system consists of differently connected oscillatory circuits. The transient processes can trigger of high values of voltages, so called inner overvoltages. High voltages can be very dangerous for insulation of electrical equipment. The causes for the appearance and existence of the different types of inner overvoltages and their consequences are numerous and different, and therefore special attention should be paid to them by means of power system reliability and security.

Switching overvoltages are one of inner overvoltages. This type of overvoltages is caused by breaker's commutation in the cases of normal regime or in the cases of failure. Due to large number of influencing parameters, calculation of these overvoltages is very complex, and exact results demand application of advanced computer programs.

The possibility, which can make the calculations and analysis of switching overvoltages originated by different causes faster and easier by using relatively simple, but exact enough, derived mathematical method and computer application, will be presented in the paper. Calculated results will be used for the analysis of the advantages and disadvantages of the proposed procedure and for validation of the introduced improvements.

KEY WORDS

Ship’s power systems, power system failures, inner overvoltages, switching overvoltages.

1. INTRODUCTION

Ships electric power systems can work in different work regimes. They usually works in normal work regime in which needs of all customers are fulfilled with values of frequency, voltages and other characteristic variables deviations in ranges defined by regulations. Transitions of regimes can be spontaneous (as consequence of some unpredictable events such as failures, environment influences and so on) or by purpose (as consequence of dispatching operations). They cause transient processes because ship’s power system consists of differently connected oscillatory circuits. The transient processes can cause high values of voltages, so called inner overvoltages, which appear in systems because of very large number of different reasons [1].

Beside many others, switching overvoltages are one of inner overvoltages. This type of inner overvoltages is caused by breaker's commutation in the cases of normal regime or in the cases of failure.

In the paper switching overvoltages originated by cable energizing, as one of most often-performed operations in practice, have been analyzed. From that reason, it is necessary to determine all subsequent consequences in real conditions.

In the literature there are several methods for calculation of switching overvoltages. The most often used methods are: method of Laplasian transformations in the networks with concentrated parameters, method of lattice diagram, discrete method etc. In the paper, the analysis of switching overvoltages originated by cable energizing is performed by using method of Laplasian transformations, with the mathematical model for calculation of switching overvoltages in the network with concentrated parameters. This method represents basic approach for calculations in networks with concentrated parameters. The simple system, which consists of a generator, a transformer and a cable, has been observed. By using derived mathematical model of the observed system and mentioned model the computer program written in MATLAB [2], which enables very quick and quite easy calculations, has been made. The program enables the needed calculations and the graphical presentations of the obtained switching overvoltages, as well as the analysis with the different rated voltages and characteristics of the observed elements – generator, transformer and cable and with different beginning conditions. For the comprehensive analysis a number of concrete real cases have been analyzed, and the obtained results have been discussed.

2. MATHEMATICAL MODEL

For the purpose of illustration of method applied for calculation of switching overvoltages in the network with concentrated parameters, the simple system that consists of generator, transformer and energizing cable is observed (Figure 1) [3,4].

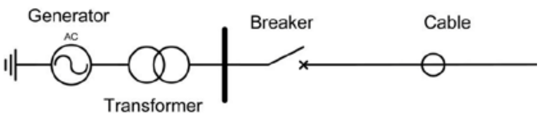

Figure 1. Scheme of part of ship power system

Two characteristic cases are analyzed:

1. When the cable was disconnected from system for enough time that it doesn't consist residual voltage.
2. With the fast automatic reclosing of cable, so there is a certain value of cable's residual voltage.

For the purpose of switching overvoltage analysis, single line diagram of system with concentrated parameters usually has been observed. This simplifies analysis with its accuracy in allowable range. Also, it is assumed that all cable's parameters have constant values. In reality, inductance and resistance of cable depend on frequency of current that passes through cable because of skin effect on conductor and in return way through ship. Capacity of cable increases with voltage.

Single line diagram of the observed system, with only one T-scheme of cable, is given on figure 2. For the purpose of calculation it is assumed that electromotive force is given with $e(t) = E \cdot \cos(\omega \cdot t + \psi)$, where:

ω - angular frequency of electromotive force, ϕ - angle of cable energizing.

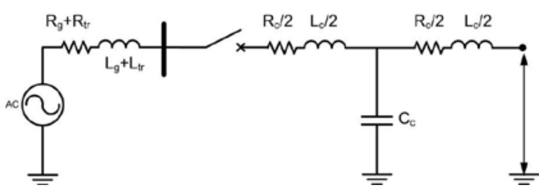

Figure 2. Single line diagram of the observed system

On the figure 2, labels are: e (t) – electromotive force (emf), R_g, R_{tr}, L_g, L_{tr} – resistance and inductance of generator and transformer, R_c, L_c, C_c – resistance, inductance and capacity of cable, U – voltage on the cable.

Differential equation that describes circuit on the figure 2, is given as [3]:

$$e - R \cdot i - L\frac{di}{dt} - u = 0 \qquad (1)$$

where:
$L=L_g+L_{tr}+L_c/2$ – overall inductance,
$R=R_g+R_{tr}+R_c/2$ – overall resistance.

Voltage on cable, i.e. on the cable capacity can be derived from:

$$u = \frac{1}{C}\int_{-\infty}^{0} i\,dt + \frac{1}{C}\int_{0}^{t} i\,dt \qquad (2)$$

In the case of short no-voltage pause it is $\frac{1}{C}\int_{-\infty}^{0} i\,dt = U_o \neq 0$, so equation (2) can be written as:

$$u = U_o + \frac{1}{C}\int_{0}^{t} i\,dt \qquad (3)$$

Beginning conditions for solution of differential equation are:

$i(0) = 0$ - cable current in the moment before cable energizing,
$u(0) = U_o$ - residual voltage on the cable (takes into consideration duration of no-voltage pause).

Resistances don't have significant influence on magnitude and frequency of transient processes. Besides that, calculation of switching overvoltages when resistance is taken into consideration is very complex. From these reasons, resistance of generators, transformers and cables have been neglected in this analysis. Therefore, slightly higher values of overvoltages will be obtained (because resistance of elements causes attenuation of overvoltage wave shape), but analysis is faster and easier.

Equations (1) and (3) are solved by transition from time domain into complex domain by using Laplasian's transformations.

Taking into consideration introduced assumptions, time form of equation for voltage on the cable can be written as:

$$u(t) = \frac{E \cdot \cos(\omega t + \psi)}{K_f} - \frac{E \cdot \cos\psi \cos\omega_1 t}{K_f} + U_o \cdot \cos\omega_1 t + \frac{E}{k_f}\frac{\omega}{\omega_1}\sin\psi \cdot \sin\omega_1 t \qquad (4)$$

where

$\omega_1 = \frac{1}{\sqrt{L \cdot C}}$ is circuit frequency,

$k_f = \frac{1}{1 - \left(\frac{\omega}{\omega_1}\right)^2}$ - Coefficient k_f takes into consideration increase of voltage because of Ferranti's effect. This effect represents phenomena of increase of voltage on the open-end of the cable in comparison to value of voltage on beginning of the cable. Reason for this is capacitive current that passes through cable's inductance.

It can be expected that equation (4) represent time form of voltage on the middle of cable because it is determined for voltage on the capacity of cable, which is placed on the middle of cable.

Magnitude of the fourth part in equation (4) is very small in comparison to the other parts (because $\omega_1 >> \omega$), so it can be neglected from further analysis.

Equation (4) now can be written in the form:

$$u(t) = U_{stat} + U_{trans} \qquad (5)$$

where: $U_{stat} = E \cdot k_f \cos(\omega \cdot t + \psi)$
$U_{trans} = (U_o - E \cdot k_f \cdot \cos\psi) \cdot \cos\omega_1 t$.

From the equation (5) it is obvious that transient component of overvoltage U_{trans} doesn't attenuate in the case when resistances are neglected. However, in the reality transient component of overvoltage attenuates because resistance of generators, transformers and cables always exist in the system. In the case when attenuation is taken into account, transient component of overvoltage has form:

$$U_{prel} = (U_o - E \cdot k_t \cdot \cos\psi)\cos\omega_1 t \cdot e^{-\delta t} \qquad (6)$$

where is $\delta = \frac{1}{2}\frac{R}{L}$.

From previous analysis it is evident that resistance influence is taken into account only for attenuation of transient process, while angular frequency is calculated without resistance influence. From these reasons, calculation of overvoltage magnitude i.e. calculation of overvoltage coefficient is little bit less accurate.

The most important parameter that determinates value of overvoltage is moment of cable energizing. This moment determines angle of cable's energizing ψ. In the case of three phase systems, at least one pair of breaker's contacts is closed in bad conditions by means of high value of electromotive force, which causes appearance of high values of overvoltages in that phase. In the paper, it is assumed that cable energizing is performed in the moment when electromotive force has its maximum, because it is the worst possible case.

3. PROGRAM DESCRIPTION

On the basis of previously presented mathematical model program in MATLAB, which enable calculations of overvoltage coefficient and graphical presentations of voltage in the case of cable energizing, has been written.

Program is written in GUI (Graphic User Interface) [2]. Main program window is presented in figure 3.

Input data that are necessary for calculation of switching overvoltages in the case of cable energizing by using this program are parameters of the generator, transformer and the cable.

Output data of the program are overvoltage coefficient and the moment of appearance of overvoltage maximum value, as well as graphical presentation of overvoltage's time diagram in transient process.

The program enables the analysis with the different rated voltages and characteristics of the observed elements – generator, transformer and cable. The cases with or without residual voltage can be easily taken into consideration.

4. EXAMPLES OF PROGRAM APPLICATION

All necessary input data for the illustration of the calculation by using this program are given in the table 1. Calculation of switching overvoltages in the case of 6.6kV cable energizing is performed for cables XHP 48 (-A) 6/10 kV with cross section of 70mm^2 and for cable lengths of 200m (cables no. 1 and 3) and 1000m (cables no. 2 and 4). These examples are taken from number of performed calculations as characteristic for relatively short and long cables. Cases with (cables no. 3 and 4) and without (cables no. 1 and 2) residual voltage (U_0) in the moment of cable energizing have been observed. Also, it is assumed that cable energizing is performed in the case when electromotive force has maximal value (i.e. when angle of cable energizing is ψ=0) because that represents most critical case by means of obtained overvoltage value. Results of calculations are given in the table 2, and graphical representations of voltages time-forms are given on the figures 4 to 7 in relative values in respect to maximum value of electromotive force.

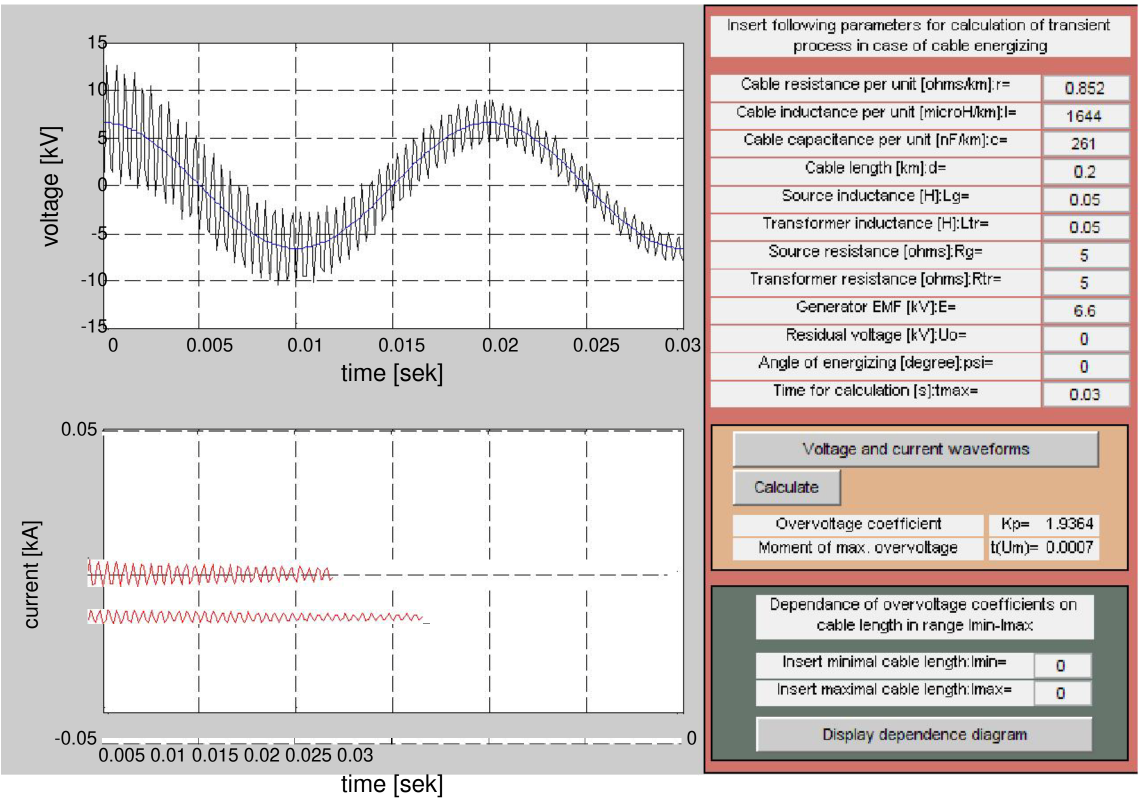

Figure 3. Main program window

Table 1. Input data for calculation

Para-meter	Cable no.	1	2	3	4
E	(kV)	6.6	6.6	6.6	6.6
R_L	(Ω/km)	0.443	0.443	0.443	0.443
L_L	(∝H/km)	644	644	644	644
C_L	(nF/km)	261	261	261	261
d	(km)	0.2	1	0.2	1
R_g+R_{tr}	(Ω)	1	1	1	1
L_g+L_{tr}	(H)	0.1	0.1	0.1	1
ϕ	(°)	0	0	0	0
U_O	(kV)	0	0	-E/2	-E/2

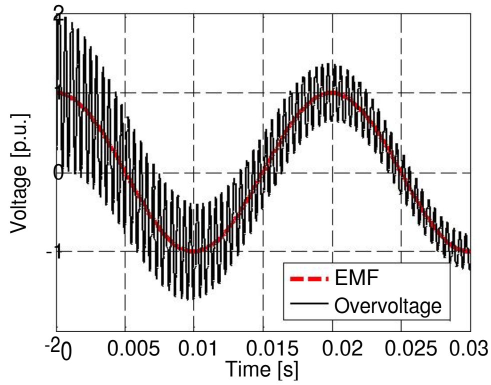

Figure 4. Voltage on cable no. 1

Table 2. Results of calculations

Cable no.	Umax (kV)	Overvoltage coefficient	The moment of Umax (ms)
1	10.705	1.9865	0.235
2	10.6121	1.9693	0.52
3	13.3683	2.4807	0.235
4	13.2442	2.4577	0.515

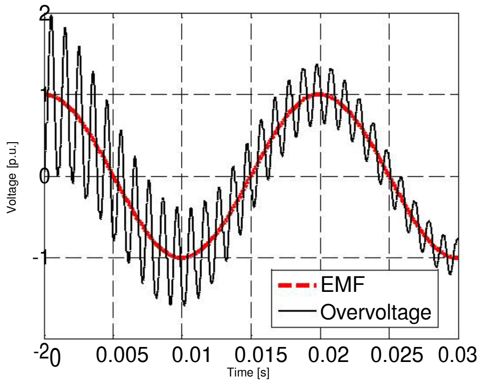

Figure 5. Voltage on cable no. 2

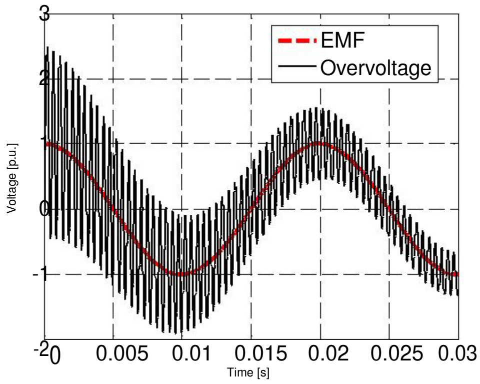

Figure 6. Voltage on cable no. 3

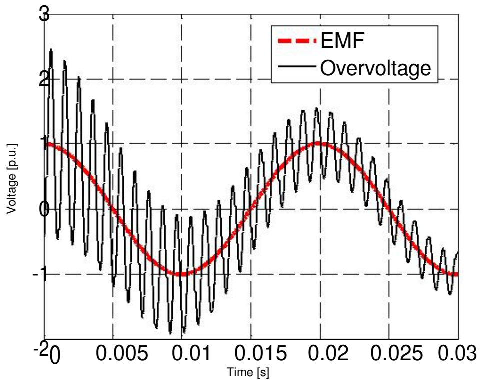

Figure 7. Voltage on cable no. 4

5. ANALYSIS OF THE OBTAINED RESULTS

By using analysis of the results in the table 2 and diagrams on the figures 4 to 7, it can be noticed:

1. Duration of time period from the moment of cable energizing to the moment when overvoltage reaches its maximum value is longer for longer cables.
2. Regardless of cable length, maximum value of overvoltage appears in the first half-period of normal frequency voltage
3. For observed cables and their length ranges, overvoltage values don't depend on cable lengths.
4. However, overvoltage values significantly depend on value of cable residual voltage.

The obtained results can be explained as consequence of decrease of ratio between frequencies ω_1 and ω (normal power frequency). Decrease of frequency ω_1 is caused by increase of overall cable capacity and inductance in the cases when length of cable increases. Decrease of frequency ω_1 causes increase of overvoltage period. From this reason, duration of time period from the moment of cable energizing to the moment when overvoltage reaches its maximum value increase, as well as time that is needed for establishment of stationary state.

6. CONCLUSION

Cable energizing is one of most often-performed operation. From that reason, it is necessary to determine all subsequent consequences in real conditions. In the network for the case of the worst starting (beginning) conditions for this type of switching overvoltages, three times higher value from nominal phase to neutral voltage can appear.

In the paper, the analysis of switching overvoltages originated by cable energizing is performed by using method of Laplasian's transformations. The mathematical model for calculation of switching overvoltages in the network with concentrated parameters is used. From the derived mathematical model of the system and applied method the computer program written in MATLAB, have been made.

The program enables analysis of the switching overvoltages in the case of cable energizing taking into consideration resistance of elements not only on attenuation of transient process, but also on frequency and magnitude of overvoltage wave shape.

The program enables the needed calculations and the graphical presentations of the obtained switching overvoltages, as well as the analysis with the different rated voltages and characteristics of the observed elements – generator, transformer and cable and with different beginning conditions. Program also enables graphical presentation of dependence of overvoltage coefficient on angle of cable energizing in the range from 0 to 360 degrees and dependence of overvoltage coefficient on cable length in range of lengths specified with input data l_{min} and l_{max}.

Examples of calculation of switching overvoltages in the case of cable energizing for 6.6kV cables are illustrated by using this program. Cables with lengths of 200m and 1000m are analyzed as characteristic examples for relatively short and long cable.

Further improvement of program should include cable representation with a number of T-schemes. This will enable calculation of voltages on the beginning and on the end of cable with more accuracy. On that way, obtained results would be compared with results obtained by using other methods for calculation of switching overvoltages that use distributed cable parameters.

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COMPULSORY LIABILITY INSURANCE UNDER CROATIAN MARITIME LAW

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ABSTRACT

The owner of the ship may as a result of its use sustain substantial losses by incurring liability to third parties. Various sources of maritime law impose an obligation on the shipowner or other person operating the ship to have sufficient insurance covering his liability for damage caused by the ship to other persons and property. Moreover, these sources of law impose obligations on the State in whose port the ship enters as well as on the State in whose register the ship is entered to verify the existence of liability insurance cover and to take appropriate measures in respect of ships not covered by such insurance. These sources of law are international agreements to which Croatia is a party, EU regulations and directives as well as Croatian internal laws. All these sources are identified and studied in this paper. Special attention is given to a number of important and recent amendments to Croatian maritime legislation dealing with this subject-matter. Main objectives to be achieved by prescribing compulsory liability insurance are better protection for victims, property and shipowners as well as the elimination of substandard ships. Generally, compulsory liability insurance may be a useful tool to improve the quality of merchant shipping. However, there are some problems related to the implementation of these rules. They are elaborated in the paper.

KEY WORDS

maritime law, marine insurance, compulsory liability insurance of shipowners, direct action, Protection & Indemnity (P&I) Clubs.

1. INTRODUCTION

Contract of marine insurance is a contract whereby the insurer, against the payment of an insurance premium by the insured, undertakes to indemnify the insured, in the manner and to the extent thereby agreed, against marine losses, that is to say, the losses incident to marine adventure[1].

There are three basic types of marine insurance: hull insurance (on the ship and machinery), cargo insurance (on cargo) and liability insurance. Moreover, income from the operation of the ship including freight, charter hire and passenger's fare, expected profit on cargo as well as crew's wages and other remuneration may be subject-matter of marine insurance. One could say that each property which may sustain loss from a maritime peril as well as the liability and expenses arising there from could be subject-matter of marine insurance.

It is desirable for the shipowner, ship operator, carrier or other person using the ship to arrange and maintain appropriate insurance covering their possible liability arising from such use. This insurance cover shall significantly reduce various risks related to the carrying of business. If such professional liability of the person using the ship

[1] United Kingdom Marine Insurance Act, 1906, Section 1. Definitions contained in some other statutes are similar. Croatian Maritime Code, „Narodne novine" ("Official Gazette") No. 181/2004, 76/2007, 146/2008, 61/2011, 56/2013) also contains provisions regulating contract on marine insurance (Articles 684-747.d) but does not explicitly define that type of contract, Drago Pavić: "Pomorsko osiguranje, pravo i praksa, s osnovama kopnenoga i zračnog transportnog osiguranja" ("Marine insurance, law and practice with the basic elements of land and air transport insurance"), Književni krug Split, 2008, p. 81-82.

arises, the insurer shall, directly or indirectly, bear the financial burden and pay damages sustained by third party. Without such insurance cover and in cases of substantial amount of damages, shipowner or other liable person probably should not be able to pay these damages. That may lead to the bankruptcy of the shipowner. Therefore, the third party probably could not be compensated to the amount of damages really suffered or at least not to the amount of damages that could have been compensated if the liability insurance previously has been arranged.

Possible risks and liabilities arising from the use of the ship may be huge. Such liability is therefore in practice not insurable at the standard insurance market. For that reason marine liability insurance for shipowners and other persons exploiting ships is in most cases provided by the Protection and Indemnity Clubs (P&I Clubs), mutual associations of shipowners who, by means of contributions known as calls, provide mutual protection against liabilities related to the exploiting of ships. Shipowners and other persons who contribute to a P&I club are members of that club. Such ships are said to be entered with the club. A certificate of entry shall be issued in respect of such ship. It may serve as evidence that a ship is covered by the club's insurance. Moreover, even some other formal certificates of insurance (like so called *Blue Cards*) may be issued by the club pursuant to provisions of relevant international maritime conventions[2].

One could notice that pursuant to relevant international agreements dealing with maritime law (maritime conventions and protocols), EU regulations and directives as well as under domestic laws in a significant number of states, shipowner or other person using the ship is required to arrange and maintain his liability insurance cover. Without the proof of such insurance cover, a ship may not be entered in the register of ships. Such ship may not operate in ports of a state which law prescribes such compulsory insurance. Moreover, if compulsory insurance cover is missing in respect of a particular ship, competent authorities of the port state may detain such ship. Finally, a fine may be imposed against the shipowner or/and other person responsible for the lack of compulsory insurance cover.

Main reason for introducing compulsory liability insurance is, as it has been mentioned, the concern that claimants will not obtain the compensation due to them because of insolvency of the liable party. Closely associated with this reason is the concern for accessibility: the claimant must be helped to overcome the problems of pursuing a claim against a "paper shipping company" in a remote jurisdiction. The third reason for compulsory insurance is that it is believed that third party providers of insurance cover will contribute to higher standards of ships. If a ship is not seaworthy, it would not get insurance and a compulsory insurance requirement will prevent it from sailing[3].

Various types of compulsory liability insurance are required under provisions of Croatian maritime law. Such provisions may be found in international maritime conventions ratified by Croatia as well as in EU legislation and Croatian domestic laws. All these types of compulsory marine liability insurance under Croatian law shall be elaborated in following chapters.

2. COMPULSORY LIABILITY INSURANCE REQUIRED BY VARIOUS SOURCES OF CROATIAN MARITIME LAW

2.1 Civil Liability Convention 1992

Croatia is a State Party to the International Convention on Civil Liability for Oil Pollution Damage 1992 (CLC 1992)[4]. CLC 1992 provides a

[2] Peter Brode, „Commercial Shipping Handbook", Second edition, Informa, London, 2006, p. 243-244. More on marine insurance and P&I Clubs, see Edgar Gold, Gard Handbook on P&I Insurance, 5th Edition, Arendal, Norway, 2002.

[3] Erik Røseg, "Compulsory Maritime Insurance", Scandinavian Institute of Maritime Law Yearbook 2000, Marius No 258, Nordisk Institut for Sjørett, Oslo. Marine insurance is also very important in respect of the protection of the environment, see Colin de la Rue, Charles B. Anderson, Shipping and the Environment, Second Edition, Informa, London, 2009 as well as: Adriana Vincenca Padovan, "Uloga pomorskog osiguranja u zaštiti morskog okoliša od onečišćenja s brodova", ("The Role of Marine Insurance regarding Protection of Marine Environment from Ship Pollution"), Hrvatska akademija znanosti i umjetnosti (Croatian Academy of Sciences and Arts), Zagreb, 2012.

[4] „Narodne novine – međunarodni ugovori"(Official Gazette – International Agreements") No. 2/1997, 3/1999. CLC 1992 being articles I to XII *ter* of the earlier Civil Liability Convention

uniform set of international rules for determining liability and provide compensation to those who have suffered damage caused by the escape or discharge oil of from ships. CLC 1992 applies to damage caused in the territory and waters of a State Party as well as in exclusive economic zone or, alternatively when such zone is not declared, an area beyond and adjacent to the territorial sea of that state, but not more than 200 nautical miles from the baselines from which the territorial sea is measured. Generally, only oil carried on board is covered by CLC 1992. Bunker oil is covered only if it is carried as a cargo or if it escapes from a convention vessel as defined in Article 1 of the CLC 1992. Liability for damage is strict with some possible exemptions available[5].

Liability is limited and channelled only to the registered shipowner[6]. Therefore, he is the person required to take out the necessary compulsory liability insurance cover required by CLC 1992. More precisely, owner of the ship carrying more than 2,000 tons of oil in bulk as cargo, must maintain liability insurance or other financial security up to the limits required in CLC 1992 for such ship. A formal certificate confirming the existence of such liability cover must be obtained by the shipowner from the maritime authorities of the state of registry and must be kept on board. Liability cover is usually provided by the P&I club.

Provisions very similar to described provisions of CLC 1992 may be found in Article 62 paragraph 1 and Article 820 of the CMC.

1969 as amended by the 1992 Protocol to that Convention. CLC 1992 is in force internationally since May 30, 1996. It is in force in respect of Croatia since January 12, 1999. The current list of states which ratified CLC 1992 and all other maritime conventions elaborated in this paper may be found at http://www.imo.org/About/Conventions/StatusOfConventions/Pages/Default.aspx.

[5] The shipowner may be exempted from liability if he proves hat damage either a) resulted from an act of war, hostilities, civil war or insurrection; b) resulted from a natural phenomenon o fan exceptional, inevitable or irresistible character; c) was wholly caused by an act or omission done with intent to cause damage by a third party; d) was wholly caused by the negligence or other wrongful act of any government or other authority responsible for the maintenance of lights or other navigational aids in the exercise oft hat function.

[6]This protects other service providers (ship managers, charterers, officers and crew members, pilots etc.) from being charged as liable.

2.2 Bunker Convention 2001

International Convention on Civil Liability for Bunker Oil Pollution Damage (Bunker Convention) has been adopted by the International Maritime Organization at London on March 23, 2001. It is in force from November 21, 2008. Croatia is a State Party to the Bunker Convention.

Bunker Convention is modelled on the CLC 1992 system. Liability for pollution from bunkers is channelled to the shipowner, which term, unlike the CLC 1992, includes not only the registered owner but also bareboat charterer, operator or manager of the polluting vessel. The scope of application covers only pollution damage in the territory, territorial sea or exclusive economic zone of states that have accepted the convention. Liability of shipowner is strict with exemptions similar to CLC 1992 exemptions. His liability is limited but, unlike the CLC 1992, there are no separate provisions on liability figures. Instead, claims under Bunker Convention will fall to be limited under any applicable national or international general limitation of liability regimes, such as the Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1996) and respective 1996 Protocol. Croatia is a State Party to both mentioned international instruments.

For ships over 1,000 gross tons, the registered owner, but not the other persons falling within the definition of "owner", must maintain insurance equal to the amounts of liability under the applicable national or international limitation regime applicable in the flag state, but not exceeding the limits in the LLMC 1976, as amended[7]. Obligations regarding formal certificate confirming the existence of insurance cover are similar to those prescribed by CLC 1992[8].

CMC in Article 62 paragraph 3 and 4 as well as in Articles 823.a-823.f contains provisions similar to described provisions of Bunker Convention[9].

[7] Amendments to further increase the limits of liability in the 1996 Protocol to the LLMC 1976 were adopted by the Legal Committee of the International Maritime Organization (IMO), when the Committee met for its 99th session in London. The new limits are expected to enter into force 36 months from the date of adoption, on April 19, 2015, under the tacit acceptance procedure.

[8] Supra, Chapter 2.1.

[9] By 2013 Amendments to CMC subject-matter of bunker oil pollution liability is systematically and precisely regulated.

2.3 2002 Athens Convention and Regulation (EC) No 392/2009 - Liability for Passengers

Since 1996, the Legal Committee of IMO has discussed proposals to further amend the 1974 Athens Convention relating to the Carriage of Passengers and Their Luggage by Sea (Athens Convention)[10]. As a result of these efforts, the new 2002 Protocol to the Athens Convention has been adopted. This Protocol together with articles of 1974 Athens convention which are not amended should be read together and referred to as the 2002 Athens Convention.

Date of entry into force of 2002 Athens Protocol is April 23, 2014. Croatia has acceded to this international instrument. On the mentioned date of entry into force of 2002 Athens Protocol, earlier 1974 Athens Convention and respective 1976 Protocol shall cease to be in force in respect of Croatia[11].

The 2002 Athens Protocol establishes a two tier liability system in cases where death of or personal injury to a passenger is caused by a shipping incident. The carrier is liable for the death of or personal injury to the passenger up to the limit of SDR 250,000 per passenger on any individual occasion, unless the carrier proves that the incident resulted from an act of war, hostilities, civil war, insurrection or a natural phenomenon of an exceptional, inevitable and unavoidable character; or was wholly caused by an act or omission performed by a third party with the intent of causing the incident. Therefore, the 2002 Protocol introduces strict liability of the carrier (and performing carrier) for the death of or personal injury to a passenger up to the abovementioned limit (the first tier of liability)[12].

If the loss caused by the shipping incident exceeds the limit of SDR 250,000 per passenger on any distinct occasion, the carrier is further liable - up to a limit of 400,000 SDR per passenger on each distinct occasion - unless the carrier proves that the incident which caused the loss occurred without the fault or neglect of the carrier (the second tier of liability).

For the loss suffered as a result of the death of or personal injury to a passenger not caused by a shipping incident, the carrier is liable if the incident which caused the loss was due to the fault or neglect of the carrier. The burden of proving fault or neglect lies with the claimant. The carrier liability cannot exceed SDR 400,000.

The limits contained in the 2002 Athens Protocol set a maximum limit, empowering - but not obliging - national courts to compensate for death, injury or damage up to these limits. The 2002 Athens Protocol also includes an "opt-out" clause, enabling State Parties to retain or introduce higher limits of liability (or unlimited liability) in the case of carriers who are subject to the jurisdiction of their courts. A State Party, which makes use of this option, is obliged to inform the IMO Secretary General of the limit of liability adopted or of the fact that there is none.

The 2002 Athens Protocol requires performing carriers to maintain insurance or other financial security, such as the guarantee of a bank or similar financial institution, to cover the limits for strict liability under the 2002 Athens Protocol regarding the death of and personal injury to passengers. The limit of the compulsory insurance or other financial security shall not be less than 250,000 SDR per passenger on each distinct occasion. A certificate attesting that insurance or other financial security is in force always has to be on board a ship. A model certificate is attached to the 2002 Athens Protocol.

For the first time in an IMO international agreement, a regional economic integration organization (for example the European Union) may sign the 2002 Athens Protocol[13].

The objective of the 2002 Protocol is to enhance passenger remedy protection. Together, compulsory insurance and significantly increased liability limits could lead to very significant liability

[10] At that time 1974 Athens Convention has already been amended by 1976 (SDR) Protocol and 1990 Protocol. The later has never entered into force.

[11] „Narodne novine - međunarodni ugovori (*Official Gazette - International Agreements*) No 2/2013, 9/2013.

[12] „Carrier“ means a person by or on behalf of whom a contract of carriage has been concluded, whether the carriage is actually performed by him or by a performing carrier. „Performing carrier” means a person other than the carrier, being the owner, charterer or operator of a ship, who actually performs the whole or a part of the carriage.

[13] The European Union acceded to the 2002 Protocol and urged its Member States to do the same). At the same time, the European Union made a reservation in accordance with IMO Guidelines.

on the part of the insurer. The Protection and Indemnity Clubs (P&I Clubs) were strongly opposed to the amounts of liability prescribed in the 2002 Athens Protocol. They particularly pointed out that the prescribed limits are too high, taking into consideration the situation on the insurance market and the danger of catastrophic incidents caused by acts of terrorism or other "acts of war". The problem arises from the fact that 2002 Athens Protocol does not contain explicit provisions reducing carriers' (as well as insurers') liability in cases where death of or personal injury to a passenger is caused by terrorism. Finally, P&I Clubs expressed their unwillingness to cover carriers' liability as set out in the 2002 Athens Protocol. The consequence is that for a long period of time since its adoption, only few states acceded to the 2002 Athens Protocol.

In order to solve the problem, new and lengthy discussions took place under the auspices of IMO, resulting in a new instrument - IMO Reservation and Guidelines for Implementation of the Athens Convention (hereafter - IMO Guidelines) adopted in October, 2006. This document is considered as a non-mandatory *lex specialis* in relation to the 2002 Athens Protocol. IMO Guidelines recommend that States which ratify or accede to the 2002 Athens Protocol should include a reservation concerning a limitation of liability for carriers and a limitation for compulsory insurance for acts of terrorism, taking into account the current state of the insurance market. IMO Guidelines set out new provisions in respect to limits for carrier's liability in respect to the death of or personal injury to a passenger caused by any war risks[14]. Under these provisions, carrier's liability for the death of or personal injury to a passenger caused by war risks (terrorism included) cannot exceed lower of the following amounts:

- 250,000 SDR in respect of each passenger on each distinct occasion; or
- 340 million SDR overall per ship on each distinct occasion.

Under the IMO Guidelines, separate insurance cover is required covering liability for the death of or personal injury to a passengers caused by war risks limited to the abovementioned figures.

Additional insurance is required for covering carriers' liability for the death of or personal injury to passengers caused by non-war risks. This insurance cover must be provided in accordance with the 2002 Athens Protocol.

Regulation (EC) No 392/2009 of the European Parliament and of the Council of 23 April 2009 on the liability of carriers of passengers by sea in the event of accidents (hereafter - Regulation 392/2009)[15] incorporates in EU law provisions of the 2002 Athens Protocol of n (Annex I to the Regulation 392/2009). It also makes binding parts of the IMO Reservation and Guidelines for Implementation of the Athens Convention adopted by the Legal Committee of the IMO (Annex II to the Regulation 392/2009)[16].

[14] War risks include war, civil war, revolution, rebellion, insurrection or civil strife arising there from, or any hostile act by or against a belligerent power, capture, seizure, arrest, restraint or detainment, and the consequences thereof or any attempt thereat, derelict mines, torpedoes, bombs or other derelict weapons of war, acts of any terrorist or any person acting maliciously or from a political motive and any action taken to prevent or counter any such risk, confiscation and expropriation. Under IMO Guidelines, both war and non-war insurance may be excluded subject to the Institute Radioactive Contamination, Chemical, Biological, Bio-chemical and Electromagnetic Weapons Exclusion Clause as well as to the Institute Cyber Attack Exclusion Clause. Furthermore, insurance cover is subject to automatic termination upon the outbreak of war between any of the "Five Power States" (UK, USA, France, the Russian Federation, and the People's Republic of China).

[15] OJ L 131, 28 May 2009, p. 24. The Regulation apply from 31 December 31, 2012 to any international carriage and to carriage by sea within a single Member State on board ships covered by Class A and B in accordance with Article 4 of Directive 98/18/EC, if the ship is flying the flag of or is registered in a Member State, or the contract of carriage has been made in a Member State, or the place of departure or destination, according to the contract of carriage, is in a Member State. In respect of carriage by sea within a single Member State on board ships of Class A, Member States may choose to defer application of this Regulation until four years after the date of its application. In respect of carriage by sea within a single Member State on board ships of Class B, Member States may choose to defer application of the Regulation until December 31, 2018. Some Member States already made such choice like United Kingdom, Italy, Belgium, and Latvia. Regulation applies to ships Class A and B from December 31, 2012 in Croatia, Poland and France. Regulation applies to domestic carriage and Class A, B, C and D vessels from December 31, 2012 in Netherlands, Finland and Denmark. Source: http://www.gard.no/ikbViewer/Content/20663771/Member%20Circular%2008%202012%20Entry%20into%20force%20of%20the%20Regulation%20EC%20No%20392%202009.pdf, February 10, 2013.

[16] The European Union acceded to the Protocol of 2002 to the Athens Convention, see Council Decisions of 12 December

Furthermore, under the Regulation 392/2009 the carrier who actually performed the carriage when the shipping incident occurred shall make an advance payment sufficient to cover the immediate economic requirements proportional to the damage suffered, within 15 days from the identification of the person entitled to damages. In the event of death, this payment shall not be less than EUR 21,000. The provision in respect of advance payment shall apply if the incident occurred within the territory of a Member State, or occurred on board a ship flying the flag of a Member State or is registered in a Member State. It will also apply if the carrier is established within the EU[17].

Pursuant to Article 62 paragraph 5 of the CMC, domestic passenger ship in international carriage as well as foreign passenger ship entering/leaving a Croatian port is required to maintain passenger liability insurance which meets the requirements of the Regulation 392/2009. According to Article 615.a of the CMC, each carrier who actually performs international carriage partly or wholly by a ship entered into Croatian register of ships and who is licensed to carry more than 12 passengers must maintain insurance pursuant to Regulation 392/2009. At the request of the abovementioned performing carrier, a formal certificate shall be issued by the competent harbour master office confirming that such insurance is in force in respect of a particular ship[18].

2.4 Directive 2009/20/EC – Insurance of Shipowners for Maritime Claims

Under Directive 2009/20/EC of the European Parliament and of the Council of 23 April 2009 on the Insurance of Shipowners for maritime claims (the Insurance Directive)[19], owners of ships flying the flag of an EU/EEA State (including non-EU ships), of 300 gross tonnage and above, are required to maintain insurance or other financial security to cover the majority of third party maritime claims of the type described by the 1976 LLMC, as amended by the 1996 Protocol. All EU Member States were obliged to bring into force laws necessary to comply with the Insurance Directive before January 1, 2012.

The Insurance Directive is transposed into Croatian law by 2013 CMC Amendments introducing Articles 62 paragraph 8 and Articles 747.a-747.d. Owners of ships are required to maintain appropriate insurance pursuant to the Insurance Directive. This obligation is imposed to owners of ships flying Croatian flag as well as to owners of foreign ships entering a Croatian port or an off shore objects located in Croatian territorial waters or continental shelf. It is also imposed to owners of foreign ships operating in Croatian internal waters, territorial waters or continental shelf. The existence of the insurance must be proved by one or more certificates issued by its provider and carried on board the ship. Insurance certificate must provide information as prescribed in the Insurance Directive and CMC. Insurance cover provided by members of the International Group of P&I Clubs shall be acceptable as well as other effective forms of insurance (including self insurance) and financial security offering similar conditions of cover. Insurance may be with or without deductibles. If the insurance certificate is not carried on board, a ship shall be detained in Croatian port and an expulsion order shall be issued. This order shall be notified to the Commission, the other EU Member States and the flag State concerned.

2.5 Wreck Removal under 2013 CMC Amendments

CMC Amendments adopted in 2013 introduce a complete new chapter called "Raising and removal of wrecks and sunken objects"[20]. It contains

2011 (2012/2/22/EU and 2012/2/23/EU), OJ L 8, 12.1.2012, p.1-15.

[17] This provision is inspired by the similar provision contained in the 1999 Convention for the Unification of Certain Rules for International Carriage by Air (Montreal Convention). The European Union is a Party to the Montreal Convention. This Convention is implemented in the EU law by the Regulation (EC) No 889/2002 of the European Parliament and of the Council of 13 May 2002 amending Council Regulation (EC) No 2927/97 on air carrier liability in the event of accidents, (2002), OJ L 140, 30.5.2002, p. 2.

[18] These provisions are introduced in CMC by the 2013 CMC Amendments.

[19] OJ L 131, 28.5.2009, p. 128.

[20] Part VIII, Chapter VI. (Articles. 840.a – 840.z) of the CMC. See: Vesna Skorupan Wolff, Adriana Vincenca Padovan, "Kritika važećeg i prijedlog novog pravnog uređenja vađenja i uklanjanja podrtina i potonulih stvari" („A Critical Review of the Positive Legal Regime of the Recovery and Removal of Wrecks and Sunken Objects and the Proposal of a New One"), *Poredbeno pomorsko pravo,* Vol 51, No. 166, 2012, p. 11-77.

provisions regulating administrative and property issues related to the removal of wrecks and sunken objects. Although Croatia is not a State Party to 2007 Nairobi Wreck Removal Convention[21], some CMC provisions are inspired by solutions contained in that Convention.

The owner of the wreck/other sunken object is required to remove it[22].

Owner's liability for damage caused by the wreck is strict with only few exemptions (Act of God, intentional harmful act done by a third party, harmful act of competent public authorities and contributory negligence of the claimant). In case of compulsory removal of wrecks/sunken objects performed by the State, the owner is liable for the costs of locating, marking and removing the wreck[23]. His liability is unlimited.

Owners of a ship of over 300 gross tonnage which is registered in a Croatian ship register is required to take out insurance or other financial security to cover these costs. Insurance cover must at least correspond to the "other claims" liability limits prescribed by LLMC 1976 as amended by 1996 Protocol[24]. A formal document (done in Croatian or English language) confirming existence of such insurance must be carried on board. It must contain information required by the CMC. Insurance cover provided by a member of International Group of P&I Clubs (evidenced by the Certificate of entry) shall be acceptable, as well as other effective forms of insurance and self insurance or other financial security offering similar conditions of cover.

Furthermore, pursuant to Article 62 paragraph 7 of the CMC, owner of a foreign ship of over 300 gross tonnage entering Croatian internal waters or adhering the off shore object in Croatian territorial sea, is required to present evidence on existing insurance coverage for claims related to locating, marking and removal of wrecks. The amount of insurance cover must at least correspond to the "other claims" liability limits prescribed for "other claims" in LLMC 1976 as amended by 1996 Protocol (just the same as in respect of Croatian ships).

2.6 Repatriation of Crew Members

Pursuant to Article 138 of the CMC, if a crew member has been discharged from a ship during his employment on board or after its termination outside his port of boarding, the shipowner must ensure his return to his place of residence (repatriation of a crew member). If the shipowner fails to do so, the return journey to crew member's place of residence shall be secured by the diplomatic or consular office of the Republic of Croatia at the expense of the shipowner from whose ship the crew member has been discharged. Therefore, the costs of the crew member's return journey shall be borne by the shipowner. The shipowner shall be entitled to recourse of expenses from the crew member pertaining to his return journey, when such crew member leaves the ship without authorisation, causing termination of employment, or if he leaves the ship as a consequence of self-inflicted injury or illness caused intentionally or by gross negligence. The expense of a return journey of a crew member shall encompass cost of accommodation, board and transportation of said crew member from the time of discharge from the ship to the time of return to a place of residence[25].

Under the Article 139.a of CMC, a ship operator is required to maintain insurance or other financial security covering repatriation costs of crew members. Furthermore, a ship operator must ensure that rules on crew members rights regarding repatriation are on board and available. This rules must be drafted in English or other official language used.

These CMC provisions represent implementation of

[21] The Nairobi International Convention on the Removal of Wrecks, 2007, was adopted by a diplomatic conference held in Kenya in 2007. It provides the legal basis for States to remove, or have removed, shipwrecks that may have the potential to affect adversely the safety of lives, goods and property at sea, as well as the marine environment. The Nairobi Convention has not entered into force yet.

[22] If the wreck or other sunken object is not removed for the period of two years from the date of it's sinking, it shall become property of the Republic of Croatia.

[23] The removal of a wreck or other sunken object is compulsory if such object represents a danger for the safety of navigation or environment.

[24] „Other claims" are claims different from the claims for the death or personal injury. Therefore, insurer's liability in respect of wreck removal costs is limited.

[25] The return journey shall also be deemed as provided if a suitable task has been ensured for the crew member on a ship bound for his port of boarding. In such a case, a crew member shall be entitled to payment for the tasks completed on board, see Articles 138-141 of CMC.

the 2006 Maritime Labour Convention (MLC). Croatia is a State Party to MLC[26]. This liability insurance is commonly provided by standard P&I Club insurance, just the same as shipowner's liability for sickness, injury or a death of a crew member[27].

2.7 Liability of Nuclear Ship Operators

CMC contains provisions on the liability of the operator of a nuclear ship for the nuclear damage (Articles 824-840)[28]. He is exclusively liable for the nuclear damage. His liability is strict with some exemptions (if the damage is caused by war, hostility, civil war, rebellion, contributory negligence of the claimant). Liability is limited to the amount of SDR 100 million[29]. However, when a foreign state whose flag the nuclear ship flies provides a higher limit of liability, the operator shall be liable up to said higher limit.

Nuclear ship operator is required to maintain insurance, or other financial security covering his liability for nuclear damage. Amount of such insurance must cover prescribed limit of operator's liability[30].

2.8 Liability of Boat and Yacht Owners to Third Parties

Liability of boat and yacht owners for the death of or personal injury to a third party is regulated by the CMC (Articles 808-810). Principles of such liability vary depending on the location and the nature of the incident occurred.

However, compulsory liability insurance for described damages in respect of boat and yacht owners is prescribed by Articles 41-42 of the Law on Compulsory Traffic Insurance[31]. Pursuant to these provisions, the owner of a boat or a yacht with engine power exceeding 15 kW, which is entered in the appropriate boat or yacht register pursuant to registration regulations, is required to maintain insurance covering his liability to a third party in the event of death, bodily injuries or health hazard due to the use of the yacht/boat[32]. The minimum amount of the insurance cover is HRK 3,5 million (app. 460 000 €) per incident (harmful event). This sum may be raised pursuant to the decision of the Croatian Government made upon the proposal of the Croatian Financial Services Supervisory Agency.

This liability insurance is also compulsory in respect of the owners of foreign boats/yachts entering Croatian territorial sea.

3. ENFORCEMENT OF THE COMPULSORY LIABILITY INSURANCE

There are at least three very important elements, "legislative weapons" for the successful enforcement of provisions on compulsory liability insurance. The first one is so called "direct action"- *action directa*, the right of a third party who has a liability claim against an insured to proceed directly by suit against the insurer. The second one is the

[26] MLC has entered into force on August 20, 2013. For the list of ratifications, see http://www.ilo.org/dyn/normlex/en/f?p=1000:11300:0::NO::P11300_INSTRUMENT_ID:312331, page visited on February 10, 2014.

[27] Shipowner's liability for death, injury of sickness of a crew member is regulated by Article 145 of the CMC. There is no provision in CMC requiring compulsory insurance in respect of such liability. However, if such insurance cover is actually in force, the direct action against the liability insurer is allowed (Article 743 paragraph 2 of the CMC).

[28] "Nuclear damage" means loss of life or personal injury and loss or damage to property which arises out of or results from 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. "Operator" means the person authorized by the licensing State to operate a nuclear ship, or where a State itself operates a nuclear ship, that State.

[29] SDR, Special Drawing Right, is an international value used to provide a regular comparative evaluation by the International Monetary Fund of the currency of member nations. Value of a national currency will rise in SDR as the value of the national currency rises on the world market, see: www.imf.org, page visited on February 10, 2014.

[30] Public nuclear chips owned by a State are exempted from such obligation.

[31] „Narodne novine" („Official Gazette") No. 151/2005, 36/2009, 75/2009, 76/2013). Although one could say that this Act is not a source of (only) maritime law, abovementioned insurance is without and doubt marine insurance.

[32] The term „third parties" does not include persons on board the yacht/boat causing the damage. Moreover, this term does not include persons who sustained damage while being on the sailing object other than the yacht/boat which caused the damage.

effective system of inspections of ships carried out by competent flag sate and port state authorities. Finally, the third element is related to fines imposed against shipowners and other persons who have not fulfilled their obligations in respect of maintaining liability insurance. Each of three mentioned elements shall be briefly elaborated in following chapters.

3.1 Direct Action (*Actio Directa*)

Pursuant to Article 743 paragraph 2 of CMC, a party suffering damage may claim damages directly from the liability insurer if the insured is liable for damages and up to the insured amount. However, this direct action against insurer is allowed only in two types of cases:

a) when such right of direct action is explicitly prescribed; or

b) in respect of liability for death, personal injury or health deterioration of a crew member[33].

Therefore, the right to direct action is not "automatically" allowed for compulsory liability insurance. It should be explicitly prescribed for a specific type of insurance. Under CMC such right is not explicitly prescribed in respect of insurance of shipowners for maritime claims[34] and of insurance for repatriation of crew members[35] It is worth to mention that direct action is not prescribed under relevant EU and international sources dealing with these types of insurance - Directive 2009/20/EC in respect of shipowner's liability for maritime claims and MLC in respect of liability for the repatriation of crew members. For other types of compulsory liability insurance prescribed in CMC and relevant international maritime conventions direct action is explicitly allowed[36].

In a case of a direct action against insurer, he is entitled to limit his liability (even if insured party has lost such right). He may further avail himself of the defences (other than the bankruptcy or winding up of the assured) which the assured would have been entitled to invoke. Furthermore, the insurer may avail himself of the defence that damage resulted from the wilful misconduct of the assured, but the insurer shall not avail himself of any other defence which he might have been entitled to invoke in proceedings brought by the assured against him.

Direct action against insurer in respect of liability insurance of boat and yacht owners for the damage caused to third parties is allowed pursuant to Article 11 of the Law on Compulsory Traffic Insurance.

3.2 Compulsory Liability Insurance and Inspections

Pursuant to Articles 165-178 of CMC, inspection of foreign ships in the ports of the Republic of Croatia shall be conducted in compliance with the procedures established by the Paris Memorandum of Understanding on Port State Control. While conducting an inspection of a foreign ship, it shall be established whether the ship is in possession of valid documents with regard to the provisions of *inter alia* international conventions and EU regulations and directives elaborated in this paper. Therefore, competent Croatian authorities shall check the existence on board of prescribed insurance certificates. These rules apply equally to Croatian ships and other maritime objects. In case that some certificate is missing on board, such a ship shall be detained. All other measures provided in Paris Memorandum may be taken too. Generally, it could be concluded that such a ship shall be deemed to be unseaworthy.

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[33] Abovementioned provision is introduced by CMC 2013 Amendments. Before this amendment, under CMC direct action was permissible in respect of any compulsory insurance or (voluntary) liability insurance for crew members.

[34] *Supra*, Chapter 2.4. Moreover, Article 747.d of CMC explicitly prescribes that direct action is not allowed in respect of compulsory insurance of shipowner liability, except in cases when this insurance is prescribed as compulsory by some other CMC provision (for example, compulsory passenger liability insurance).

[35] *Supra*, Chapter 3.5.

[36] It should be noted that, under Article 982 of CMC, in the disputes with international elements, the existence of the right to direct shall be judged pursuant to the law applicable to the obligation in question or law applicable to the insurance contract. Such provision is in line with the Regulation (EC) No 864/2007 of the European Parliament and of the Council of 11 July 2007 on the law applicable to non-contractual obligations (Rome II), Article 18.

3.3 Fines

Pursuant to Article 1016.e of CMC, an owner, operator or a company of a ship operating without certificate or other document evidencing existence of compulsory insurance cover in respect of such a ship, shall be charged with the fine of HRK 50.000 to HRK 150.000 (app. 6.600 -19.800 €). The master of such a ship and the responsible person in shipping company shall be charged with the fine of HRK 5.000 to HRK 15.000 (app. 660 - 2.000 €)[37].

4. CONCLUSIONS

Various sources of Croatian maritime law (international conventions, EU legislation and domestic laws) contain provisions on compulsory liability insurance of shipowner and other persons operating the ship. One could notice that a number of types of compulsory liability insurance are significantly increasing. Compulsory liability marine insurance, being a specific type of professional insurance, becomes legislative and practical standard in commercial shipping. The aim of the compulsory liability insurance is to ensure better protection for victims. It should also contribute to the elimination of substandard ships as well as to the establishing more effective competition between ship operators. Three important elements may be (and in most cases they are) included in the concept of compulsory liability insurance: direct action against insurer, inspection of ships by port states and flag states authorities and effective system of fines in cases when rules on compulsory insurance are not respected. The crucial role in respect of providing such insurance is played by the P&I Clubs. Therefore, each future step in this area should be taken only with due coordination between states, international shipping community and P&I Clubs. CMC and other Croatian domestic laws are in line with applicable international conventions, EU laws and widely accepted legislative standards dealing with this subject-mater.

[37]Special provision on fines for shipmaster is prescribed by Article 1001 paragraph 1 in respect of ship carrying more than 2,000 tons of oil which does not possess an insurance certificate or other financial security covering liability for damages caused by oil pollution when it enters or leaves a Croatian port or when it loads or unloads oil. The amount of fine is HRK 5.000-50.000. Generally, system of fines has to be established pursuant to obligations contained in international conventions and EU legislation. For example, see Article 7 of Directive 2009/20/EC.

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USING ANALOGY TO EXPLAIN CHEMICAL EQULILIBRIUM TO PARTICIPANTS OF THE SPECIAL EDUCATION PROGRAMME FOR SEAFARERS

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ABSTRACT
A model of lifelong learning known as Special education programme for seafarers has been offered by Croatian universities from March 2011. It is an alternative programme which enables participants to meet requirements for the award of vocational competency certificates for the highest ranking positions on board the ships. According to IMO model programmes Special education programme for seafarers in marine engineering contains course Fuels, Lubricants and Water. One of the topics covered in the course is industrial water treatment. Participants have practical experience in the field and they are familiar with significance of achieving the adequate water quality, water pH being one of important parameters. However, to the question why is necessary to adjust pH of boiler water, participants answer that water becomes acidic at higher temperatures. In order to rectify this spread misconception, concept of chemical equilibrium has to be introduced. In this paper we propose the use of analogy in order to qualitatively explain temperature dependence of ionic product of water to students who graduated from high school some time ago and therefore may have insufficient background in chemistry.

KEY WORDS

maritime education, teaching/learning chemistry to maritime students, boiler water treatment, chemical equilibrium.

1. INTRODUCTION

One of the enrolment requirements for Special education programme for seafarers in marine engineering is a minimum of 36 months of aggregated sea service as an engineer officer in charge of a watch in the engine room with the machine propulsion power of 750 kW or more. Therefore participants belong to so-called non-traditional students since they delay enrolment (do not enter postsecondary education in the same calendar year that they finished high school). Only 4 % of 73 participants who completed programme until 2014 graduated less than 10 years ago before the enrolment, with averagely 21 years of pause in formal education. Using the criterion of age, they are „adult learners“, because they are 25 or older. The average age of participants at the beginning of the programme was 40 years. Adult learners' characteristics are different from those of the traditional students and faculty in higher education has a responsibility to expand their repertoire of teaching methods [1]. The usage of analogies has been recognised as one of the successful teaching methods for adults [2].

The actual sophisticated ship technology based on the automatisation of processes requires understanding of all the segments of ship exploitation. Basic knowledge of natural, technical and information sciences provides the understanding of these processes, needed for the management level. Such knowledge enables higher degree of professionalism as well as the alternative thinking which surpasses the operational understanding of a process.

Special education programme for seafarers in marine engineering does not contain Chemistry course. However, basic knowledge of chemistry is important for studying the specialised courses needed for profession in an efficient way. Since students have spent at least 3 years on board the ship, they are familiar with practical aspects of water treatment. The goal of the course Fuels, Lubricants and Water is to correlate their experience and basic science.

Understanding the physical and chemical properties of water is essential for grasping why certain chemicals and procedures are used. One of the major elements of boiler water treatment is maintaining boiler water pH slightly alkaline to control corrosion. The acid-base behaviour of water is related to the chemical equilibrium, central concept to quantitative discussion of most chemical phenomena. At the same time, chemical equilibrium has been considered as one of the most difficult chemistry concepts to learn [3]. It is a complex concept which cannot be mastered unless numerous concepts such as mole, concentration, stoichiometry, physical behaviour of gases are fully understood.

Use of analogy is one of the ways to accomplish basic understanding of the chemical equilibrium [4,5]. Analogies enable chemical concepts to be conveyed in a form that students can relate to. They provide visualisation of abstract concepts, help students to build conceptual bridges between new information and what they already understand and they motivate students to actively participate in the learning process. It is important to select a familiar domain ("analog" domain) with objects related to each other in the same way as objects in the domain to be learned ("target" domain). In order to be efficient teaching method, the analogy has to be accepted by students who must have prior knowledge of the "analog" domain [6].

2. A COMMON MISCONCEPTION: IF PH OF WATER IS 7, WATER IS NEUTRAL

Water is amphiprotic, water molecule may act as an acid by donating a proton to another water molecule acting as a base. It is an example of an autoprotolysis equlibrium:

$$2H_2O \rightleftarrows H_3O^+ + OH^- \quad (1)$$

Two reactions are proceeding, one to the right (formation of hydronium ions and hydroxide ions from water) and the other to the left (hydronium ions and hydroxide ions react to form water). The change from left to right in the equation is called the forward reaction, and the change from right to left is the reverse reaction. At the beginning of a reversible process reactants react to form products. The amount of reactants decreases and consequently the forward reaction slows down. At the same time the product amounts increase and the reverse reaction speeds up. Eventually the rates of forward and reverse reactions become equal. The system has reached equilibrium: both, reactant (water) and products (hydronium and hydroxide ions) are present but their concentrations no longer change with time. Although apparently nothing happens since there is no net change, the chemical equilibrium is a dynamic process in which both reactions are occurring, but changes in one direction are balanced by changes in the other.

Like any other equilibrium process, autoprotolysis of water can be described quantitatively by an equilibrium constant, in this case autoprotolysis constant**.** Autoprotolysis constant is given by the following expression:

$$K = \frac{a(H_3O^+)a(OH^-)}{a(H_2O)} \quad (2)$$

where a is the activity, a kind of "effective" concentration. Water activity is almost exactly one and in very dilute aqueous solutions, activities can be replaced by concentrations. In pure water no other ionization processes are significant and the term autoprotolysis constant is synonymous with 'ionic product', K_w [8]:

$$K_w = [H_3O^+]\ [OH^-] \tag{3}$$

Value of ionic product of water provides information on composition of equilibrium mixture. In pure water, for every hydronium ion formed, there is a hydroxide ion formed as well, so concentrations of H_3O^+ and OH^- are equal. Therefore $[OH^-]$ term in the K_w expression can be replaced by $[H_3O^+]$ or $[H^+]$ since hydronium ion is often shown simply as H^+:

$$[H^+]^2 = K_w \tag{4}$$

Magnitude of H_3O^+ concentration in aqueous solutions can vary over a wide range from 10 mol dm^{-3} to 10^{-15} mol dm^{-3}. To express values more conveniently, pH scale is extensively used, where

$$pH = -\log_{10} [H^+] \tag{5}$$

By taking logarithms of the expression (4), we get:

$$pH = ½\ pK_w \tag{6}$$

At 25°C value of pK_w is 14 and the calculation produces well known value of 7 for neutral pH. When a system at equilibrium is disturbed by a change in concentration of one of the components (adding or removing hydronium or hydroxide ions) at certain temperature, system responds in a way that tends to minimize the effect of the disturbance. The equilibrium concentrations of components change, but value of the equilibrium constant does not change. Addition of hydroxide ions will cause a shift of equilibrium position, equilibrium mixture will contain less hydronium ions, but their product remains 1×10^{-14}.

Unlike the changes in concentration, volume and pressure, temperature affects equilibrium constant. Ionic product of water increases as temperature increases. However, regardless the temperature, in the case of the pure water always the same number of hydronium ions and hydroxide ions are present and water remains neutral. The neutral value of pH is calculated from $K_{w,}$ meaning that at higher temperatures neutral pH is lower than 7. For example, at blood temperature, 37°C, when pK_w is 13.68 neutrality corresponds to pH = 6.84, and at 100°C, neutral pH is 6.14 [7]. Associating neutrality with pH 7, acidity with pH lower than 7 and alkalinity with pH higher than 7 is widely spread, and even in some textbooks about industrial water treatment, wrong statement that water becomes acidic at higher temperatures appears.

3. DESCRIPTION OF THE ANALOGY

Three key aspects of chemical equilibrium: incomplete reaction, reversibility and dynamics are difficult for students to understand [9]. Consequently, many misunderstandings are observed. Students often believe that at equilibrium the concentrations of the reactants and products are equal, that the rate of the forward reaction increases with time until the equilibrium is established, they fail to discriminate between rate and extent and demonstrate an inability to judge how equilibrium constant changes with temperature.

A full grasp of the chemical equilibrium concept is possible only if students have studied chemical thermodynamics which is not a part of marine engineering curriculum. Furthermore, thermodynamics treatment demands dealing with mathematical formulas, against which the majority of students show great resistance [10]. Also, introducing the concept by focusing on low-level details can make understanding of the concept more difficult due to the perceived complexity and chemistry jargon and it is unlikely to be interesting. Hence a kinetic introduction of chemical equilibrium has been used.

In order to increase the effectiveness of teaching chemical equilibrium, a number of analogies (dancing couples, two groups throwing the balls/apples back and forth, fish between two aquariums, bees in a beehive, sugar in tea, busy highway being some of them), suitable for different student population have been proposed over the years [5,11].

Analogy presented here is developed by Marin Becerra *et al*. [12]. Familiar domain is a system of two interconnected containers filled with water. This “hydraulic” analogy is appropriate since students are familiar with basic physical and mechanical properties of liquids used to illustrate

chemical behaviour. Original familiar domain is slightly adapted to a system of two interconnected barrels filled with rum. A daily tot of rum has been handed out to all seafarers by Royal Navy for more than 300 years and it is a well known naval tradition [13].
The rate of rum flowing into and out of barrels can be mapped to the forward and reverse rates of a reversible chemical reaction [12]. The rate of a chemical reaction can be expressed in a simplified form:

$$V = k\,R \tag{7}$$

where k is the rate constant and R is the overall concentration of reactants.
Similarly, the rate of rum coming out through the tube is proportional to a constant related to the cross section of the tube, q and height of the rum in the barrel, h:

$$V = q\,h \tag{8}$$

In a blackboard drawing (Figure 1) two barrels drain into each other at the same time which could not happen in reality, but students are aware of that from experience.
The rate of draining of fully filled barrel will be the highest at the beginning and will decrease as the liquid height decreases, similarly to the rate of forward reaction. The rate of draining of the initially empty barrel will increase as liquid level increase, similarly to the rate of reverse reaction [12]. Eventually both barrels will be filled and drained at the same rate and, likewise no change in concentration of reactants and products at equilibrium is being observed, the amounts of liquid in each barrel are different, but stay the same. Furthermore, each barrel is drained and filled simultaneously; rum circulates between two barrels so the process is dynamic.

Figure 1. Illustration of the chemical equilibrium by two barrels filled with rum circulating between them. Once the equilibrium has been reached, the amount of rum in the barrels remains constant.

To illustrate the effect of adding or removing reactants or products from system at equilibrium, discussion about effect of removal or addition of rum from barrels can be used [12]. Removal of rum from the top of one barrel will decrease the speed of its draining in comparison with the speed of its filling. Consequently the level of rum in that barrel will increase and the level in the other barrel will decrease until new equilibrium state is attained.
A change in temperature influences the rate of chemical reactions. The rates of most chemical reactions increase as the temperature rises. An increase of temperature will lead to increase in rates of both reactions (water dissociation and formation of water), but not to the same extent. Dissociation of water is an endothermic process, it absorbs heat, and formation of water from hydronium ions and hydroxide ions is an exothermic process, it releases heat. At equilibrium at a certain temperature, the heat effect is zero. The increase in temperature favours the endothermic direction. Consequently, at higher temperatures equilibrium concentrations of hydronium ions and hydroxide ions both rise in comparison to concentrations at room

temperature, leading to higher value of the equilibrium constant.

In familiar domain [12]., if two barrels contain the same amount of liquid, the barrel with the wider tube will drain faster. Widening both tubes will increase both draining rates, just as increase of temperature will increase the rates of both reactions, but effect will be more pronounced for barrel with bigger difference in constant q. Uneven shifting of q will change the original ratio of rum levels, which corresponds to the value of equilibrium constant.

4. CONCLUSIONS

With the increasing number of non-traditional students, faculty in higher education has a responsibility to use different approach to teaching in order to achieve effective learning. Knowledge of basic chemical concepts related to professional practices provides students with a solid background and enables them to understand practical procedures. The usage of analogy is an appropriate teaching method for adults. The analogy proposed here could facilitate understanding of chemical equilibrium, essential for understanding many other topics in chemistry, acid-base behaviour being one of them.

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SIMULATION OF IMPORTANT FACTORS' IMPACT IN THE CHOICE OF DIELECTRIC MATERIAL FOR MARINE APPLICATIONS

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ABSTRACT

In maritime's practice, dielectric materials, as a part of ship's systems, are under significant influence of different factors. The most influential factors, which are responsible for material's selection, are the area of application, operating frequency range, predictable temperature range and moisture of the environment (operating atmosphere). If other less important factors are in tolerable/acceptable range, it is necessary to select optimal material based on dominant influential factors. Based on the fact that dominant factors contribute directly to the value of the relative dielectric constant (permittivity), and the relative dielectric constant is the material's characteristic, a material is numerically represented by the value of it. Numerical simulation of the mentioned factor's influence to the complex relative dielectric constant is simulated in the paper. Program package Octave (compatible with Matlab) is used for the simulation.

KEY WORDS

dielectric materials, complex relative dielectric constant (complex permittivity), material's selection.

1. INTRODUCTION

Dielectric materials are widely used in maritime technology. Primary function of dielectrics is to be used for electric insulation, from electronics to electrical machines and energy distribution. Dielectrics are used in fiber optics communication and internet systems, as liquid crystals in LCD technology, as substrate and packaging of integral and electronic circuits. Furthermore, some materials exhibit dielectric properties, such as piezoelectric ceramics.

Impact of different parameters to dielectric materials was scope of many references. In this paper, there are divided by parameters of their scope.

The moisture's impact to dielectrics is researched in [1 – 6]. Due to moisture in marine environment, it is important to understand how chemically-adsorbed moisture degrades the reliability performance and the electrical properties of the dielectrics in order to prevent problems or to include in the design process tolerance for such occurrences.

Frequency was in the scope in [7 – 13]. Temperature, as a single parameter, was in interest of research in [14, 15].

Since dielectrics can be under the influence by multiple factors at the same time, there were researches, which considered influence of the combinations of factors. Combination of temperature and frequency impact to dielectric's properties is considered in [16 – 18]. Combination

of moisture and frequency was considered in [19 – 21].
It can be seen, from various titles that research interests are very dispersed and depend on the application. There are no general considerations.
The benefits of inclusion of the impact factors to design of dielectrics are economical, and in prevention of casualties and environmental damage.
In this paper, impacts of moisture, temperature and operating frequency to complex relative dielectric constant are simulated in Octave software.

2. DIELECTRIC CONSTANT EXPLICIT DEPENDENCIES ON DOMINANT FACTORS WITH CORRESPONDING SIMULATIONS

Dielectric properties of materials depend on many factors. Due to marine environment specificity, it is important to study which factors dominantly contribute to dielectric constant in maritime affairs and how.
Operating frequency depends on application. Frequencies of fields that penetrate dielectrics are high (kHz to GHz range) in communication equipment. However, power supply is usually at low frequencies (50 or 60 Hz). Therefore, the conclusions made for one application do not coincide with the conclusion made for the other application. Furthermore, different models for simulation and different equivalent circuits are used for different frequency ranges.
Another important factor is temperature, which can vary even in the same product due to heat from operation and influence of the environment.
Moisture is candidate for consideration as well. Moisture can chemically degrade material's properties.

2.1. Impact of frequency to complex relative dielectric constant

There are to usual ways to describe frequency dependence of dielectric constant: Cole-Cole plot or Debye equations.
It can be said that Debye equations are actually an attempt to describe the frequency response of the complex relative permittivity of a dipolar medium through the use of a single relaxation time, τ, to describe the sluggishness of the dipoles driven by the external AC field.
Real and imaginary part of complex relative dielectric constant is expressed according to Debye [1, 22, 23]:

$$\varepsilon'_r = \varepsilon_{r\infty} + \frac{\varepsilon_{rDC} - \varepsilon_{r\infty}}{1+(\omega\cdot\tau)^2} \tag{1}$$

$$\varepsilon''_r = \frac{(\varepsilon_{rDC} - \varepsilon_{r\infty})\cdot(\omega\cdot\tau)}{1+(\omega\cdot\tau)^2} \tag{2}$$

where ε'_r and ε''_r are real and imaginary parts of the complex relative dielectric constant, $\varepsilon_{r\infty}$ the value of relative permittivity at the frequencies where other polarization mechanisms are negligible except electronic, ε_{rDC} the value of relative permittivity at DC electric field, relaxation time $\tau = \frac{1}{\omega_r}$ and ω_r is the resonant frequency of the material.
Cole-Cole plot is a custom way to visualize frequency dependence of imaginary and real part of the complex relative dielectric constant. Figure 1 shows the example of Cole-Cole plot obtained in Octave/Matlab program package for ceramic material $La_{0.7}Sr_{0.3}MnO_3$. The frequency range taken for calculations is between 10 Hz and 60 MHZ. Resonant frequency of the material is 6 kHz. Relative permittivity under DC field is 3.6 and at high frequencies ($\varepsilon_{r\infty}$) 2.58.
This theory can be, in some cases, modified to fit the characteristics of specific group of materials. Since ceramics are used more every day, it is logical to try to fit such materials to Debye's theory.
In [23], the Debye equations are modified to fit ceramic characteristics with distribution of relaxation times *g(ln τ)* to expressions (3) and (4):

$$\varepsilon'_r = \varepsilon_{r\infty} + \left(\varepsilon_{rDC} - \varepsilon_{r\infty}\right)\int g(\ln\tau)\cdot\frac{1}{1+(\omega\tau)^2}\,d\ln\tau \quad (3)$$

$$\varepsilon''_r = \left(\varepsilon_{rDC} - \varepsilon_{r\infty}\right)\int g(\ln\tau)\cdot\frac{(\omega\cdot\tau)}{1+(\omega\cdot\tau)^2}\,d\ln\tau \quad (4)$$

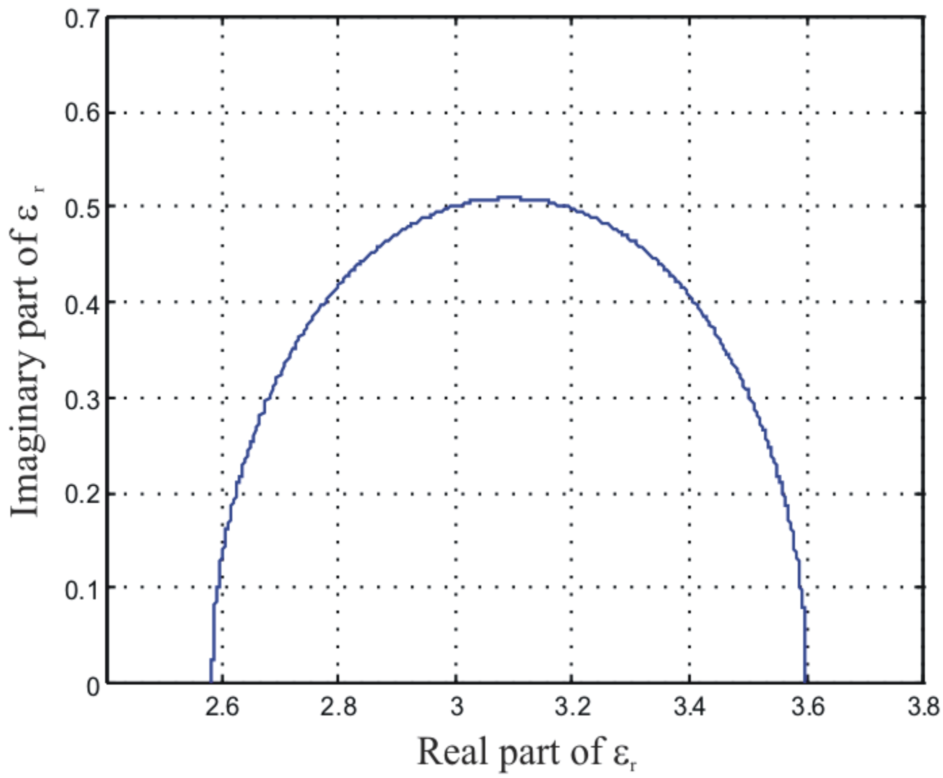


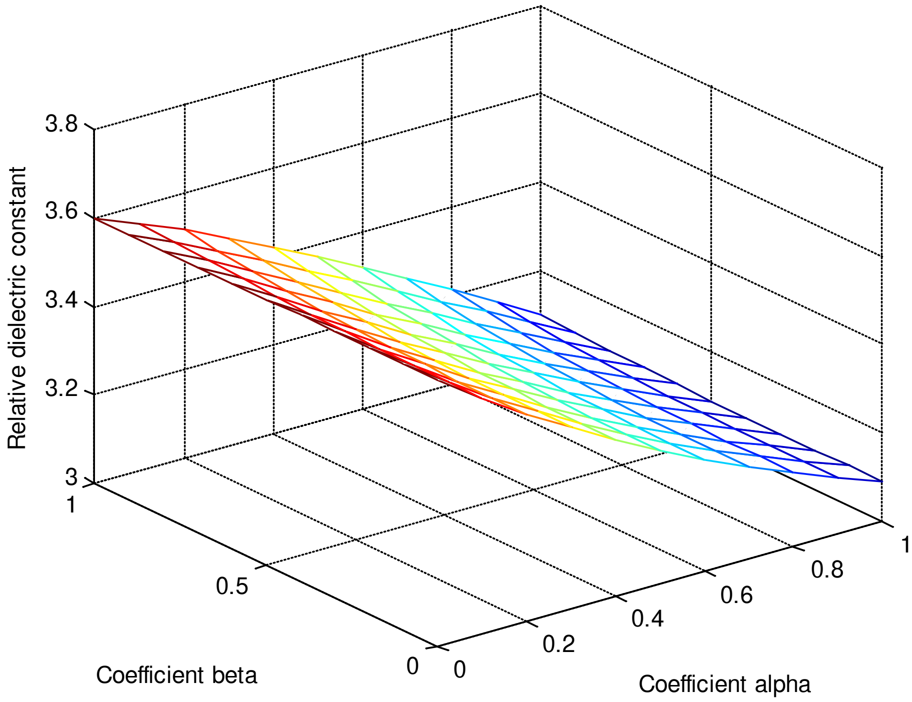
Figure 1. Simulation result presented as Cole – Cole plot of ceramic material $La_{0.7}Sr_{0.3}MnO_3$

From equations (3) and (4), it can be concluded that:
- if $\omega\tau$ << 1, the relaxation process does not contribute to dielectric loss,
- if $\omega\tau$ >> 1, the relaxation process does not contribute to real or imaginary parts of dielectric constant, and
- if $\omega\tau \sim 1$, the relaxation process contribute to both real and imaginary part of relative permittivity.

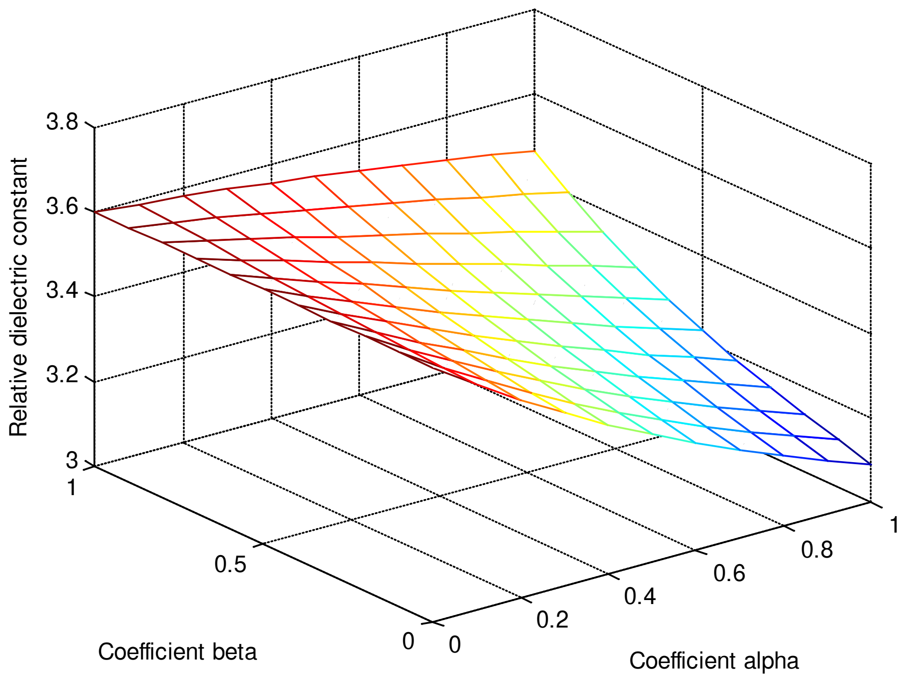
Furthermore, cases of materials with nearly Debye relaxation are not the only ones. In order to cope with polymer dielectrics, which have more than one relaxation peaks, Debye equations were modified to:

$$\varepsilon_r = \varepsilon_{r\infty} + \frac{\varepsilon_{rDC} - \varepsilon_{r\infty}}{\left[1+(j\omega\cdot\tau)^{\alpha}\right]^{\beta}} \quad (5)$$

where solution for real and imaginary parts depends on constants α and β, which are typically less than 1. If $\alpha = \beta = 1$, the Debye relaxation law is respected. For $\alpha = 1$ and $\beta \neq 1$, the Cole-Cole exponential relaxation law is obtained. Effects of α and β to relative dielectric constant are simulated for this research as well: figure 2 shows the results of modified Debye equations simulation for all combinations of α and β.



a)



b)

Figure 2. Simulation results for modified Debye equations: a) f = 40 kHz, b) f = 16 kHz

Figure 2.a shows the results of numerical experiment in 3D graph for 40 kHz and figure 2.b for 16 kHz.
Simulation data are for the ceramic material mentioned in the previous simulation.

2.2. Impact of temperature to complex relative dielectric constant

Impact of temperature can be included in different manners. Typically, it is included through τ. If temperature dependence of τ is known, then it is possible to calculate ε_r at any temperature.
Another way to calculate temperature impact is through *g (ln τ)* in (3) and (4). At low temperatures, *g (ln τ)* decreases with decreasing temperature. At high temperatures, *g (ln τ)* is almost zero. Near relaxation peaks, *g (ln τ)* increases with decreasing temperature.
Since infrared range is vital for optical communications, it is obvious that fiber optic materials' properties are interesting for the research [15]. However, optical characteristics are in relationship with dielectric properties and can be explicitly linked with relative dielectric constant. For example, a reflectivity spectrum is given with [15]:

$$S(\omega)=\frac{\varepsilon(\omega)-1}{\varepsilon(\omega)+1} \quad (6)$$

where ε (ω) represents dielectric function. Temperature dependence can be expressed through $\varepsilon_{r\infty}$ as:

$$\varepsilon_{r\infty}(T)=\varepsilon_{r\infty}(T_0)+e\cdot[T-T_0] \quad (7)$$

where *e* is a constant coefficient and T_0 a reference temperature.

2.3. Impact of moisture to complex relative dielectric constant

Moisture also influences the dielectric constant. Since in electrical applications dielectrics are usually considered to be in hermetic conditions, there are no direct researches about moisture influence to the value of the dielectric constant of the electrical products. However, raw material, such as different soils, is considered in many researches. It is our assumption that the raw material exhibits the same properties as the final product made from it.
As shown in [20], the real part of the dielectric constant increases exponentially with moisture percentage. Tangent of dielectric loss or imaginary part of dielectric constant increases linearly with volumetric moisture content.
Results from [18], shows that electromagnetic transparency increases by drying the material and that transmitted power decreases if moisture increases, which can be directly linked to the dielectric constant. It was shown that in i.e. X-band exists direct relation between moisture and dielectric constant, expressed with:

$$\text{Real}\ (\varepsilon_r) = 3.95\exp(2.79Mc) - 2.25 \quad (8)$$

$$\text{Imag}\ (\varepsilon_r) = 2.69\exp(2.15Mc) - 2.68 \quad (9)$$

where numbers depends on material and these numbers were obtained for the researched material [18]. *Mc* is the designation for moisture content.
According to [4], porous low-value dielectric constant materials absorb more moisture dense ones. Furthermore, the chemically absorbed moisture degrades electrical and reliability performance of the dielectrics with low value of the dielectric constant.
Section 2.1, 2.2 and 2.3 describes some aspects of relative permittivity dependences.

2.4. Impact of combinations of dominant factors to complex relative dielectric constant

Similarly to resistivity temperature dependence, the dielectric constant temperature dependence can be introduced by defining distribution of relaxation times depending on temperature. If it is prepared for (3) and (4), the distribution is expressed as function of ln(τ):

$$g(\ln(\tau))=\begin{cases}0, & \tau<\tau_0,\tau>\tau_1\\ 1/\ln\left(\tau_1/\tau_0\right), & \tau_0\le\tau\le\tau_1\end{cases} \quad (8)$$

The value of τ_0 is associated with inverse of the vibration frequency of the ions in the material, which should be in order of 10^{10} to 10^{13} Hz. This corresponds to the smallest polar regions in the material. The value of τ_1 is associated with the biggest polar regions in the material. Equation (3) can be rewritten as in [23]:

$$\varepsilon_r = \varepsilon_{r\infty} - B(T)(\ln\omega + \ln\tau_0) \quad (9)$$

where *B(T)* at reasonable low temperature can be calculated with:

$$B(T) = \exp\left[\alpha_1 + (T/\beta_1)^{\delta}\right] \quad (10)$$

Equations (9) and (10) present an framework for description of temperature and frequency dependence of ceramic materials' dielectric constant.

Next simulation present 3D graph of PMN-PT ceramic material. The constants for PMN-PT are: $\varepsilon_{r\infty} = 278$, $\alpha = 3.11$, $\beta = 151.1$ K, $\delta = 1.95$, and $\tau_0 = 1.3$ ns.

Simulated frequency range is between 100 Hz and 100 kHz. Simulated temperature range is between -100 and 200°C. Figure 3 shows the simulated results. Numbers (*no*) at T-vector and F-vector axes represent the vector elements, and not the values of vector elements. For example, the fist value in T-vector is -100°C and it is designated with number 1 in the graph.

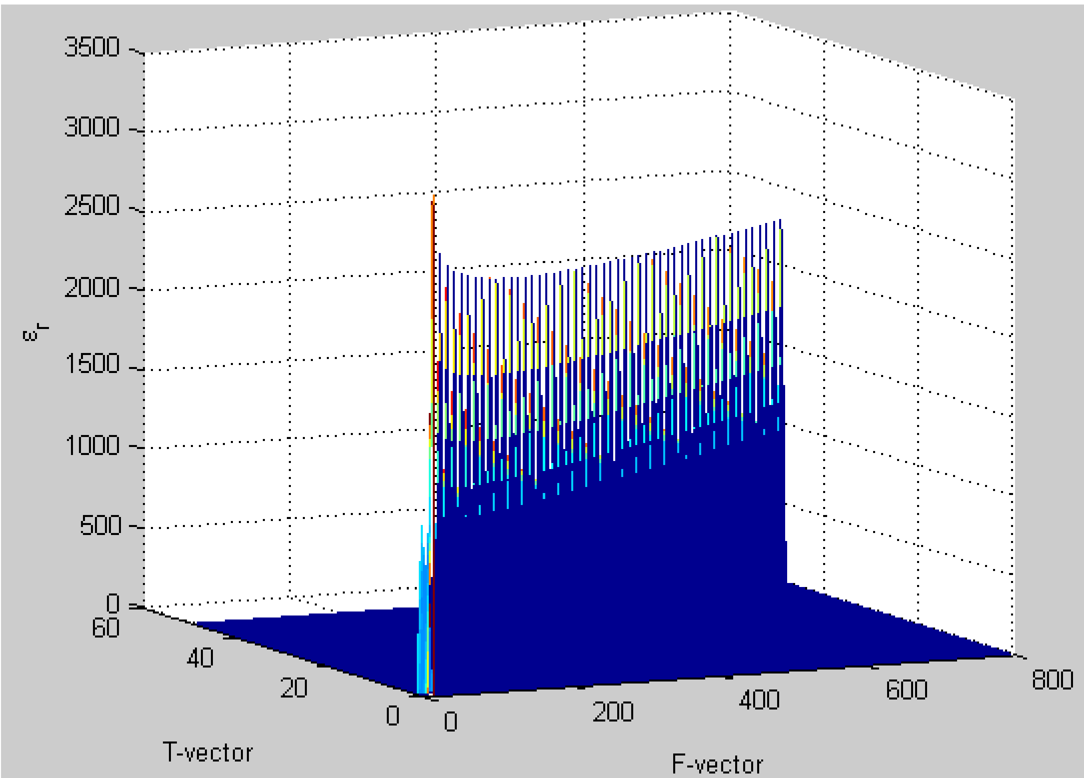


Figure 3. Results of simulation for PMN-PT ferroelectric ceramic – dependence of the relative dielectric constant on frequency and temperature (absolute value)

So the actual values of the T-axe (temperature, ϑ in °C) and F-axe can be obtained by:

$$\vartheta\,[°C] = -100 + (no - 1)\cdot 15 \quad (11)$$

$$f\,[Hz] = 100 + (no - 1)\cdot 50 \quad (12)$$

According to research in [5] temperature, frequency and moisture are connected. We can derive the formula for the explicit relationship between these dominant factors. Although, the research in [5] gives the experimental results for moisture dependence for analyzed materials, we can generalize the law for the same set of materials as a set of materials with linear and the set of materials with cubic law. The relationship between moisture and dielectric constant:

$$\theta = a \pm b\varepsilon_r \tag{13}$$

$$\theta = a \pm b\varepsilon_r \pm c\varepsilon_r^2 \pm d\varepsilon_r^3 \tag{14}$$

where θ is the volumetric material moisture, and *a*, *b*, *c*, *d* are coefficients, which depends on material and are experimentally obtained.

If a combination of influences by moisture, temperature and frequency is wanted, then it is important to take account a type of material's group and the application limitations. For fiber optics, [15] can be combined with [5] and the expression (16) is obtained by developing from (15), which is classic dielectric model:

$$\varepsilon_r(\omega) = \varepsilon_{r\infty} + \sum_j \frac{S_j \Omega_j^2}{\Omega_j{}^2 - \omega^2 - i\gamma_j \omega} \tag{15}$$

where ε_∞, Ω_j, S_j and γ_j are respectively the high-frequency value of the dielectric constant, and the transverse optical wave number, the dielectric strength and the damping of the j^th phonon.

The combination of all three dominant factors for fibber optic communication's material can be expressed as:

$$\begin{aligned}\theta &= a \pm b \cdot \left(\varepsilon_{r\infty} + \sum_j \frac{S_j(T)\Omega_j^2(T)}{\Omega^2{}_j(T) - \omega^2 - i\gamma_j(T)\omega} \right) = \\ &= a \pm b \cdot \left(\varepsilon_{r\infty}(T_0) + e \cdot [T - T_0] + \sum_j \frac{\left(S_j(T_0) + b_j(T - T_0)\right)\left(\Omega_j(T_0) + a_j(T - T_0)\right)^2}{\left(\Omega_j(T_0) + a_j(T - T_0)\right)^2 - \omega^2 - i\gamma_j(T)\omega} \right)\end{aligned} \tag{16}$$

where parameters sensitive to temperature are [15]:

$$\Omega_j(T) = \Omega_j(T_0) + a_j[T - T_0] \tag{17}$$

$$S_j(T) = S_j(T_0) + b_j[T - T_0] \tag{18}$$

$$\frac{\gamma_j}{\Omega_j}(T) = \frac{\gamma_j}{\Omega_j}(T_0) + c_j[T - T_0] \tag{19}$$

and a_j, b_j, and c_j being constant coefficients. $\varepsilon_{r\infty}$ exhibits a linear temperature-dependence as in equation (7).

Figure 4 shows the simulation results for dependence of dielectric material on all three dominant factors: operating frequency, temperature and moisture. It is possible to shown the results only in 3D graph as surface.

The simulation results are obtained for vectors of temperature and frequency:

T = [300 400 500 600] [K]

f = [50 100 500 1000 5000 10000 50000 100000 500000 1000000] [Hz]

For every moisutre precenatge, a new surface like in Fig.4 is obtained.

Numbers at temperature and frequency axes are number of sample in frequency or temperature vectors. Temperature in Kelvins can be obtained by formue in the figure:

$$T = 300 + (no - 1) \cdot 100 \text{ [K]} \tag{17}$$

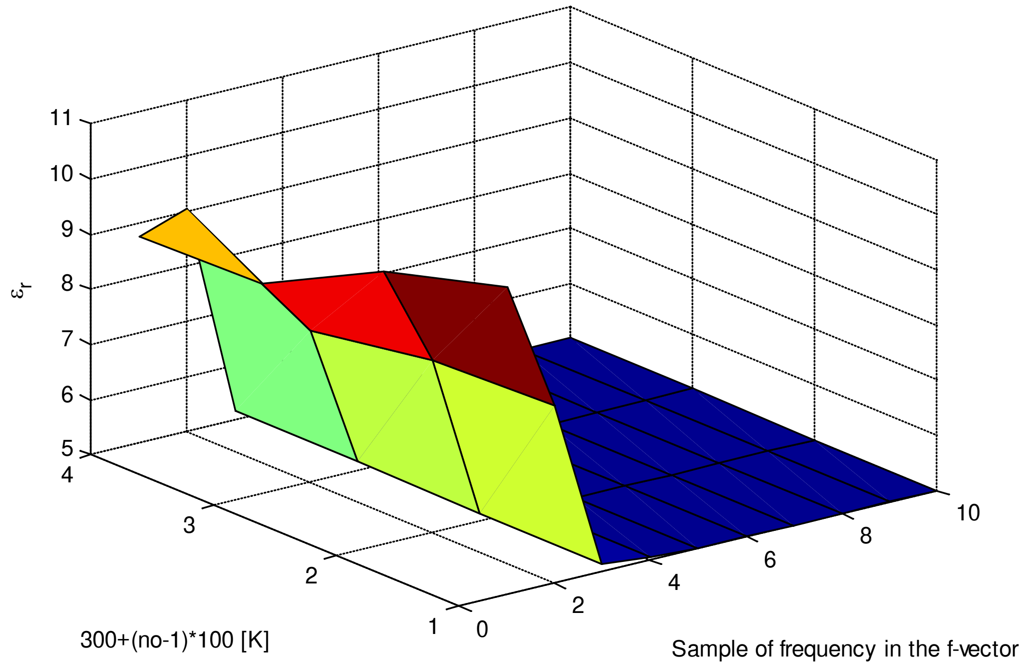


Figure 4. Relative dielectric constant dependence on dominant factors in marine applications – operating frequency, temperature and moisture

3. CONCLUSIONS

Dielectric materials are widely used in marine applications. The operation of dielectric materials is usually taken for granted. However, the design of such material should include different factors, which can degrade the properties of the dielectric materials.

The paper presents simulation results for dielectric materials' dependences on dominant factors in marine applications. Example of material is taken to simulate all three dominant dependences.

The influence of dominant factors is analyzed through relative dielectric constant, which is characteristic of specific material. The results show that the relative dielectric constant should be normalized to referent values of dominant factors in order to recognize the material by its dielectric constant.

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LIGHTHOUSES IN THE SYSTEM OF METEOROLOGICAL SAFETY OF NAVIGATION

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ABSTRACT

The Adriatic is a semi-enclosed sea, a large bay enabling the Mediterranean to get deep into the European continent. The importance of the Adriatic Sea in maritime communications system at the European and global levels was fully recognized by the Austrian-Hungarian government, which created a system of waterways as we know it today. Specifically, during the nineteenth and early twentieth century, Austria-Hungary built all major lighthouses along the eastern coast, thus establishing a network of light landmarks, making the journey to the eastern side of the Adriatic feasible even at night and in adverse meteorological conditions. The task of maritime meteorological service provided by the Marine Meteorological Center Split, an organizational unit of the Meteorological and Hydrological Service of the Republic of Croatia, is to enable and to enhance the efficiency and economy of maritime activities. In order to operate efficiently, marine meteorological services require data from the high seas. Since the lighthouses are built at the most prominent and/or farthest points of Croatian territorial waters, meteorological data observed and measured in such places are of particular importance. The paper gives an overview of Croatia's major lighthouses performing active meteorological service for the benefit of the safety of navigation. [1]

KEY WORDS

lighthouses, Adriatic Sea, meteorological service, safety of navigation.

[1] *"The results presented in the paper have been obtained in the scientific research project No. 250-2502209-2364 and the international research Project "The possibilities of reducing pollutant emissions from ships in the Montenegrin and Croatian Adriatic implementing Anex VI of MARPOL Convention" supported by the Ministry of Science, Education and Sport of the Republic of Croatia."*

1. INTRODUCTION

The mankind has known the power of light since the dawn of time. The light breaks through the darkness allowing man to move and find the way. History books say that the world's first lighthouse was built on the island of Pharos, Egypt, around 300 B.C. to warn ships of the dangerous sandbars off Alexandria. It was designed by the Greek architect Sostratus and was one of the structures to be named on the list of the Seven Wonders of the Ancient World. It was around 117 meters high and stood in three levels. At the peak of the lighthouse was a concave mirror that reflected the light of the sun at day. At night, wood and resin were used to feed a fire. Legends claim that the light was visible from 35 miles away. The Pharos of Alexandria stood and remained in use until two earthquakes, in the 14th century, reduced it to rubble. The name of the island Pharos has become a generic term for *lighthouse*, while the scientific study of lighthouses and signal lights, their construction and illumination, has been named *pharology*.
The safety of navigation across the Adriatic Sea is not threatened by high ocean waves, but there are dangers related to the indentedness of the coastline and a large number of islands, islets and rocks. Since ancient times man has tried to mark safe passages and avoid underwater rocks and the rocks that barely emerge above the sea level.

2. LIGHTHOUSES

In 1797 the Republic of Venice was abolished after the French conquest and Austria-Hungary gradually took control over Croatian coast and islands in the eastern Adriatic. The monarchy established efficient administration and invested considerable assets in the network of land and sea communications. Laws and regulations were introduced to regulate maritime traffic and aids to navigation. During the 19th century and early 20th century the monarchy built a network of landmarks and lighthouses that still exist today. For the first time the safety of navigation at night and in adverse meteorological conditions was ensured on the eastern side of the Adriatic Sea.

Lighthouses were constructed as public domain at prominent and barely accessible sites on the hills and points of the islands and the mainland. Mostly solitary buildings, they are juxtaposed with the elements of nature – the harsh karst, deep sea, poor vegetation and strong winds.

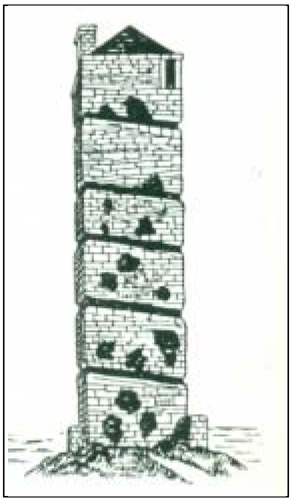

Figure1. Lighthouse La Coruna from Roman times

Out of forty-eight lighthouses on the eastern side of the Adriatic Sea, thirty-three are cultural heritage monuments. All Croatia's lighthouses are run by state-owned company Plovput, seated in Split. On behalf of the Republic of Croatia, the company is in charge of maintenance of maritime fairways in the internal sea waters and the territorial sea. Plovput is a member of the International Association of Lighthouse Authorities (IALA).

One of the most impressive lighthouses in the entire Adriatic is Savudrija. Built in 1818, it is the oldest, westernmost and northernmost lighthouse that is still in function. It stands next to the Slovenian border, warning the vessels of the shallow waters at the entrance to the bay of Savudrija. An entire chain of lighthouses were built towards the south. The last one to be constructed was Grebeni lighthouse, built in 1872, one nautical mile off Dubrovnik. It was named after the rocks (Croatian: *grebeni*) where many fishermen's boats and commercial ships ran aground and disappeared in the sea.

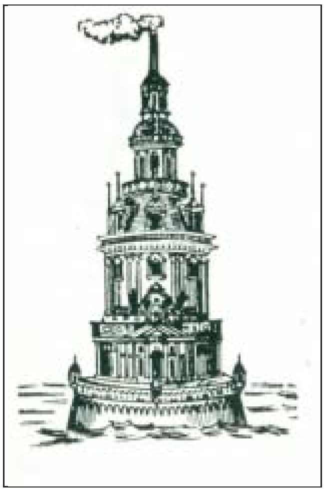

Figure 2. Lighthouse Cordouan, 1611

One of the most important and the most impressive lighthouse lies far offshore, in the middle of the Adriatic Sea, on Palagruža Island. Constructed in 1875, the stone structure stands 110 meters high at the top of the narrow and steep islet of Palagruža Vela. Archaeological research has proved that the islet was inhabited 9000 years ago. In the Middle Ages, a convent was built whose ruins are still visible in the central saddle of the island. Church archives keep records of the visit of the pope Alexander III when his fleet headed for Croatian coast.

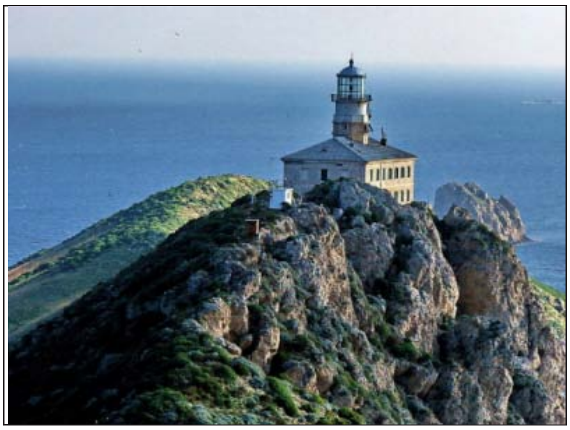

Figure 3. Lighthouse Palagruza, 1875

Croatia's major lighthouses are beautiful well-preserved solitary structures made of white stone. Their magnificence, as well as myths, legends and anecdotes related to them, attract a number of visitors and tourist who can book accommodation in most of them.

Table 1. Lighthouses of the eastern Adriatic[2]

nr.	lighthouses	position	
		φ	λ
1	Savudrija	45°29.4' N	013°29.5' E
2	Rt Zub	45°17.9' N	013°34.4' E
3	Sv. Ivan	45°02.6' N	013°37.1' E
4	Peneda	44°53.3' N	013°45.5' E
5	Verudica	44°50.0' N	013°50.3' E
6	Porer	44°45.5' N	013°53.8' E
7	Marlera	44°48.2' N	014°00.4' E
8	Crna punta	44°57.4' N	014°09.0' E
9	Mlaka	45°20.0' N	014°25.0' E
10	Susak	44°30.8' N	014°18.5' E
11	Vnetak	44°37.2' N	014°14.4' E
12	Zaglav	44°55.3' N	014°17.6' E
13	Prestenice	45°07.2' N	014°16.6' E
14	Vošćica	45°14.3' N	014°35.7' E
15	Oštro-Kraljevica	45°16.4' N	014°33.9' E
16	Stražica	44°56.0' N	014°46.4' E
17	Trstenik	44°40.1' N	014°35.0' E
18	Grujica	44°24.6' N	014°34.4' E
19	Veli rat	44°09.1' N	014°49.5' E
20	Vir	44°18.2' N	015°01.9' E
21	3 Sestr. rivanjske	44°10.3' N	015°01.0' E
22	Puntamika	44°07.8' N	015°12.5' E
23	Tajerske sestrice	43°51.2' N	015°12.5' E
24	Babac	43°57.4' N	015°24.0' E
25	Prišnjak	43°49.5' N	015°33.8' E
26	Blitvenica	43°37.5' N	015°34.8' E
27	Jadrija	43°43.3' N	015°51.3' E
28	Mulo	43°30.9' N	015°55.0' E
29	Murvica	43°28.0' N	016°03.7' E
30	Ražanj	43°29,2' N	016°24.9' E
31	Pokonji dol	43°09.4' N	016°27.4' E
32	Stončica	43°04.4' N	016°15.6' E
33	Host	43°04.6' N	016°12.6' E
34	Sv. Petar	43°17.7' N	017°00.8' E
35	Sv. Nikola	43°21.7' N	016°44.4' E
36	Sućuraj	43°07.5' N	017°12.1' E
37	Lovište	43°02.8' N	017°00.4' E
38	Pločica	43°01.8' N	016°49.2' E
39	Sušac	42°45.0' N	016°29.7' E
40	Palaguža	42°23.5' N	016°15.6' E
41	Struga	42°43.4' N	016°53.4' E
42	Glavat	42°45.9' N	017°09.0' E
43	2 Sestri.-Korčula	42°57.8' N	017°12.7' E
44	Olipa	42°45.5' N	017°46.9' E
45	Slano	42°46.6' N	017°52.7' E
46	Daksa	42°40.2' N	018°03.6' E
47	Grebeni	42°39.1' N	018°03.2' E
48	Sv. Andrija	42°38.8' N	017°57.3' E

[2] *Source: Plovput Ltd., Split*

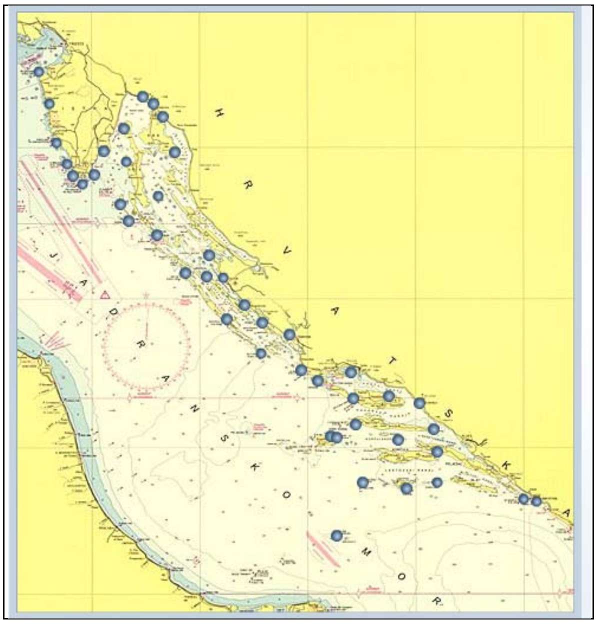

Figure 4. Distribution of the major lighthouses on the Adriatic's east side

Lighthouses are the largest and most important structures, designed as aids to navigation, which ensure safe navigation in their areas both at day and at night. They were constructed at the most prominent and/or most remote points of the Croatian territorial sea. All of them are made from stone, having a high light tower equipped with the main and stand-by light. The range of the main light is up to 30 NM. Some of the lighthouses are equipped with racons and/or fog detectors and fog sirens.

All lighthouses are automated and remotely supervised. However, due to their importance for the safety of navigation and in order to preserve these buildings and protect them from degradation, 17 lighthouses are still manned, with the crew consisting of 1 or 2 keepers per shift.

3. MARITIME METEOROLOGICAL SERVICE

Under the auspices of the United Nations and in line with the International Convention for the Safety of Life at Sea (SOLAS), the World Meteorological Organization (WMO) and the International Maritime Organization (IMO) have established and elaborated the standards and recommendations for this branch of meteorology, defining them in a number of documents. Members of the WMO are expected to meet the requirements defined in the WMO's *Technical Rules* which principally imply the establishment and maintenance of adequate type and organisation of sea-based and shore-based observing stations, maritime meteorological service, various communication systems, personnel training, research, and application and development of technical assets and technologies. Both WMO and IMO act within the system of World Weather Watch (WWW).

Maritime meteorological service in the Adriatic Sea has been an efficient and indispensable meteorological safety service for more than hundred years. It was established along with the Hydrographic Institute by Austrian-Hungarian monarchy in Trieste in 1860. As of 1874, meteorological reports for the entire Adriatic were made on a daily basis and as from 1878 meteorological data were gathered from across Europe and were used for creating charts and producing forecasts for seamen.

The first meteorological station in the Adriatic was set up in Dubrovnik and started to operate in 1851, while it is believed that the meteorological station at Hvar began to provide services in 1857. That year the Hvar station was integrated into the European meteorological network so that the year of 1857 is considered as the beginning of meteorological service on the Croatian side of the Adriatic.

The requirements of safety in maritime affairs significantly contributed to the development of maritime meteorology, particularly since mid 18th century when the American captain Maury published *Wind and Current Chart of the North Atlantic*, based on the data gathered from the logs of the ships sailing in the Atlantic Ocean. The accidents of French and English vessels in the Black Sea during the Crimean War in 1854 greatly assisted in recognising the importance of meteorology in maritime affairs.

Each type and size of the vessel has their own sea-keeping characteristics, hence different needs with regard to the wide range of the available information and notices along the route. The safety of traffic at sea is threatened by meteorological phenomena and processes which are often small-scale and hard to forecast at micro-locations. Given the indentedness of the eastern Adriatic shoreline, greater attention should be paid when forecasting and warning about exceptional meteorological phenomena within the system of the meteorological safety of navigation.

The safety of navigation is at risk when certain critical meteorological conditions, set as meteorological minimums for vessels, are exceeded. Many of these minimal values are not defined by direct meteorological measurements nor obtained through analysis. Instead, they are often determined by estimation and experience, and these methods are usually in the area of ship mates' responsibility.

Maritime meteorological service for the eastern Adriatic has been seated in Split since 1947. Every day the Marine Meteorological Center prepares and publishes meteorological bulletins, warnings, reports and weather (including the state of the sea) for a specific area or a sailing route. All these reports make part of the meteorological navigational documentation.

4. METEOROLOGICAL SERVICE AT THE LIGHTHOUSES

A network of meteorological coast stations has been developed in the eastern side of the Adriatic Sea and some lighthouses take part in the system. Given the positions of the lighthouses, the data gathered through measurements at these sites are crucial for the safety of navigation.

The measurements of meteorological parameters at these locations are not uniform; they are performed in various forms and at various levels:

- climatological stations
- port meteorological stations
- auxiliary meteorological stations
- stations for measuring the sea temperature
- automated meteorological stations

<u>Climatological (standard meteorological) stations</u> carry out observations at 07, 14 and 21 o'clock local time, keeping record on meteorological occurrences during the day. These tasks are carried out by professional observers, usually trained lighthouse keepers. At the end of the month, observation logs are delivered by mail to the Meteorological and Hydrological Institute of the Republic of Croatia (Marine Meteorological Center in Split), where the data are controlled, entered into computer, and filed. The data are processed and used directly or by means of user programs. Spatial distribution is in compliance with WMO regulations.

Standard meteorological station performs the observation and measurements, as follows:

1. observation of:
    - atmospheric occurrences
    - quantity of clouds (overcast level)
    - visibility
    - phonological monitoring (as needed)
    - wind force
    - state of the sea

2. measurement of:
    - wind direction and speed 10 m above soil
    - temperature of air 2 m above soil
    - extreme (minimum and maximum) temperatures of air 2 m above soil
    - humidity of air 2 m above soil
    - precipitation (type and quantity)
    - height of snow cover

Table 2. Lighthouses with climatological stations and their operation period

CLIMATOLOGICAL STATIONS		
light-house	Sv. Ivan na pučini*	1984 - 2009
	Tajerske sestrice*	1981 - 2009
	Palagruža	1948 - present

* Since 10 September 2009 ceased to produce SYNOP[3] reports (automated meteorological station was installed).

Port meteorological stations at lighthouses enter observations and measurements of weather parameters into port meteorological logs that are also delivered to Marine Meteorological Center in Split at the end of the month.

Table 3. Lighthouses at port meteorological stations and their operation period

PORT METEOROLOGICAL STTAIONS		
light-house	Veli rat	1966 - 1997
	Tajerske sestrice	1954 - 2009
	Stončica	1951 - present

Auxiliary marine meteorological stations produce descriptive reports (wind force, visibility, clouds and state of the sea) twice a day at 08:00 and 12:00 o'clock.

Table 4. Lighthouses with auxiliary meteorological stations and their operation period

AUXILIARY METEOROLOGICAL STATIONS		
lighthouse	Murvica	1988 - present
	Stončica	1988 - present
	Ražanj	1988 - present
	Susak	2000 - present

[3] *SYNOP report is used for reporting surface synoptic observations and measurements performed by manned and automated weather stations.*

The temperature of the sea is not a typical meteorological parameter as it is not within the atmosphere. Nevertheless, it is of exceptional importance to the processes in the atmosphere as it indicates the thermal state of water mass contained in the seas.

Table 5. Lighthouses with stations for measuring the sea temperature and their operation period

TEMPERATURE OF THE SEA		
light-house	Sv. Ivan na pučini	1957 – present
	Veli rat	1966 - 1997
	Jadrija	1961 - present

Automated meteorological systems (AMS) meet the need for performing measurements, records and transfer of the data about essential meteorological elements at the weather stations within the primary network and at places that are unsuitable or inaccessible to man, depending on the service requirements and special user demands.

Table 6. Lighthouses with automated meteorological stations and their operation period

AUTOMATED METEOROLOGICAL STATIONS		
light-house	Porer	2009 - present
	Sv. Ivan na pučini	2009 – present
	Veli Rat	2009 – present
	Palagruža	1995 – present

The increased scope of maritime traffic and the growing demands for the safety of navigation require the installation of automated meteorological systems, especially at inaccessible locations. However, just like any other systems, these meteorological systems have their shortcomings. Namely, safe navigation requires information on the state of the sea which is expressed by means of the Douglas Sea Scale. Installation of the system for automatic measurements on the Lighthouse of Tajerske sestrice in 2009 disabled the information on the state of the sea (previously observed by the keepers), which represents a considerable disadvantage obstructing a clear insight into the real state of weather in the area. This resulted in the lack of information on the state of the sea between the marine meteorological station Komiža on Vis Island and the marine meteorological station Mali Lošinj, which represents a huge shortcoming in the system of meteorological safety of navigation.

Given the importance of the meteorological data available from the lighthouses, the operations of measuring, observing, gathering and processing meteorological data should be performed by strictly defined standards, rules and recommendations of the World Meteorological Organization which ensures the correspondence of the measured information by place and by time.

The above presented tables and the information they contain clearly show that only 10 lighthouses, or 21% of the available capacities, have been included in the system of maritime meteorological measurement and observation.

Although the Adriatic Sea is a semi-enclosed bay of the Mediterranean, it is an area where exceptional, extreme and dangerous marine meteorological phenomena may occur. Therefore, each piece of information on the real state of weather conditions is precious in the system of meteorological safety of navigation.

5. CONCLUSIONS

It has always been very important to safely bring a vessel, people and cargo onboard her, from one port to another and to pay particular attention to the passage conditions and the duration of the voyage. There are a number of factors affecting the safety of the maritime passage, and proper meteorological preparation and observing the development of weather conditions during the voyage are among the most important ones. Today, these factors are assisted by well organised meteorological services both at the local and the global level.

Special attention should be focused on finding ways of obtaining maximum meteorological data from lighthouses, particularly in view of the fact that every lighthouse has prerequisites for performing meteorological measurement and observation. The fact that only 21% of Croatia's major lighthouses have been involved, in various ways, in the meteorological observation service implies that there is a considerable potential for the development of the meteorological lighthouse service.

Maritime meteorological service carried out by the Marine Meteorological Center in Split is a modern service based on the long maritime tradition, meteorological science, cutting-edge technologies and telecommunications. Its principal task is to ensure security and safety of life and navigation. Maritime service has to develop in line with professional and scientific tendencies in Croatia, the Mediterranean, Europe and the world.

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WINDWAVE REGIME IN THE PORT OF SPLIT

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ABSTRACT

Given that the wind is a meteorological element that largely affects (directly and/or by causing waves) on the safety and stability of vessels at sea, knowledge of the distribution of wind speed and direction is vital during the planning of operations of crews during docking. Features of surface waves generated by wind primarily depend on the direction and strength of wind blowing over some areas, the dynamics of changes in direction and strength of the wind, its duration, fetch length for each direction, and the topography of the seabed. The mechanism of creation of the waves due to the wind indicates a correlation of wind and high waves it causes. Knowing the wind-wave regime of the area can reduce the negative impact of wind and waves in the system safe docking. Split port is intended also for international public transport. Exceptional and also record passenger traffic of 4.230,075 passengers and 642,104 vehicles in the 2012th puts the Split port in the first place of the passenger ports in Croatia and in the top of the leading maritime seaport on the Mediterranean. This paper presents a windwave regime port of Split and its impact on the safety of maritime traffic in the port.

KEY WORDS

wind, waves, port, security.

1. INTRODUCTION

Port of Split is the largest seaport, cultural and economic center of Dalmatia, with North harbor in the eastern part of the Gulf of Kastela and the city harbor and marina on the south coast. It is important shipping and maritime center.

Bora and jugo can blow with gale force. On the west coast jugo can cause rough seas, and the east coast is protected. Southwest winds cause strong waves in the eastern part of the harbor.

The prevailing tidal speeds are up to 0.3 knots. Storm winds can increase the speed of currents of 1.0 knots.

Mean tidal amplitude are of 0.2 to 0.3 m. Long-term storm winds can raise sea levels up to 0.5 m (cyclonic jugo) and lower to 0.3 m (anticyclonic bora).

Tourist boats and larger yachts can dock with the approval of the Port Authority on the south side of Wharf of St. Nicholas and along part of the Lazaretto Coast and Coast Duke Domagoj. Wharf St. Peter and part of the Coast Lazaretto are provided for passenger ships and tourist lines. On the north side, and with the head of Wharf of St. Duje is customs ports, and from the south side of Wharf St. Duje is the ferry pier. Smaller vessels are advised mooring in the western part of the port.

In the west of the port of Split, east of Cape Sustipan, there is a marina Split. West of the marina are two boat docks.

Bora, jugo and SW wind (libecchio) are very strong, but the ships are in touch with the inner side of the breakwater and piers assured by all the winds and waves. Along the outside of the inner breakwater ships are exposed to the bora. Strong south and SW winds in this part cause confused sea. Weather forecast and notices to mariners can be obtained in the administration of the marina.u
Docking in/out ports necessarily represent those of the knowledge of meteorological parameters that can have a significant impact on the safety of the vessel, as well as knowledge of the climatic characteristics of the site or micro locations of operational activities. In addition to the general characteristics of the time, or the "average condition" in the longer term, there are significant rare events and extreme weather conditions. Since meteorological elements can achieve values that have significant consequences for the safety of navigation, they need to be taken into account through appropriate design criteria. Meteorological element that largely affects the safety of the vessel is definitely the wind as a horizontal component of motion of air and sea state (wave height).

2. DYNAMICS OF MARINE FACILITY

Vessels at sea are under the influence of wave and loads of the wind and sea currents. These loads must be taken into account when developing an integrated model approach anchorage and mooring facility.
Wind load has a significant share of the total load on the marine facility. It should be noted that the wind, except for a constant, has also a variable component. One part of the variable component has low frequencies that are very close to the frequencies of the anchored vessel.
In order to determine the wind force it is first necessary to define the frequency spectrum of the wind. Expression for the spectrum is shown in the form of (literature 15.):

$$s(\omega) = \frac{[\sigma(z)]^2}{\omega_p \left[1 + \frac{1.5\omega}{\omega_p}\right]^{5/3}} \qquad (1)$$

where:

$S\ (\omega)$ - range of the wind
ω - frequency in rad / s
ωp - frequency spectrum peak in rad / s
$\sigma(z)$ - the standard deviation of wind speed
z - the height of the free surface of the sea

The link between high seas and excitation forces acting on the marine facility are transfer functions.
It is assumed that the load due to ocean currents has only constant component. To determine the amount of the load the following terms are used (literature 16.):

$$F_{xc} = \frac{1}{2} C_{xc} \rho_w V_c^2 L_{pp} T \qquad (2)$$

$$F_{yc} = \frac{1}{2} C_{yc} \rho_w V_c^2 L_{pp} T \qquad (3)$$

$$M_{xyc} = \frac{1}{2} C_{xyc} \rho_w V_c^2 L_{pp} T \qquad (4)$$

where:

Fxc - longitudinal force of sea currents
Fyc - shear force of sea currents
Mxyc - moment sea currents
Cxc - the coefficient of longitudinal forces of sea currents
Cyc - the coefficient of transverse forces of sea currents
Cxyc - moment coefficient of sea currents
T - draft marine facility or vessel
ρW - density of seawater
Vc - speed of currents

To determine the coefficients in the above expressions type of maritime vessel and direction of arrival of ocean currents are taken into account.

3. WIND REGIME

Basic wind regime in Croatia is influenced by several factors, such as proximity to the Alpine massif to the northwest, along the Adriatic coast Dinarides, the Pannonian Plain in the northeast of the country and the existence of the Adriatic and the Mediterranean Sea.

Specific features of current patterns on the Croatian territory, especially its coastal area, make the need for knowledge of the temporal and spatial variability of wind speed and direction even more important. The wind that occurs on our coast can reach a maximum speed greater than 50 m / s, and is significantly dependent on the local characteristics of the surrounding terrain. Its characteristics in addition to it is also the large gustiness and turbulence (large differences between the mean wind speed and the current maximum impact, sudden changes in wind speed and direction as well as a general feature of wind speeds increase with height). Therefore, the position of the coast and islands, and orographic complexity of this area causes a complex circulation of the atmosphere. Features of wind climate of an area are numerous and can be displayed in different ways.

Figure 1. Floorplan port of Split

Wind conditions in the Adriatic are therefore determined with geographic location, distribution areas of high and low air pressure of general circulation, the influence of the sea and hinterland, time of day and year, etc. Surely that the individual sites are under the influence of other factors such as exposure, concavity, convexity, slope relief, elevation, vegetation type, the existence of urban obstacles etc. So the wind is extremely spatially and temporally varying meteorological parameter because it depends on orographic and other local conditions in a given area.

Due to the orography developed coastal areas and the impact of the distribution system in areas of high and low air pressure synoptic and meso scale, it is obvious that the coastal area has a complex local and circulatory flow regime.

Figure 2. Port of Split

The measured wind data (speed and direction) in the meteorological services are collected in a relatively sparse network of stations. The existing network of measuring points was selected to enable the acquisition of general characteristics of large-scale flow at a height of 10 m above the ground in order to reduce the effect of friction due to surface roughness. However, the representative value at some point for a wider area depends on the terrain, rough terrain and close the cover (barriers) around the measurement site, near the sea, etc.

Table 1. The probability of simultaneous occurrence of different wind directions (relative frequency of), by class strength (Bf) and velocity (m / s) from the port of Split, for a year, the period 2000 to 2009

GODINA (relativne čestine u ‰)

jač. (Bf)	0	1	2	3	4	5	6	7	8	9	10	11	12	zbroj
brz. (m/s)	0.0-0.2	0.3-1.5	1.6-3.3	3.4-5.4	5.5-7.9	8.0-10.7	10.8-13.8	13.9-17.1	17.2-20.7	20.8-24.4	24.5-28.4	28.5-32.6	32.7-36.9	
N		14.8	16.6	4.9	2.0	0.6	0.2	0.01						39.0
NNE		11.7	27.5	21.9	25.5	19.2	6.5	1.2	0.2	0.1				113.9
NE		17.4	60.1	50.1	42.4	28.5	7.9	2.0	0.6	0.06	0.02			209.0
ENE		13.8	38.1	17.9	4.5	1.4	0.2	0.03						76.0
E		9.1	13.7	8.3	2.4	0.2	0.01	0.02						33.8
ESE		10.5	14.9	15.9	22.1	14.5	5.7	1.1	0.01					84.7
SE		10.6	11.9	14.3	22.3	24.2	13.3	3.4	0.3					100.4
SSE		11.0	13.1	3.2	2.6	2.6	1.8	0.5	0.06					34.9
S		11.3	10.2	1.6	1.3	1.2	0.8	0.5	0.01					27.0
SSW		11.1	27.5	6.1	1.8	1.3	0.7	0.2	0.02					48.7
SW		21.0	49.2	21.8	2.5	0.3	0.1	0.01						94.9
WSW		14.0	20.2	12.7	1.7	0.02								48.7
W		4.0	6.3	1.9	0.2	0.01								12.4
WNW		5.3	9.5	1.7	0.05	0.01								16.6
NW		9.5	16.6	4.2	0.4	0.03	0.02							30.8
NNW		10.8	10.2	2.7	0.5	0.09								24.3
C	5.1													5.1
zbroj	5.1	186.0	345.7	189.3	132.3	94.0	37.2	9.0	1.2	0.2	0.02			1000.0

To view the current regime in the port of Split annual contingency table and the relative frequency of the (probability) of occurrence of certain velocity associated with the wind direction from the main meteorological station in Split since year 2000 to 2009 has been analyzed, and on the basis of these data, the wind rose for the port of Split has been made.

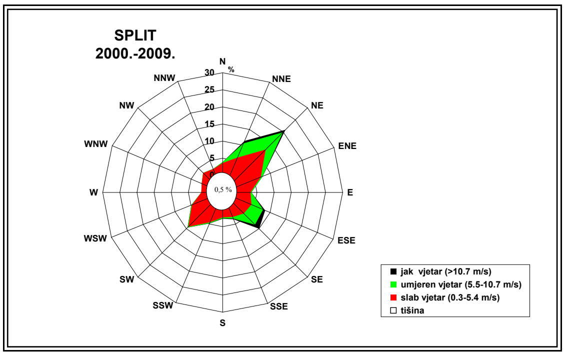

Figure 3. Annual wind rose for the port of Split in the period 2000-2009

On the basis of the analyzed data it is shown that the most frequent wind direction in the area of the airport Split are: NE (20.9%), NNE (11.4%), SE (10.0%) of total number of data throughout the year. These are known gale winds bora and jugo.

In the applied marine climatology, especially for the safety of various vessels, of interest are events that occur infrequently, such as, among others, extremely high wind speeds. As the wind speed changes continuously, and can achieve different extreme value, it is appropriate to apply the theory of extremes in order to find out the probability that the extreme is found in a given interval.

For the analysis of extreme values of meteorological parameters generalized extreme value distribution by Jenkinson or Gumbel distribution is commonly used as one solution to these distributions.

Jenkinson gave general form of parametric distributions extremes that satisfies the postulate of stability:

$$P(x) = \exp\left[-e^{-y(x)}\right] \qquad (5)$$

where *P(x)* is the probability that the annual extreme maximum equal to *x*, *y (x)* is reduced variates:

$$y = -\ln\ln\frac{1}{P(x)} \qquad (6)$$

Jenkinson general solution postulates stability has the form:

$$x = x_o + \alpha\frac{1-e^{-ky}}{k} \qquad (7)$$

Size x_o is the value that can be expected annually with $y = 0$, α is the slope of *x*, *y* curve at the point $x = x_o$.

$y = 0$, and *k* is the curvature parameter

General solution includes all three types of borderline cases, which are determined by the value of the parameter k:

- In the case of $k > 0$ curve tends final value:

$$x_{\max} = x_o + \frac{\alpha}{k} \quad (8)$$

- In the case $k = 0$ curve has the shape of the line:

$$x = x_o + \alpha y \quad (9)$$

and tends to infinity, and is called Gumbel distribution.

- In the case $k < 0$ 0 curve has no upper limit and the lower asymptote is:

$$x_{\min} = x_o - \frac{\alpha}{k} \quad (10)$$

Return period T (x) is defined as the mean time interval that elapses between two overshooting value of x can be written as:

$$\frac{1}{T} = 1 - P(x) \quad (11)$$

which implies the relation:

$$y = -\ln\ln\frac{T}{T-1} \quad (12)$$

The relationship between the estimated extremes x and associated return period T is given by:

$$x = x_o + \alpha\frac{1 - \{\ln[T/(\ T-1\ )]\ \}^k}{k} \quad (13)$$

According to the above, the Jenkinson distribution is parametric distributions (k, x_o *i* α). The evaluation of the expected maximum wind speed value x_o corresponds to the expected maximum velocity U za $y = 0$.
The form Jenkinson distribution, however, depends on the values of the parameters that determine it. If the parameter k is greater than *0*, value of expected extremes asymptotically approaches a final value for infinitely long return period. Such values are usually more realistic to estimate the maximum wind speed for different return periods usually up to 100 years. If $k < 0$ in Jenkinson distribution or $k = 0$ in Gumbel distribution, then for large return periods (100 years or more) can give unrealistically high estimated value. Application of the theory of extremes requires that the sample was random and large enough (at least 10 years of annual extremes) in order to estimate the expected maximum speed was as reliable. Estimates of the parameters at intervals of 2 to 100 years for the port of Split (2000 - 2009) were calculated using maximum likelihood samples from the annual maximum hourly average wind speed and annual maximum wind gusts, depending on wind direction and regardless of the direction of wind.
The calculated theoretical distributions expected maximum 10-minute average hourly wind speed and maximum wind gusts in the port of Split are shown in Table 2.

Table 2. The expected 10-minute wind speed (V10, m / s), for Split between the 2004 to 2009, the maximum mean hourly wind speed (Vs, m / s) and maximum gusts (Vblow, m / s), regardless of direction and wind directions and the corresponding probability for a return period of T years obtained by Jenkinson distributionof extremes of wind speed measurement data, for Split in the period 2000-2009

T (years)	P (%)	V_{10} (ms^{-1})	V_{hour} (ms^{-1})	V_{blow} (ms^{-1})
2	50	23.0	20.4	35.6
5	80	24.6	22.6	38.5
10	90	25.6	24.1	41.0
20	95	26.6	25.5	44.0
25	96	26.9	26.0	45.1
50	98	27.7	27.4	49.1
100	99	28.4	28.9	54.0
N direction				
2	50	14.2	10.8	29.1
5	80	16.4	13.1	33.0
10	90	18.1	14.2	33.9
20	95	19.8	15.1	34.2
25	96	20.3	15.3	34.3
50	98	22.0	15.9	34.4
100	99	23.7	16.4	34.5
NNE direction				
2	50	21.4	16.9	34.4
5	80	23.8	19.7	37.4
10	90	25.5	22.2	38.8
20	95	27.0	25.2	39.9
25	96	27.5	26.3	40.2
50	98	28.9	30.4	40.9
100	99	30.1	35.5	41.5
NE direction				
2	50	21.8	18.2	34.4
5	80	23.9	22.1	39.1
10	90	25.4	24.1	40.8
20	95	26.8	25.7	41.9
25	96	27.2	26.1	42.2
50	98	28.5	27.3	42.8
100	99	29.7	28.2	43.2
ENE direction				
2	50	16.7	11.24	33.5
5	80	18.4	13.39	38.4
10	90	19.5	14.74	39.7
20	95	20.6	15.98	40.3
25	96	20.9	16.36	40.4
50	98	21.8	17.50	40.7
100	99	22.6	18.59	40.8

\- continuation of **Table 2.**

T (years)	P (%)	V_{10} (ms^{-1})	V_{hour} (ms^{-1})	V_{blow} (ms^{-1})
E direction				
2	50	10.3	9.0	25.0
5	80	10.9	10.8	29.3
10	90	11.2	12.4	30.5
20	95	11.4	14.2	31.2
25	96	11.4	14.9	31.3
50	98	11.6	17.2	31.6
100	99	11.8	19.9	31.7
ESE direction				
2	50	16.4	15.8	26.6
5	80	17.5	17.1	28.4
10	90	18.2	17.5	29.2
20	95	18.7	17.6	29.9
25	96	18.9	17.7	30.1
50	98	19.3	17.7	30.5
100	99	19.6	17.8	30.9
SE direction				
2	50	19.4	18.2	28.5
5	80	20.4	19.5	30.9
10	90	21.0	20.0	32.2
20	95	21.5	20.4	33.4
25	96	21.7	20.5	33.7
50	98	22.1	20.7	34.7
100	99	22.5	20.8	35.6
SSE direction				
2	50	18.8	16.2	29.4
5	80	20.4	18.1	31.2
10	90	21.4	19.2	31.6
20	95	22.2	20.1	31.8
25	96	22.4	20.3	31.9
50	98	23.1	21.0	31.9
100	99	23.7	21.7	32.0
S direction				
2	50	18.7	14.9	26.4
5	80	21.0	17.0	29.2
10	90	22.5	17.9	30.0
20	95	23.9	18.6	30.4
25	96	24.3	18.7	30.4
50	98	25.5	19.2	30.6
100	99	26.5	19.5	30.6
SSW direction				
2	50	18.8	15.1	25.7
5	80	20.7	16.9	28.8
10	90	22.0	17.4	29.6
20	95	23.1	17.6	29.9
25	96	23.4	17.6	30.0
50	98	24.3	17.7	30.1
100	99	25.1	17.8	30.1
SW direction				

2	50	13.1	11.0	24.0
5	80	15.0	13.2	26.7
10	90	16.5	14.2	28.7
20	95	17.9	14.8	30.8
25	96	18.4	14.9	31.5
50	98	19.8	15.3	33.9
100	99	21.2	15.6	36.4

WSW direction				
2	50	9.8	6.8	21.6
5	80	10.8	7.6	23.4
10	90	11.5	8.3	23.7
20	95	12.1	9.0	23.9
25	96	12.3	9.3	23.9
50	98	12.8	10.1	24.0
100	99	13.3	11.1	24.0
W direction				
2	50	7.2	6.2	15.6
5	80	7.7	7.1	20.0
10	90	8.0	7.5	21.8
20	95	8.3	7.9	22.9
25	96	8.4	7.9	23.2
50	98	8.6	8.1	23.8
100	99	8.7	8.3	24.3
WNW direction				
2	50	7.5	5.2	17.2
5	80	8.5	6.5	19.8
10	90	9.3	7.4	21.4
20	95	10.0	8.1	22.8
25	96	10.2	8.4	23.3
50	98	11.0	9.1	24.5
100	99	11.7	9.8	25.7
NW direction				
2	50	8.3	6.6	19.4
5	80	9.2	7.4	21.0
10	90	10.0	8.0	21.4
20	95	10.7	8.6	21.6
25	96	10.9	8.8	21.6
50	98	11.6	9.4	21.7
100	99	12.3	10.0	21.8
NNW direction				
2	50	8.4	7.2	19.7
5	80	9.6	8.5	21.5
10	90	10.4	9.3	23.0
20	95	11.3	9.9	24.8
25	96	11.6	10.1	25.4
50	98	12.5	10.7	27.6
100	99	13.4	11.2	30.2

The values listed in the above table shows that the average climatic conditions, with a return period of 50 years, with a probability of 98% that can not be exceeded, they can expect a maximum 10-minute wind speed of 28.4 m / s, with the proviso that it should be emphasized that a series of 10-minute measurements of wind speed given by the 2004 to 2009 year.

Maximum hourly average wind speed is expected to be 27.4 m / s and maximum gusts of 49.1 m / s The maximum gust of 54.0 m / s can be expected once in 100 years.

4. WAVE REGIM

The term generation of waves by wind is considered the transfer of energy from wind waves over the contact surface. The complexity of the mechanism of transfer of energy from the wind to the waves makes it difficult to even attempt to describe the main characteristics of this mechanism, therefore, the process of transfer of energy from the wind on the waves has not yet been fully explained.

Wave forecast is defined as the process of determining statistically representative wave parameters (height and period) in deep water. Direction joines forecasted sizes. Only deepwater significant wave height is forecasted from which based on the theory, can perform other representative test deepwater wave height, and deepwater wave spectra. All made wave forecasts are local and are valid only for the microclimate.

As a port of Split, which is located in shallow water, and wave forecasts given deepwater wave, it is a short-term representative waveform parameters are determined using mathematical models of propagation of waves from deep to shallow water.

In the Split harbor large ships sail that generate waves, which can have an effect on the agitated waters of noewly planned summer moorings.

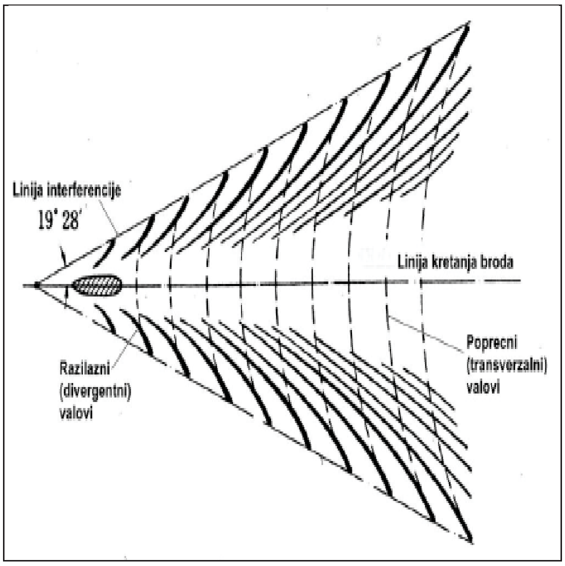

Figure 4. Showing waves caused by passing ship

The boat in motion causes the wave to the forward part of the ship. At the same time, and at the stern of the ship appears rise of water level, stern wave, and in the middle of the hull is lowering the water level.

Sail through the calm water, the boat creates two basic types of waves: transverse and divergent waves (Figure 4). The system of these waves occurs at the bow and stern of the ship. Superposition of transverse and divergent waves the line of interference is generated.

For subcritical speed boat (F_R<1, $F_R = \frac{V}{\sqrt{gd}}$, V–boat speed [m/s], d-sea depth [m]), it was observed that the line of an angle is 19°28' with the axis of the vessel. As the speed of the ship is approaching critical, this angle increases. For speed $V = \sqrt{gd}$, ($F_R = 1$) ,or the speed of propagation of waves in shallow water (approaching the coast), the angle would amount to 90°. Speed boats are mostly subcritical, especially in conditions of limited width and depth for navigation (in port).

Wave heights on the line interference can be estimated according to the formula:

$$H_{sec} = A_w \frac{V^{8/3}}{g^{4/3}(u')^{1/3}} f_{cr} \tag{14}$$

Hsec - the height of the waves on the line interference [m]

Aw - the coefficient of wave height depends on the shape, size and load of the ship and the depth of water (Aw = 0.25 for conventional vessels)

Fcr - rate coefficient (*fcr* = 1 for $V = 0.8\sqrt{gh}$)

u' - distance from ship to shore [m]

5. CONCLUSIONS

May occur the situation waves generated by wind waves occurring simultaneously with the passage of ships. In such a situation the interference of waves, or their addition.

However, the common occurrence of waves of ships and wind generated surface waves do not threaten the functionality and stability of the port. Research has shown that the average climatic conditions with a probability of 98% can expect a maximum 10-minute wind speed of 28.4 m / s. Probability of maximum wind gusts of 54.0 m / s is relatively small, which means that the gust of strength can be expected once in 100 years.

Since the Split Airport is located in shallow water, and wave forecasts give deepwater wave, it is a short-term representative waveform parameters are determined using mathematical models of spreading of waves from deep to shallow water. By analyzing the wave regime and defining wave forecasts it is possible to define the speed of the ships, which are mostly subcritical, especially in conditions of limited width and depth for navigation as in ports.

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HUMAN RESOURCES ASPECT OF THE GAS FUELLED FLEET EXPANSION

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ABSTRACT

Increasingly stringent environmental requirements, the availability as well as the price of fuel oil, encourage maritime industry to develop and use alternative propulsion systems. Liquefied natural gas (hereinafter LNG) propulsion is one of the solutions that has recently gained more attention.
The article outlines the benefits of LNG fuelled vessels from the economic and environmental point of view, however the focus is given to the necessary skills and knowledge that crew members in various roles on board of such vessels need to attain in order to assure constant safety of operations and navigation.

KEY WORDS

LNG, LNG fuelled vessel, emissions, fuel price, crew licensing, crew certificates.

1. INTRODUCTION

Although shipping is considered to be the most environmentally friendly as well as most economically efficient mode of transportation there is still space for improvement.
The International Maritime Organization (hereinafter IMO) report says that the global limit of 4.50% sulphur in force until January the 1st 2012 under the International Convention for the Prevention of Pollution from Ships (hereinafter MARPOL) Annex VI has not contributed to global emissions reduction, however it is estimated that that the 1.50% sulphur limit in Baltic Sea and North Sea emissions controlled area (hereinafter ECA) led to a 42% reduction in sulphur dioxide – SO_2 form shipping in these areas during 2008 (Einemo, 2009). According to MAPRPOL Annex VI the sulphur limits are subject to a series of step changes as can be seen in Table 1.

Table 1. Current and future sulphur limits in shipping

Outside ECA	Inside an ECA
3.50% on and after January 1st 2012	1.00 on and after July 1st 2010
0.50% on and after January 1st 2020 (2025)	0.10% on and after January 1st 2015

Source: (OJEU, 327/2012)

For newbuildings fuel consumption reduction means designing more fuel efficient ships, which, among others, includes fitting more efficient engines, as the design of the main engine, is the single most important influence on fuel consumption (Stopford, 2009, p. 234). Nowadays there are several types of engines being fitted into the ships, for example diesel engine, diesel-electric engine, steam turbine or dual fuel engine, etc.
Dual fuel engine running on either diesel or gas are

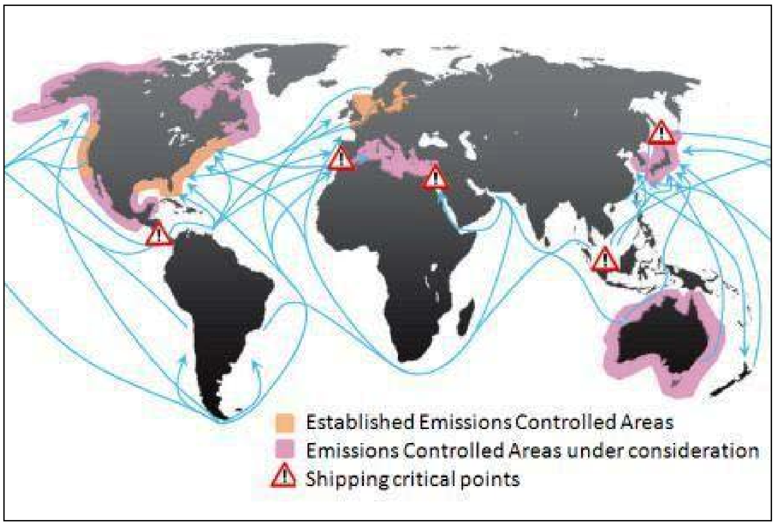

Figure 1. Established ECAs and ECAs under consideration
Source: (Santala & Manager, 2012)

Furthermore several new ECAs could be established in future as can be seen in Figure 1.
The bunker prices are highly correlated to crude oil prices (see e.g. UNCTAD, 2010) and the mechanism for determining crude oil prices is very sophisticated and depends on several factors, such as: Organization of the Petroleum Exporting Countries (hereinafter OPEC) production, non OPEC supply, global oil inventories, global economic growth (demand), exchange rates and inflation, geopolitical risks, speculations etc. Fuel costs are thus difficult to predict and often represent a high burden to shipping companies. As shipping companies cannot control the bunker prices they at least try to improve the ships fuel efficiency.
There have been many technical and operational solutions identified to reduce fuel consumption and consequently harmful emission from shipping, like slow-steaming or kite technology.

safe, reliable and environmentally desirable (MAN, 2012), LNG is thus considered the fuel of the future, not solely for LNG carriers but for all kinds of ships.

2. LNG AS A SHIP FUEL

LNG has been in use for many decades as a fuel on LNG carriers. In fact, there are almost 400 LNG carriers, many of which are dual fuel, so they can decide on the fly whether to burn their boil-off or regasify it (Morris, 2013). But there is also about 10 years of experience, mainly in Norway, on small ships with LNG propulsion, e.g. ferries and offshore supply vessels (Harperscheidt, 2011).
There are about 30 LNG-powered vessels in service worldwide today and there are another 30 or so in design or construction (Morris, 2013). Two 181

meters long pure car truck carriers (hereinafetr PCTC) fitted with the dual fuel engine will be delivered in the second half of 2016. These ships will be the first PCTCs to be fitted with an LNG-fuel propulsion system and will be able to complete a 14-day round voyage in the Baltic using solely LNG fuel for main engine and auxilary power generation (NYK, 2014).

The costs of an LNG propelled ship are 10-15% higher than that of a conventional ship, but at the moment the price of LNG is significantly lower compared to conventional fuels. In addition maintenance costs of LNG fuelled ships are expected to be 50% lower (CNSS, 2011). Benefits of operating a LNG fuelled are shown in Figure 2.

LOW COST ENERGY	STABLE PRICING
• LNG costs less than IFO, HFO or MGO which will be required in ECAs	• Worldwide gas inventories reduce price volatility from geopolitical impacts • Low feedstock costs
CLEAN	**SAFE**
• SO_X reduction by almost 100% • NO_X reduction by 60% • PM reduciton by 72% • CO_2 reduction by 25%	• Zero fatalities over 40-year life of the industry

Note: IFO – Intermediate fuel oil, HFO – heavy fuel oil, MGO – marine gas oil, SO_X – Sulphur oxides, NO_X – nitrogen oxides, PM – Particulate maters, CO_2 – carbon dioxide

Figure 2. Benefits of using LNG as a ship's fuel
Source: Authors, based on (Hill, 2013) and (CNSS, 2011)

Currently it seems that conversion of existing ships (although it is very costly) or the construction of new LNG fuelled ships is reasonable in shore sea or liner trades. It still remains to be seen if LNG can be used as fuel in bulk and tramping. This depends on if the crew can reliably troubleshoot cryogenic system failure and confidently establish total operational self-sufficiency on the high seas (Hsu, 2013).

3. CREW REQUIREMENTS FOR THE LNG CARRIERS AND LNG FUELLED SHIPS

While LNG has some extreme properties, its characteristics and behaviour are mostly predictable. However, crew members on LNG carriers must complete specific training and education on safety aspects of this cargo as LNG is cryogenic liquid - it can cause burns on skin or can crack steel decks, while natural gas presents an asphyxiation hazard. Therefore LNG crew has to undergo extensive trainings which are set and prepared by International convention on Standards of Training, Certification and watchkeeping (hereinafter STCW) and Society of International Gas Tanker and Terminal Operators (hereinafter SIGTTO). SIGTTO is an organization that aims to ensure the safety of the LNG business, from production to consumption.

In order to provide safe transportation of liquid gas the crew aboard LNG carriers must prove their knowledge and competences regarding physical and chemical characteristics of LNG, LNG cargo operations, methods to prevent hazards etc. in several different ways, that is: in-service experience, training ship experience and simulator training (IMO, 2010, pp. 159-171). It thus in average takes from 10 to 12 years to train from Cadet to Senior Officer aboard an LNG ship (Clucas, 2013). Figure 3 represents training methodology in LNG industry.

Similar competence gas would present danger on LNG fuelled ships as well thus similarly rigorous training regime will need to be applied also to crew members of LNG fuelled ships. This crew will need to be able to recognise risks and be aware of specific points of attention related to LNG as well as to operate the related systems. In addition they must be able to perform LNG bunkering operations (shipboard) in a safe and controlled manner, recognise potential problems and handle emergency situations related to LNG (DNV, 2013).

The regulations governing the education and training for the crew of commercial vessels involved in international trade are comprised into the IMO STCW convention which among others contains description on special training requirements for personnel on certain types of ships, including tankers, but not gas fuelled ships. Therefore IMO published MSC.285(86) Resolution titled *Interim Guidelines on the safety for Natural gas-fuelled engine installation in ships* in June 2009. These Guidelines apply to ships other than LNG carriers and are not mandatory.

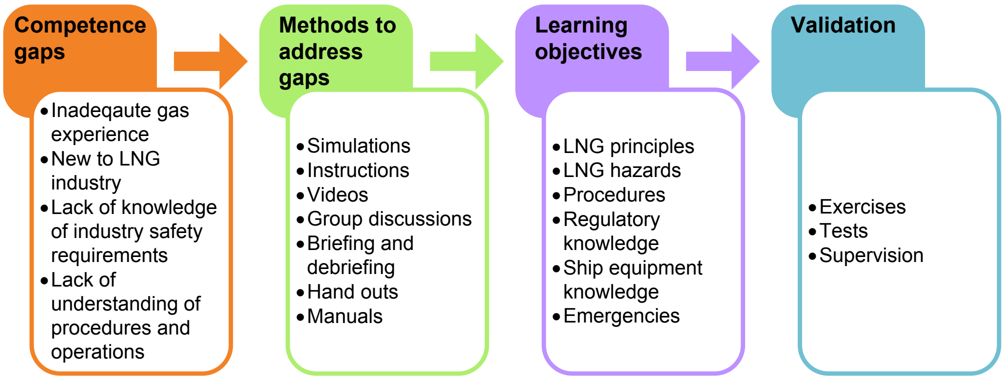

Figure 3. Training methodology in LNG industry
Source: (Clucas, 2013)

IMO is preparing International Code for Safety for Ships using Gases or Other Low Flashpoint Fuels (hereinafter IGF-Code) which was originally scheduled for completion in 2012, however the approval of the IGF Code cannot occur before November 2014 and the earliest possible entry-into-force date for the IGF Code is now July 2017 (LNG World Shipping, 2013).

Currently IMO Sub-Committee on Human Element, Training and Watchkeeping is working on IGF-Code section related to training of the crew. The main issue is to determine if training requirements for gas and chemical tankers already in place are suitable for officers and crew serving on ships fuelled by gas or low-flashpoint fuels.

The whole operational crew of a gas-fuelled cargo and a passenger ship should have necessary training in gas-related safety, operation and maintenance prior to the commencement of work on board. Additionally, crew members with a direct responsibility for the operation of gas-related equipment on board should receive special training. The company should document that the personnel have acquired the necessary knowledge and that this knowledge is maintained at all times (IMO, 2009).

IMO MSC.285(86) Resolution suggests to divide the training on gas-fuelled ships into three categories:

- Category A: Basic training for the all Officers / crew regardless of role or function;
- Category B: Supplementary training and requirements for deck officers; and
- Category C: Supplementary training and requirements for engineer officers.

Det Norske Veritas AS has compiled a standard that represents an upgrade to IMO guidelines and can be used as a reference to familiarise crew or to assess crew of LNG fuelled vessels as well as a guide to training providers.

The standard is divided into 12 chapters with precisely specified knowledge and cognition levels required for the above mentioned crew groups aboard of LNG fuelled vessel, and ranging from basic training on gas-safety, operation and maintenance to special training for operation of gas-related equipment. The summary of this standard is presented in Table 2.

Table 2. The summary of required competences for the crew on LNG fuelled vessel

General knowledge and understanding (physics and chemistry; risk awareness, health and safety)
The storage system (bunker tanks; bunker transfer arrangement; tank connection space; pressure control; temperature monitoring; level gauging systems)
The gas supply system (repairs and exchanging parts; cryogenic valves and pumps; gas isolation valves; high pressure pumps; in-tank pumps; spray pumps)
The LNG monitoring system (control and alarm board; vapour control)
Venting and ventilation (importance of venting and ventilation; double walled piping; fuel gas venting system)
Compressors (high duty compressors)
Safety systems and components (gas detection system; emergency shutdown system; safety relief valves; fire detection system; portable gas detection equipment; ex-certified equipment)
Auxiliary systems (inert gas generator; nitrogen generation and distribution; air and inert gas dryers; gas heaters; vaporisers; water curtain; control air)
Bunkering (bunkering preparations; bunker transfer; bunker calculations; shore connections / emergency release)
Tank conditioning (warming up; gas freeing; inerting; purging)
Warm up / heating (water glycol intermediate circuit; heating system)
Contingencies (general; LNG spills; LNG leaks; LNG fire; emergency shutdown; emergency unloading / transfer of LNG; emergency discharge / release; emergency separation)

Source: Authors, summarized from (DNV, 2013)

3.1 Worldwide crew supply

The worldwide supply of seafarers was estimated to 624,000 officers and 747,000 ratings in 2010[1], while the worldwide demand for seafarers was 637,000 officers and 747,000 ratings (BIMCO/ISF, 2011). A Japanese study on future global supply and demand for seafarers concluded that around 32,000 additional officers and 47,000 ratings would be needed to man the projected fleet in 2020 (Sulpice, 2011). Clucas (2013) states that at least 1,200 additional officers to will be needed by the year 2016 to fulfil the needs of the expanding LNG fleet.

Several reasons affect the shortage of seafarers, for example the fact that:

- in many countries, a seafaring career is not viewed as an attractive employment option;
- the senior officer cadre from the traditional maritime nations is aging;
- officers from "second generation" supply nations appear less keen to continue in seagoing service beyond the age of 50;
- criminalisation of seafarers is a disincentive to taking up a senior seagoing positions (Drewry, 2006, p. 97).

4. CONCLUSIONS

The skills needed to operate ships are changing with the technological changes in maritime industry. One of ten major functions aboard the ship is main engine operation (see e.g. (NRC, 1990)), so the expansion of LNG fuelled fleet will fetch important changes as the crew members will have to attain specialized skills to be able to safely operate such ships. Will these requirements pose additional pressure on the already scanty number of seafarers?

LNG is environmentally friendly, its supplies are abundant, and it is priced significantly lower than distillate or residual petroleum fuels. LNG is thus considered a fuel of the future. However, the LNG fuelled ships similarly as LNG carriers will require specially trained crew.

While the mandatory on-shore courses (Basic tanker safety and Advanced liquefied gas tanker safety) are fairly inexpensive (around 600 EUR) and not time consuming (around 60 hours), the on-board training and testing is much more demanding. This is necessary to continue achieving excellent safety records on LNG carriers as well as LNG fuelled fleet.

And while the LNG industry offers an attractive career at sea from the financial point of view it still remains unanswered how will be the extra qualifications rewarded on LNG fuelled ships. However, it is quite clear that some benefits will have to be provided in order to attain and maintain adequate crew.

[1] For comparison, there were 823,000 ratings in 2000 (Drewry, 2006, p. 99).

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A CASE STUDY ON THE PREDICTION OF SOME HYDRODYNAMIC CHARACTERISTICS OF A SMALL MARINE VEHICLE

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ABSTRACT

The determination of hydrodynamic characteristics of a marine vehicle is an important element of ship design process. Among the hydrodynamic characteristics, the prediction of resistance and power is one of the most important elements of ship design process, because they affect the size and weight of propulsion plant, assessment of fuel consumption and operational cost. Prediction of resistance and power can be achieved through experimental methods, CFD calculations, regression equations and data of systematic series. The choice of power predication method depends on available capacity, the accuracy required, funds available and the approach to project development. Among the possible options in the hands of the designer to predict the resistance and power the experimental procedure remains the most reliable prediction tool.

Nevertheless, for certain type of hull, the results based on data of systematic series have a high reliability on the final result of calculations, comparable to that of the experimental procedure. In this paper will be treated a specific procedure for the prediction of power and resistance of a small marine vehicle based on data of NPL systematic series. Also, in this paper, will be treated the assessment of some other hydrodynamics characteristics of this boat, based on data of NPL series. The assessment of these characteristics is achieved by combining the data of NPL series with CAD applications, as supporting part of the design process.

KEY WORDS

Resistance, Power, Hull, Systematic Series, CAD

1. INTRODUCTION

Prediction of ship propulsion power and of other hydrodynamic characteristics is one of the most important elements for the ship design process. Knowing the required power, in order that ship reaches the maximum speed required, allows the dimensioning of the propulsion plant, determining the amount of fuel for a certain autonomy and the completion of the evaluation process of weights and center of gravity of ship.

Evaluation of ship resistance is one of the key elements for determining the installed power of ship. To evaluate the resistance of a ship the designer has several options available, that are traditional methods, standard systematic series, regression based methods, direct model test and Computational fluid dynamics (CFD). The choice of method depends not only on the capability available but also on the accuracy desired and the funds available. [1],[2],[3].

The design process for the prediction of resistance and power of ship traditionally uses tests with models as the most reliable tool to predict the hydrodynamic performance of the ship. For traditional ships the calculations based on statistical and systematic series data can provide estimates of power almost with the same accuracy obtained from experimental tests. In this way for many types of ships the systematic series and statistical data are a valid instrument in the hands of the designer to predict the resistance and power.

In literature there is a great wealth of data available to the designer and analyst in the form of model data and more particularly in model data relating to standard series hull forms. [1],[2],[3].

In this article we do not intend a comprehensive treatment of all systematic series used to predict the hydrodynamic characteristics of the hull, but will treat a specific procedure that we implemented in a concrete assessment case of hydrodynamic characteristics of a small boat.

Prediction of these characteristics is made after the request of the owner of this boat.

Prediction of these characteristics is realized by combining CAD applications and the data of NPL systematic series.

2. MATERIAL AND METHODS

Systematic series of ship hull are experimental summaries of resistance and power in a family hull derived from a parent model with similarity criteria. [1],[2],[3].

In generating a series of systematic, are altered systematically the key parameters of shape such as, L/ B, B / T, CP, etc. .., to determine the effect of these parameters on resistance in calm seas. The accuracy of value of the calculated resistance for a whatsoever hull can be more satisfactory if the hull on examination is very similar to the parent hull of the series.

The weakness of a systematic series appears when the hull to be designed falls outside the limits of the definition of the series.

For the correct application of a systematic series is needed the recognizing of key ratios of the hull dimensions, recognizing of some key characteristics of hull as, displacement ∇ and the longitudinal position of center of buoyancy LCB, recognizing of coefficient of fullness as prismatic coefficient, block coefficient etc.

Traditionally calculation of hydrostatic characteristics necessary for the application of systematic series is done through the application of manual methods of approximation, which:

- require long time to realize the calculations, delaying the process of power prediction and other processes associated with it;
- lead to errors, sometimes significantly, which subsequently affect the final result obtained from the application of series;

Computer Aided Design (CAD) is an advantageous environment that helps on:

- Reducing the time of the ship hydrostatic calculations versus traditional process.
- Increase the flexibility of design analysis enabling the designer to see the impact of change of the geometric characteristics of the hull resistance and power and finding the optimal solution.

In this way, to enable the assessment of hydrostatic parameters of hulls, the designer firstly must make the hull modeling on a CAD modeling program and then conduct an analysis of built CAD model on a CAE program.

For the boat to which we must make the calculations of the hydrodynamic predictions, were available only theoretical hull lines drawing, which was made available to us by the boat owner.

For the implementation of the predictions of hydrodynamic characteristics of the boat taken in consideration firstly we have designed a schematic flow chart to be followed. In Figure 1 is presented the developed flow chart for this purpose.

Figure 1. The overall schematic flow chart

3. RESULTS AND DISCUSSIONS

The above flow chart is applied to predict the resistance and power of a small craft with the following dimensions:

- Length overall 9.200 m
- Length on design waterline 8.740 m
- Length between perpendiculars 8.125 m
- Maximum Breadth 2.000 m
- Breadth on water line 1.715 m
- Draft 0.420 m
- Depth 1.020 m
- Maximum navigational speed 20 Knots
- Scale of Design 1:5

for hull hydrodynamic predictions using systematic series and CAD applications.

In the ship lines plan are realized the necessary measurements for the creation of the cloud of points. On the basis of these measurements and the cloud of points is realized the 3D CAD model of the craft. The number of measured points in the ship lines plan is 411.

The number of section in body plan is 27. The distance between sections is 0.325. According to lines plan of the ship results that the after perpendicular coincides with section number 0 and the forward perpendicular coincides with section number 26.

This hull presents a small cylindrical body. Keel line of the hull coincides with baseline only in the region that lays between sections 18 and 21. From ordinate 18 the keel line undergoes a linear increase towards stern with an angle equal to approximately $2{,}25^0$. The forward body of this hull starts at section 21 and goes to the forward extreme in the form of a steep bow.

In total, in drawing are shown 16 water lines where 8 water lines belong to underwater part and 8 water lines belong to hull part exposed in air.

At the stern the sections of this hull are U-shaped sections which gradually are transformed in V-shaped sections in the forward part. In the lines plan drawing of the craft not result any appendage.

For the construction of 3D model of the hull surface is used the methodology of reference [4].

In figure 2 is presented the 3D wireframe model of the hull. The model is realised in Software MAXSURF PRO.

Based on the 3D model are performed the hydrostatic calculations of the craft.

From visual inspections performed, as in paper format of ship lines as well as in 3D CAD model, results that the series that approximates this hull is the NPL series, with parent model 100A NPL.

In table 1 are presented the characteristics of the parent model of the NPL series (100A) and data of the hull craft under investigations. [5]

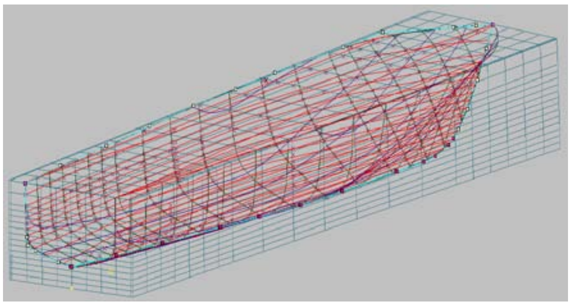

Figure 2. The 3D model of the ship hull modelled.

Table 1. Comparisons of characteristics 100A NPL with those of the modelled hull

Symbol	NPL Series	3D hull model
Block coefficient CB	0,397	0,395
Prismatic Coefficient CP	0,693	0,689
Coefficient of max. area	0,673	0,649
LCB Position	6,4 % A LWL	0,519 m A = 6,3877

As can be easily ascertained, the main features of NPL series and the main features of the designed hull are very close to each other, so the calculations of hydrodynamic performance can be performed without corrective effect. From calculations the hull wetted surface is approximately 13 m^2 while the displacement is Δ=2.947 T.

Since in the report of NPL systematic series [5] are presented the specific residual resistance values, i.e. ratio R_R/Δ, the calculations of total resistance (R_T) are made according the following formula:

$$R_T = R_F + \left({R_R}/{\Delta} \right) \cdot \Delta \tag{1}$$

Where friction resistance RF is calculated according to ITTC 57, on the basis of the friction coefficient calculated according the following relationship:

$$C_F = \frac{0{,}075}{(\log_{10} R_N - 2)^2} \tag{2}$$

The values of RR/Δ ratio are calculated on the basis of coefficient M and volumetric Froude number F∇.

$$M = 1{,}0083 \cdot {L}/{\Delta^{1/3}} = \frac{1{,}0083 \cdot 8{,}125}{2{,}497^{1/3}} = 6 \tag{3}$$

With the value of coefficient M = 6 and the ratio L/B = 4.55 we have defined the values of specific residual resistance. In Figure 3 are shown graphically the results of calculations.

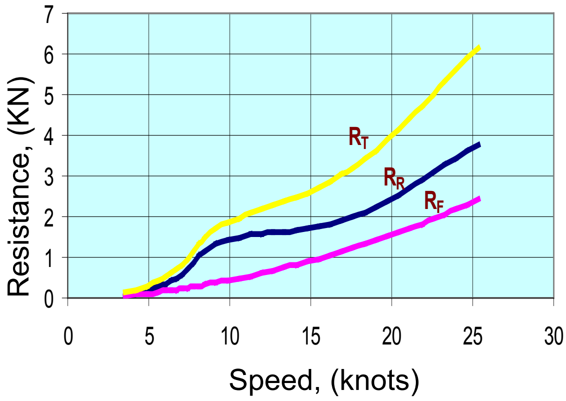

Figure 3. Graph of specific resistance V.S velocity;

Calculation of the residual resistance R_R, frictional resistance R_F, total resistance RT, total resistance coefficient C_T, residual resistance coefficient C_R and coefficient of friction resistance R_F is achieved using ITTC 57 procedures. [1],[6],[7]. Figure 4 shows the graphs of the resistance coefficients.
Based on calculations of total; resistance RT is calculated the effective power:

$$P_E = R_T V \tag{4}$$

Similarly, we have realized the calculations of trim angle.
Calculations are made using the published data of NPL series [5] in function of coefficient M, L/B ratio and Froude number.
In this case these values are M = 6, L/B = 4.55 and the field of F∇ [0 – 3]. In Figure 5 are presented graphically the results of calculations.
Table 2 shows a summary of the results of calculations.

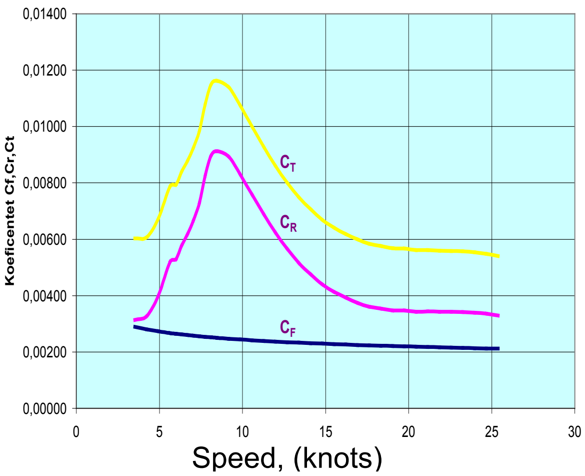

Figure 4. Graph of resistance coefficients.

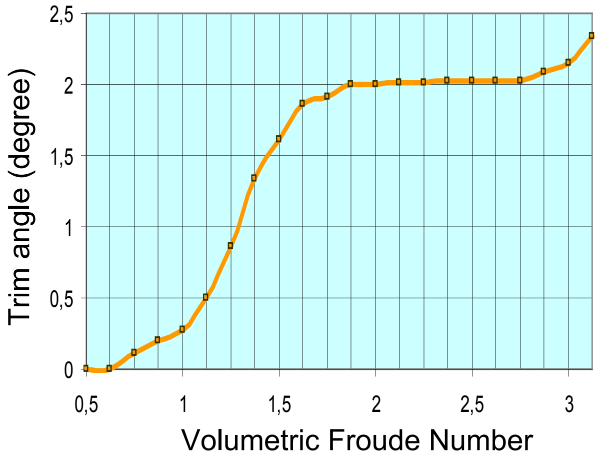

Figure 5. Graph of trim angle.

Table 2. Summary of the calculation results.

F_∇	V (knots)	R_R/Δ	R_R (KN)	R_F (KN)	R_T (KN)	CF	C_R	C_T	PE (HP)	τ
0.6	4.23	0.04	0.10	0.09	0.19	0.00280	0.00327	0.00607	0.56	0
1	7.05	0.24	0.59	0.23	0.81	0.00258	0.00666	0.00924	3.95	0.27
1.4	9.87	0.58	1.43	0.42	1.85	0.00244	0.00830	0.01074	12.60	1.3
1.8	12.69	0.65	1.61	0.67	2.28	0.00235	0.00565	0.008	19.96	1.92
2.1	14.81	0.69	1.70	0.89	2.59	0.00229	0.00439	0.00669	26.49	2.01
2.5	17.63	0.80	1.98	1.23	3.21	0.00224	0.00361	0.00584	39.02	2.03
2.8	19.74	0.97	2.39	1.51	3.91	0.00220	0.00347	0.00567	53.23	2.03
2.9	≈ 20	1.02	2.53	1.61	4.15	0.00219	0.00343	0.00561	58.51	2.08

Another important element, of the hydrodynamic design of ship, is the analysis of the maneuverability of the craft.
Generally the maneuverability analysis are related with directional stability, maneuverability and revolving capability.

- directional stability is the ability of ship to maintain the linear movement.
- maneuverability is the readiness of ship's response to actions intended to change its original path, or to restore it to original path when is removed from a random cause.
- revolving capability is the ability, of the ship, to change the direction of the movement in restricted areas.

NPL Systematic Series is one of few series that also allows a preliminary analysis of maneuverability characteristics.
In figure 6 is presented the relevant graph rotation diagramof the model 100 A NPL.
In this graphic are presented the values of the ratio L/R (length of the vessel to the radius of the rotation),as function of rudder angle, for fixed value of Froude number.

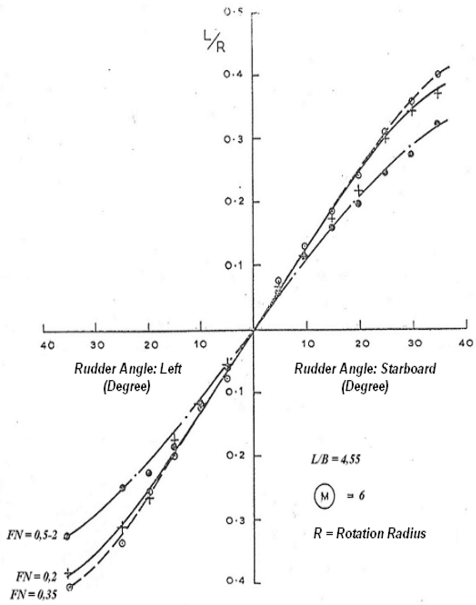

Figure 6. Rotation diagram of the model 100A NPL.

As can be easily observed all curves pass at the origin of the coordinative system.
That means that for rudder angle equal to zero the value of the ratio L/R is zero. Mathematically this value can be obtained either when the ship length is L = 0 (that physically makes no sense), or when the radius of the rotation R $\rightarrow\infty$, that geometrically represents a rectilinear movement. So, we can say that the hull under investigation has directional stability.
Also according to estimates made for the seriescan be said that the model 100 A NPL has good maneuvering and evolving ability.
Other maneuvring data estimated from report the series are:

- **Tactical diameter**

✓ Rudder angle 35^0. From the series data the ratio Tactical Diameter/Length is equal to 6.5.From this value we can define the tactical diameter:
$$D_K = 6{,}5 * 8{,}125 = 52.8125 \text{ m} \quad (5)$$
✓ Rudder angle 30^0.From the series data the ratio Tactical Diameter/Lengthis equal to*7,5.* From this value we can define the tactical diameter:
$$D_K = 7{,}5 * 8{,}125 = 60.9375 \text{ m} \quad (6)$$

- **Advance**

✓ Rudder angle 35^0. From the series data the ratio Advance/Length is equal to 3,9. From this value we can define advancing:
$$A = 3{,}9 * 8{,}125 = 31.6875 \text{ m} \quad (7)$$
✓ Rudder angle 30^0. From the series data the ratio Advance/Length is equal to *4,25.* From this value we can define advancing:
$$A = 3{,}9 * 8{,}125 = 34.53125\, m \quad (8)$$
✓ Rudder angle 25^0. From the series data the ratio Advance/Length is equal to *4,80. .* From this value we can define advancing:
$$A = 4{,}80 * 8{,}125 = 39 \text{ m} \quad (9)$$
✓ Rudder angle 25$^{\mathbf{0}}$. From the series data the ratio Advance/Length is equal to *5,5.* From this value we can define advancing:
$$A = 5{,}5 * 8{,}125 = 44{,}685 \text{ m} \quad (10)$$

- **Transfer**

✓ Rudder angle 35^0. From the series data the ratio Transfer/Length is equal to 3. From this value we can define the transfer:
$$T = 3 * 8{,}125 = 24.375 \text{ m} \quad (11)$$
✓ Rudder angle 30^0. From the series data the ratio Transfer/Length is equal to *3,25.* From this value we can define the transfer:
$$T = 3{,}25 * 8{,}125 = 26.40625 \text{ m} \quad (12)$$
✓ Rudder angle 25^0. From the series data the ratio Transfer/Length is equal to *3,5.* From this value we can define the transfer:
$$T = 3{,}5 * 8{,}125 = 28.4375 \text{ m} \quad (13)$$

4. CONCLUSIONS

In this paper was presented a complete procedure for predicting the effective resistance for a particular case of the prediction of resistance and power of a small boat. Also in the paper have been analyzed some other hydrodynamic characteristics associated mainly with the maneuverability of the vehicle. The procedure is implemented by combining CAD applications and the data of NPL systematic series. In function of speed are calculated resistance components, effective power and resistance coefficients. Results of calculations are presented either in graphic or in tabular form.
Based on the results of calculations for the design speed 20 knots the values of effective power and

trim angle are respectively PE = 58.51 HP τ = 2.08 degrees.
After the completion of these predictions the ship design process can continue with the dimensioning of other of elements such as propellers, main engine, shaft of propulsion plants, etc.
The procedure can also be applied successfully in the case of other Albanian ships for which thereis a lack of information about the hydrodynamic characteristics.

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THE OWNERSHIP RIGHT IN THE MARITIME DOMAIN

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ABSTRACT

The paper discusses the legal concept of ownership rights in the maritime domain, analyzing its aspects de lege lata and de lege ferenda. This is particularly important with regard to possible legal issues that may occur in practice, and to which the authors try to give answers: acquisition before the prohibition of the existence of ownership rights enters into force, expropriation problems and a number of other issues.

KEY WORDS

ownership rights, maritime domain, prohibition, expropriation

1. INTRODUCTION

This paper discusses two legal concepts (ownership rights and the maritime domain) which are significant and inherently interesting, even when studied separately. However, their importance becomes considerably larger when the research focuses on their **mutual relationship** exploring the <u>(in)ability of existence of ownership of the real estate located in the maritime domain</u>, i.e. exploring the ownership right and the maritime domain (sometimes referred to as *maritime demesne*) as a particularly important concept serving as an instrument for providing balance between the classical private interest (best exemplified in the case of ownership right) on the one hand, and public interest on the other. It is indisputable that the latter represents a general interest where it is not possible to acquire ownership rights, yet it is also beyond doubt that deviations from this rule are possible in a number of ways, e.g. implementation of concession models and redefining the maritime domain boundaries.

In order to facilitate a comprehensive overview, this paper outlines not only the features and changes experienced in Croatian legislation and legal practice since the independence of the state, but also the attempts that foreign legislations have made in order to find best solutions in governing the relationships between these two concepts which are inherently divergent but nevertheless compatible. The essential objective of this paper is to determine whether the existing legislative is good or not, and to define crisis points and bring suggestions *de lege ferenda*.

2. LEGAL SOURCES

Given the subject of this research, legal sources include all sources that, directly or indirectly, deal with the ownership rights and maritime domain. The Ownership and Other Proprietary Rights *Act* is the fundamental law (*sedes materiae*) that governs ownership issues, while the Land Registration Act is specifically important when the real estate is involved. Since the acquisition of ownership right implies, as a rule, both *titulus* and *modus*, and given the fact that a contract is the most common form of titulus, the Civil Obligations Act has the status of legal source as well. The legal sources also include the laws that regulate the maritime domain and ownership rights in the maritime domain, i.e. the Maritime Code and the Maritime Demesne and Seaports Act. Although still without legal power and although it may never obtain the status of legal standard, it is useful to point out the existence of the latest working version of the Draft of the Maritime Demesne and Seaports Act of 17 December 2013 (hereinafter: the Draft) which represents a rather extensive document that, *inter alia*, transparently reveals the views of the actual authorities on this issue.

3. DEVELOPMENT OF THE MARITIME DOMAIN INSTITUTE

3.1 What is maritime domain

Maritime domain has always been studied within the context of common good. The common good (*res communes omnium*) is a specific good that is shared and beneficial for all (or most) members of a given community and can not be the subject of anyone's proprietary rights or proprietary relationships. Hence, these are the goods in the non-proprietary legal regime, a concept that was and has been applied both in socialist societies and the capitalist countries *par excellance*, otherwise considered as societies strongly endorsing private ownership rights.

According to the effective definition contained in Article 3 of the Maritime Demesne and Seaports Act, the maritime demesne is the public estate of interest to the Republic of Croatia, is under its special protection, and shall be used and/or exploited under the conditions and in the manner prescribed by this law. The maritime demesne includes internal sea waters and the territorial sea, its seabed and subsoil, as well as parts of the dry land that are by their nature intended for public maritime use or are declared as such, including all areas that are permanently connected to these parts of the dry land at the surface or under it. The dry land parts include the seashore, ports and harbours, sandbars, rocks, reefs, beaches, mouths of rivers flowing into the sea, canals connected to the sea, and living and non-living natural resources in the sea and its subsoil.

The legal definition contained in the 1994 Maritime Code (Articles 48 and 49), which has been abrogated by the Maritime Demesne and Seaports Act, was only a slightly different, featuring a more detailed enumeration of what is deemed included in the maritime domain.

The new Draft of the Maritime Demesne and Seaports Act has not introduced any major changes in the definition either. In essence, the subject of potential disputes is not the very definition of the maritime domain or the enumeration of the elements it encompasses, but the exceptions to the general rule according to which it is not possible to acquire proprietary rights. Naturally, the exceptions may be effected in various ways, by allowing the acquisition of proprietary rights in the maritime domain or by introducing the regulations allowing the alteration of the maritime domain's boundary and, in this sense, the conversion of the non-proprietary status into the classical proprietary status.

3.2 Development of the maritime domain institute in foreign legislations

It can be asserted with great certainty that the groundwork of the modern maritime domain legislations lies in the Roman Law. In those days the sea and the seashore (and analogously, the rivers, lakes and their banks and shores) had the status of *res extra commercium* – things beyond commercial transaction At this point it should be explained that the public and general goods are essentially different categories. The fundamental difference arises from the fact that ownership rights can be acquired in the area declared as a public good, whereas this is not possible in the common good areas. Additional difference lies in the ability of the public good to be divided into the public good in general use (roads, bridges, parks, etc.) and the public good in public use (buildings and other premises, office furniture and other items that are in the direct service of executing the rights and duties of the State, its bodies and institutions). As the maritime domain represents an area where legal standards and codes of the civil and administrative laws are potentially both confronted and supplemented, it should be asserted that there is no reliable criterion which would ensure the delimitation between the relationships regulated by two legal fields. The issue appears even more serious given the fact that cogent (strict) norms prevail in the administrative law, while dispositive norms prevail in the civil law. As expected, exceptions can be found on both sides.

In Roman Law the legal groundwork for the construction of buildings on the publicly owned land is antecedent to the right of superficies, even to the long-term lease intended for constructing buildings on the privately owned land - *concessio ad aedificandum in solo publico*. European legislations largely benefited from the Roman Law heritage regarding civil rights: Austrian General civil act (Allgemeines Burgerliches Gesetzbuch, 1811), French Civil act (Code civil, 1803), Montenegrin Proprietary act (1888), German Civil act (Burgerliches Gesetzbuch, issued in 1896, entered into effect in 1900), Italian Civil code (Codice civile, 1938), and so forth. These European codifications of the civil right contained the foundations of the institutes of the general and public good. Due to the character of this legal area, many issues were regulated by legal norms from other areas, in particular from the administrative law. According to some sources, it is not in the nature of the civil law to define numerous important issues related to public and general goods, so that the development of the administrative law has filled the void in a way.

The theory and practice of the French legislation recognise the domains that can be public or private. There have often been controversial standpoints with regard to the public domain, from the view that the public domain implies the ownership rights of special nature, to the denial of ownership rights over the public domain (*insusceptible de propriete*). German theory distinguishes the possession of the state and other public legal entities by categorising it into financial or fiscal assets, administrative assets, and the public good or the good in general use (Sachen im Gemeingebrauch). The Austrian legal system divides the state possession into the public good (Öffentliche Gut) and state assets (Staatsvermogen).

Based on the provisions of the Codice civile on public good, Italy introduced a special code (Codice della navigazione marittima, interna ed aerea) whose initial articles bring the provisions on maritime domain. The Code closely defines the area of maritime domain that includes the seashores, beaches, harbours, anchorages, lagoons, mouths of the rivers pouring into the sea, salt or brackish waters that are connected to the sea at least during a part of the year, as well as canals that can be used for public maritime use.

American Law does not recognise the institute of the maritime domain but stipulates that the seashores belong to the state except for the seashore areas where the ownership rights of the individuals exist. However, these rights can be exclusively based on the state legal acts. In English Law the public good developed from the so-called royal land rights. It was only in the 20th century that the institute of public ownership and public corporations developed from the royal land rights. In 1908 all the docks and port facilities of the Great Port of London were declared public property, and the Port of London Authority was established as a self-funding trust and the first public corporation.

3.3 Development of the maritime domain in the former SFRY and Republic of Croatia

As the 1811 Austrian General civil act had a considerably influence in the former Socialist Federal Republic of Yugoslavia and has continued to affect the legislation of the Republic of Croatia after the independence, it is worthwhile to note that the Paragraph 278 of the Austrian General civil act contained the provision declaring the seashore as a use-only area termed the general or public good. It was the first time that one of the fundamental sources of Croatian Law used the notion of maritime domain.

The next step was the 1914 Ordinance on the enforcement of the legal article XXI on the concessions on the seashore where the Paragraph 2 prescribed that all lands in Croatia and Slavonia which, according to the maritime administration and the Croatian-Slavonian autonomous government, constitute the seashore, i.e. the general good, had to be given to the general use, while the interested parties were given the rights to appeal and seek legal protection. This was the

very first regulation to describe in detail the procedure of defining a part of the seashore as a maritime domain and of transferring such real estate into the non-proprietary regime. The next regulation governing the maritime domain issue was the Regulation with legal power on the public maritime domain, issued in 1939 by the Kingdom of Yugoslavia, which was implemented until 1974 when the Law on Maritime and Water Resources, Ports and Docks was brought. The Regulation defined maritime domain as public good, and stipulated that the Maritime Traffic Directory (*Direkcija pomorskog saobraćaja*) was in charge of establishing the boundaries of the maritime domain. Interested parties had the right to appeal and seek legal protection. The Regulation also prescribed the register of public maritime domain with the cadastral administration in accordance with the regulations on keeping the cadastral register. On the day of the independence of the Republic of Croatia, the effective regulation governing the maritime domain, i.e. the legal status of the sea and seashore, was the Law on Maritime and Water Resources, Ports and Docks was brought, which overruled the 1939 Regulation.
Shortly after the independence, in 1994, Croatian parliament passed the Maritime Code. The huge scope of the project reflected the ambitions and desires of the legislator and the general public. Unfortunately, at that time Croatia was apparently immature to bring a comprehensive and effective document that would perceive all legal, economic and political aspects, issues and consequences associated with the maritime domain.
The Ownership and Other Proprietary Rights *Act came into force in January* 1997 bringing, as *sedes materiae* for the issues of ownership, general provisions regarding the general good and public good. Although it is obvious that the Maritime Code and the Law on Maritime and Water resources, Ports and Docks have the status *lex specialis* compared to the Ownership and Other Proprietary Rights *Act, there is a need for solving inter-law conflicts that are more complex than they prima facie* appear.

Transitional and final provisions of the Maritime Demesne and Seaports Act, issued in 2003, explicitly abrogated the provisions of the 1994 Maritime Code. In 2004, the new version of Maritime Code came into force. Given the recently passed Maritime Demesne and Seaports Act, it naturally did not deal with the maritime domain.

The 2013 Draft of the Maritime Demesne and Seaports Act shows the determination of the legislator to thoroughly address the maritime domain issue. Even though it is not possible to envisage future events, the huge scope of the Draft justifies the optimism based on the presented commitment and seriousness of the approach of the Draft's makers.

4. PROBLEM FORMULATION AND ANALYSIS

4.1 General considerations

Unlike many legal problems that are relatively difficult to formulate, this is not the case when considering whether it is justified or not to establish the maritime domain as a general good where the acquisition of ownership rights is not possible. It is clear that the implementation of classical ownership rights in the seashore belt would present a context suitable for extortion and causing damage to the state. If any other form of right is taken into consideration, e.g. business premises, the worst scenario for such an object – no matter how important or unique it was – would involve the shutdown of the business at the expense of the owner (direct loss) and the wider community (through the suspension of taxes and duties, job losses and the like). However, if the access to the seashore was prohibited, this would not only hamper the free trade but also the freedom of movement, one of the essential components of the European *acquis communautaire*, which is unacceptable. It is more than justified to have a maritime area as a general good and to give the priority to public interest in case of potential conflicts between public and private sectors. It is correct to conclude that the general goods as a whole can not be owned by any civil right entity but should allow to be governed by public authorities. Indeed, it is necessary that a public authority, as a sovereign and not as an owner, manages and governs such goods for the benefit of all.
It can also be concluded that no restriction can or may be a purpose in itself. This means that every

restriction, including the implementation of the maritime domain, must have certain limits and capacity to be restricted itself, in order to avoid the effects of harassment and abuse. In each specific situation it is necessary to examine public interest, in other words, to determine whether this interest is better protected by exclusion from the maritime domain or by keeping the status of the maritime domain with or without particular restrictions.

4.2 Some specific issues

4.2.1 Introduction

When designing and implementing the regulations addressing the maritime domain as an exceptionally important form of the general good, it is necessary to take into consideration the environment, i.e. to be realistic as much as possible. This implies taking into account a large number of objects that have been built in this area despite restrictions, i.e. the huge added value on the one hand, the damaged value of the maritime domain on the other, as well as the social moment, various acquired rights, and other aspects. Fairness, in the widest sense of the word, can be considered as the fundamental criterion which forms the basis for distinguishing different situations, just and unjust. In the context of maritime domain, it is important to determine when the boundary was established, whether it is fair, whether the state participated in the acquisition, etc.

4.2.2 Maritime code (1994)

The 1994 Maritime Code was quite awkward when settling the issue of the ones deprived from their ownerships rights due to the implementation of the maritime domain. According to this Code, their compensation consists of using the objects on concession basis without paying the charges, until the amount of charges for using the maritime domain levels with the amount of compensation for the expropriated assets. The Code settles the matter in an awkward way because the charges are due as from the moment of expropriation, and if they are due, this means that the period of overdue interests commences, and since the overdue interests will be, as a rule, higher than the charges for concession, this implies that the former owner will be able to use the real estate forever. At the same time, the former owner will be aggrieved because he will not be able to use his rights as he might use the ownership rights. The state is aggrieved because it has not acquired the possession and is liable to contribute to the joint reserve funds for the maintenance of the object, which is an exclusive liability of the owner. At this point it is recommended to examine the accordance of such provisions with the Constitution which requires the market value reimbursement for any expropriation.

4.2.3 The maritime demesne and seaports act (2003)

It was expected that this Law would achieve better legal governance of the maritime domain than the 1994 Maritime Code. However, the new solutions deepened the drawbacks even further. In particular, the provision contained in Article 118 alinea 7 prescribes a special status for buildings intended for living, overlooking the fact that many buildings in the maritime domain are used for tourism business, not for living.

4.2.4 The 2013 draft

Makers of the new Draft made huge effort to address the issue thoroughly and systematically. However, an important shortcoming should be underlined. Article 234 contains a very good and practical novelty regarding the objects that were built legally in the maritime domain – now there is a possibility to start the procedure for the exclusion of part of the land upon which the object was built and which is indispensable for the regular maintenance of the building. The exclusion should be carried out in such a way that it ensures the free access to the shoreline, passage along the shoreline and the public interest in using the maritime domain. However, this provision is limited in its application as it refers only to the residential or residential-business buildings. It has already been noted that the 2003 Maritime Demesne and Seaports Act overlooks the fact that many buildings in the maritime domain are used for tourism business and not for living, when providing a special status for residential buildings. Since 2003 the trend of commercialisation has dramatically increased so that today it is very common that the owners of the buildings at prestigious locations (i.e. close to the sea or in the downtown area) move out from their houses and apartments during the tourist season, rent these buildings to tourists, and take considerably cheaper accommodation uptown.

It is our opinion that the Draft should be modified in such a way that the words "residential or residential-business buildings" are erased from Article 234, allowing the provision to apply to all buildings, under condition that they are built legally and that it is possible to ensure the free access to the shoreline, passage along the shoreline and the public interest in using the maritime domain. This modification would reconcile all the interests involved in a simple and cost-efficient way. Otherwise, countless lawsuits are likely to be filed before local and foreign courts, which implies a threat to the legally built objects regarding the legal safety and the rule of law.

In addition to standard buildings within the maritime domain which are intended for rental, there are buildings intended for other businesses. The Port terminal in Split can be deemed a paradigmatic case of how the legislator and other participants should not behave. The building was constructed in the 1970s and was owned by two physical persons and one company. By a decree of the Croatian Government of April 1997, the Split Port Authority was established for the purpose of administering, constructing and using the Port of Split. The new company took over all the assets previously belonging to the company Luka Split / Port of Split. With reference to Article 3 paragraph 3 of the Maritime Demesne and Seaports Act, affirming that ports make part of the maritime domain, a serious problem suddenly emerged. In August 2007 the State filed a lawsuit in the attempt to erase the ownership rights of the persons registered as the owners in the land-registry books and succeeded in this attempt after the court decision attained legal validity.

However, the issue has not been fully settled to date. Article 49 of the Constitution prescribes that the rights acquired through capital investment can not be reduced by law or other legal instruments, while Article 50 stipulates that exceptions can be authorised and the real estate can be reduced or expropriated under condition that the previous owner receives compensation for the expropriated real estate in the amount of the market value of the real estate which is being expropriated. The situation represents an ideal ground for the application of the standards endorsed by the European Law, especially the provisions on the right to legitimate expectation and the provisions stating that the errors made by government bodies can not be interpreted at the expense of the party. The causes of errors or negligence of a competent authority, as the author of an individual regulation applying the material law to a specific case, are not relevant – the only thing that is relevant is the fact that the errors or negligence of competent authorities can not be at the expense of citizens. This was the standpoint of the European Court of Human Rights in the case *Gashi against the Republic of Croatia* and the decision reached on 13 December 2007.

The real question is what the state interest is – to expropriate and provide compensation in the amount of the real estate's market value, or to modify the boundary of the maritime domain, avoid legal actions and the associated costs, and have some benefits from the activities performed within a specific real estate. It appears that the issue does not leave much room for doubt or hesitation and the only uncertainty that remains is the moment when the decision-makers will come to the same conclusion.

5. CONCLUSIONS

The goal of this research has been to outline the development of the institute of maritime domain in general and to analyse the issue of acquiring (and maintaining) the ownership rights on the real estate within the maritime domain. This paper deals with the issue of ownership rights in an area that indisputably represents a maritime domain, and the ways of settling potential conflicts between the state (public) and private interests. While endorsing the existence of the institute of maritime domain as the general good where it is not possible to acquire ownership rights, and while admitting that this institute has allowed exceptions and that private ownership has been nevertheless possible under various historical and political circumstances, we have attempted to point out that it is possible for the state to make profit, or reduce impending damage, at minimum cost and effort. When elaborating our views, we have taken into consideration not only the matter that should be the *ratio legis* of the national laws, but also the declared policy and standpoints of the European Court of Human Rights which make not only part of the Croatian Law but also present the judicial practise that the decisions made by Croatian courts have to be harmonised with.

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INDEMNITY CLAUSE IN STANDARD BAREBOAT CHARTER BARECON 2001

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ABSTRACT

The aim of the paper is to analyse the Indemnity Clause contained in the standard BIMCO bareboat charter form with the code name BARECON 2001 as the most frequently used contract form in a bareboat charter. Due to the complexity of this issue, a special emphasis is placed on the analysis of BARECON 2001 provisions regarding the Indemnity Clause (clause 17). This paper includes provisions for the indemnification in case of any loss of the chartered Vessel. The prescribed clauses are also compared with the clauses contained in the BARECON 89 standard form which was preceded by the BARECON 2001 and with the options prescribed by the Croatian Maritime Code. The differences in the contents of the indicated sources are emphasised. The analysis refers to other provisions of the standard form primarily those relating to the insurance of the ship. It covers the provision of the origin of the contract in case of any loss of a chartered Vessel as a result from not acting according to the clauses of the agreement. Conclusively, the detailed analysis of the Indemnity Clause in BARECON 2001 points out the relevant questions influencing the content of the rights and liabilities of the parties. The Indemnity Clause in this standard agreement form also underlines the importance of interpretation in which parties participate in the risks. Furthermore, the importance of applying this clause is in order to avoid the unwanted disputes between the parties, as is outlined in the represented terms of the contract.

KEY WORDS

Indemnity Clause, BARECON 2001, Loss of chartered Vessel

1. INTRODUCTION

A Bareboat charter contract represents a complex system of rights and obligations of the contracting parties. The contract establishes the right of Charterer to the use of the Vessel,[1] also his obligation is to act in a way that would protect the Vessel from misuse and damage. The Owner transfers the possession and control of the Vessel to the bareboat Charterer. In relation to the Vessel, the Owner is actually in the "background" (HILL 1995:185), in other words, the Owner does not take over the obligation for performance or success of the navigational ventures (SKORUPAN WOLFF 2008:578). Considering the many rights and obligations of the contracting parties, and the essential fact of transferring the possession of the Vessel to the Charterer, a question is raised, how should they share the risks that arise from signing this contractual agreement? The Charterer will seek to engage the Vessel in the most profitable manner and the Vessel becomes exposed to certain factors that may result in losses or damages incurred by the Owner. In such cases the

[1] By the use of the Vessel, the right to economic exploitation is understood, and the obtained benefits. See PAVIĆ 2006:288.

Indemnity Clause will have an important role in managing the risks associated with the bareboat charter. In discussing this clause, the importance of insurance in the maritime industry becomes evident.

The contracting parties use a contract form, which is prepared in advance, meaning a simple, fast, and above all legally secure, contractual arrangements.[2] Most parties use forms approved by the *Baltic and International Maritime Conference* (hereinafter: BIMCO).[3] First BIMCO standard forms of bareboat charter agreement, codenamed Barecon A and Barecon B,[4] quickly gained worldwide recognition and became very popular. These standard forms however were replaced with a new standard form called *The Baltic and International Maritime- Council (BIMCO) Standard Bareboat Charter*, Code Name: Barecon 89.[5] Finally, *BIMCO Standard Bareboat Charter*, Code Name: Barecon 2001[6] has replaced Barecon 89 as the industries standard form for a bareboat charter. Since its adoption onwards Barecon 2001 has been used for the vast majority of operating bareboat charters.[7] The content of Barecon 2001 clause is particularly interesting because, as we noted, the bareboat charter is a complex contractual relation. Out of all the clauses of the contract, in this paper we set aside the Indemnity Clause, which is in our opinion very specific and important in negotiating the bareboat charter.

Briefly presenting the structure of the Barecon 2001 we have aimed to determine the location of Indemnity Clauses within the provisions of the same standard form. We have analysed the provisions of the Indemnity Clause particularly trying to determine the obligation under the indemnity by the Charterer to the Owner and vice versa. The analysed provisions have been compared with the solutions contained in Barecon 89 which enabled us to make and present herein our estimation of the content of the Barecon 2001 Indemnity Clause. Finally, we have looked at the Croatian Maritime Code[8], especially the part regarding the bareboat charter and have determined which part of our legislature covers this issue about the designated conditions.

2. NOTES ABOUT THE STRUCTURE OF BARECON 2001

The Barecon 2001 follows the traditional box layout pattern used by BIMCO. The Barecon 2001, Part I, consists of boxes used for inserting the contract's key variable information pertaining to Parts II, III, IV and V.

The most extensive part of the standard form represents Part II which contains 31 clauses.[9]

Parts III, IV and V are optional parts to be applied as appropriate to the nature of the specific agreement and cover new-building Vessels, hire-purchase agreements and Vessels registered in a bareboat charter registry (*Explanatory notes for Barecon 2001*).

[2] The practice of contracting regularly uses the possibility that some of the existing provisions of the form, delete or supplement the original text with the new provisions (Rider clauses) and prominent freedom of contracting parties. For more, see *Ibid* p. 114.

[3] More about BIMCO available at: https://www.bimco.org/

[4] Following standard forms which were published in 1974 Barecon A is composed for bareboat chartering of commissioned vessels, with or without an existing mortgage, and Barecon B is composed especially for the use in case of newbuilding vessels financed by a mortgage. See TETLEY, 2002:161.

[5] Available at: https://www.bimco.org/~/media/Chartering/Document_Samples/Withdrawn/Sample_Copy_BARECON_89.ashx

[6] Available at: https://www.bimco.org/~/media/Chartering/Document_Samples/Sundry_Other_Forms/Sample_Copy_BARECON_2001.ashx

[7] Besides the mentioned standard forms, in practice some oil companies have used their own forms, e.g. Esso, BP and Shell. Shell especially uses *Shelldemis* - Time charter by demise. More available in ADEMUNI-ODEKE 1998:86 to 88. About differences between bareboat and demise charter also see PAVIĆ 2006:288.

[8] Narodne novine, no. 181/04, 76/07, 146/08, 61/11 and 56/13.

[9] Following titles are discussed: *Definitions, Charter Period, Delivery, Time for Delivery, Cancelling, Trading Restrictions, Surveys on Delivery and Redelivery, Inspection, Inventories, Oil and Stores, Maintenance and Operation, Hire, Mortgage, Insurance and Repairs, Insurance, Repairs and Classification, Redelivery, Non-Lien, Indemnity, Lien, Salvage, Wreck Remuval, General Average, Assignment, Sub-Charter and Sale, Contracts of Carriage, Bank Guarantee, Requisition/Acquisition, War, Commission, Termination, Repossession, Disoute Resolution and Notice.*

3. INDEMNITY CLAUSE IN BARECON 2001

Standard form of Barecon 2001 contains several new clauses when compering the content of Barecon 89. One of them is titled *Indemnity*.[10] This clause is under number 17, lines 560 to 586. It is divided into two sub-clauses: sub-clause (a) provides an indemnity by the Charterer to the Owner, and sub-clause (b) provides an indemnity by the Owner to the Charterer.

The precise operation of an indemnity depends fundamentally on how it is drafted and to which extent drafting properly reflects the intention of the parties. In this sense the Barecon 2001 is an example of a contractual form that helps the contracting parties to avoid possible contractual disputes. It also helps in avoiding expenses especially after the interpretation of the clause content has been formulated in such a way to protect both parties in case of any loss, damage or expense incurred by the non-defaulting party. What is important to emphasise is that the prescribed Indemnity Clause is only as good as the financial strength of the parties providing the indemnities. The Owner will be keen to ensure that the Charterer is financially sound and/or that the Charterer provides security (DAVIS 2005:98). Such security is in the form of a bank guarantee or a performance bond. Obligation prescribed by clause 24 in Barecon 2001, titled *Bank Guarantee,* whereby the bareboat Charterer, before delivery of the Vessel, submits a first class bank guarantee or bond in the sum as indicated in Box 27.[11] The purpose of submitting a first class bank guarantee or bond is to guarantee a complete performance of their obligations under bareboat charter.

3.1. Indemnity by the Charterer to the Owner

In Barecon 2001 provisions on indemnity by the Charterer to the Owner are prescribed by sub-clause 17(a), lines 561 to 564. It anticipates the Charterer's obligation to indemnify the Owner against any loss, damage or expense incurred by the Owner arising out of or in relation to the operation of the Vessel by the Charterer. Sub-clause covers indemnity for any loss, damage or expense made by the Charterer, therefore the provision very broadly provides a general indemnity. Furthermore, such formulations contribute to the protection of the Owner. It is important to point out that these are occurrences or activities for which indemnities are sought and drafted with phrases arising out of or in relation to the operation of the Vessel. When the Charterer is responsible for the loss, the question arises how will the damages be assessed. The answer to this question involves the application of the principles relating to remoteness of the damage. For them Barecon 2001 does not provide a solution, but it is left to the parties themselves to resolve the issue. In the absence of a common negotiated settlement, the role of arbitration will be of great importance.[12]

Analysing sub-clause 17(a) in BARECON 2001, logical Charterer's liability is to indemnify the Owner in case of loss, damage or expense, when taking into account the specifics arising by signing the bareboat charter. In the first place we think of transferring the possession of the Vessel and the acquisition of property to the Charterer. The Charterer, considering his place in a contractual relationship, must commit to pay the costs incurred by the Owner as a consequence of not respecting the provisions of the contractual terms. The liability for loss or damage to the chartered Vessel can range from relatively small claims for routine damage, to the total loss of the Vessel. In order to mitigate the uncertainty in this legal field, in particular the uncertainty of occurrences regarding cases for any loss of the Vessel, Barecon 2001 in Clause 13, titled *Insurance and liability*, lays down the obligation of the Charterer. In detail, sub-clause 13(a), lines 358 to 360 provide that the Charterer, at his own expense, keeps the Vessel insured throughout the Charter Period primarily against hull and machinery, war or

[10] Indemnity Clause contained in Barecon 2001 consolidates into a single clause the indemnity provisions previously found in *Non – lien and Indemnity* and *Bills of Lading* of Barecon 89. It extends the scope of these previous provisions from Barecon 89.

[11] See clause 24, lines 643 to 644 in Barecon 2001.

[12] Barecon 2001 contains a provision titled *Dispute Resolution*, it extensively regulates the manner of resolving disputes and determines the jurisdiction of the arbitral tribunal in the case a settlement was not negotiated. See clause 30 in Barecon 2001.

Protection and Indemnity risks.[13] These risks and liabilities are large enough that insurance protection is definitely necessary.

The provision of sub-clause 17(a), lines 561 to 564, is just one provision of the Indemnity Clause that should be read in conjunction with other provisions of the contractual form in order to be aware of the consequences that the described events will have on the contractual relationship for bareboat charter. Analysing other provisions of Barecon 2001, we see that in the event of a breach of contract, it would affect the indemnity by terminating the bareboat charter. Thus, in case of total loss of the Vessel, sub-clause 28(c), lines 826 to 828, provide that the bareboat charter will be deemed to be terminated if the Vessel becomes a total loss or is declared as a constructive or compromised or arranged total loss. The provision of sub-clause 28(c) of the indicated lines represents an extraordinary termination of the bareboat charter. Therefore, the Charterer will be charged for the Owner's loss, and the bareboat charter agreement will not be valid anymore. It should be noted that the provision states that the Vessel is not deemed lost until she becomes an actual total loss or an agreement has been reached in respect of her loss with her underwriters. If the underwriters fail to comply with the agreement regarding the Vessels lotal loss, the matter is then to be determined by a competent tribunal (*Explanatory notes for Barecon 2001*).

Furthermore, sub-clause 17(a), lines 564 to 566, stipulate the Charterers obligation to indemnify the Owner against any lien of whatsoever nature arising out of an event occurring during the Charter Period. This provision is pulled from Barecon 89, where its content almost entirely corresponds to clause 15, lines 387 to 388. Specifically, in Barecon 89, clause 15, includes only indemnity of the Owner when it comes to any lien arising upon the Vessel, but not in the case of compensation for any loss, damage or expense. Compensation for the Owner is stipulated by the introduction of a new form of contract. Indicated provisions do not require either breach or fault on the part of the Charterer to be operative. That means that the Charterer will not extend to any loss, damage or expense incurred as a result of the negligence by the Owner (DAVIS 2005:98 quoted according to *Smith v. South Wales Switchgear Co Ltd* [1978] 1 WLR 165).

In addition, the provision of sub-clause 17(a), lines 566 to 568 in Barecon 2001, includes indemnity by the Charterer in case that the Vessel should be arrested or otherwise detained by reason of claims or liens arising out of her operation hereunder by the Charterer. In case of occurrence of such events, according to sub-clause 17(a), lines 568 to 571, the obligation of the Charterer is to take all reasonable steps, at his own expense, to secure that within a reasonable time the Vessel is released, including the provision of bail. This clause is necessary in order for the Charterer to take all reasonable steps when it comes to a Vessel that was arrested or otherwise detained by reason of claims or liens arising out of her operation by the Charterer. Also, this provision could be interpreted in a way that arrest and detainment which occurred after the expiration of the contract is a result of claims or liens during the Chartered Period. We consider that the provision should be interpreted in such a way that the Charterer in each of these cases takes all necessary measures to release the Vessel even though the Vessel was arrested or detained upon the expiration of the contractual relationship. Although, the Owner may argue that it does not seem fair for his Vessel to be arrested or detained after the bareboat charter is terminated, however, by applying the Indemnity Clause contained in a standard form contract the Owner will not be left without compensation.[14]

Additionally, sub-clause 17(a), lines 572 to 576, in Barecon 2001, provide that, without prejudice the Charterer agrees to indemnify the Owner against all consequences or liabilities arising from the Master, officers or agents signing Bills of Lading or other documents. Talking about the Bill of Lading, it has long been recognised that in the case of bareboat charter, the Bill of Lading binds the Charterer and not the Owner. The Owner of a bareboat chartered Vessel will not be liable either in the contract or damaged for the consequences of the signing of the Bill of Lading by the Master, and such indemnity is likely to be of little practical effect (DAVIS 2005:98). In the provisions of the

[13] See the entire contents of clause 13 in Barecon 2001.

[14] The Owner has the same obligation similar to the one of the Charterer. The obligation is prescribed by sub-clause 17(b), line 577 to 581 in Barecon 2001. More *infra* section 3.2.

sub-clause other documents that are signed are also discussed, and the Charterer has to take the consequence or obligation to indemnify the Owner. Other documents may include delivery orders or sea waybills or the documents arising from contracts of carriage which the Charterer concluded on the basis of the bareboat charter.[15]

As previously stated, the provision of sub-clause 17(a),lines 572 to 576 in Barecon 2001, were previously contained in the provisions of clause 21 titled *Bills of Lading*.[16]

3.2. Indemnity by the Owner to the Charterer

When signing a bareboat charter contract it is important to take care of the issue regarding the indemnity by the Owner to the Charterer. In that sense clause 17, that we have emphasized, also contains sub-clause 17(b) dealing with the issue of indemnity by the Owner. The sub-clause 17(b), lines 577 to 581, provide that in case if a Vessel was arrested or otherwise detained by reason of claims against the Owner, the Owner shall take all reasonable steps to secure that the Vessel is released, including the provision of bail. Accordingly, this provision incorporates reciprocal indemnities for the Owner to indemnify the Charterer against the consequences of arrest prescribed by sub-clause 17(a), lines 566 to 571 in Barecon 2001.[17]

Further, sub-clause 17(b), lines 582 to 586 in Barecon 2001, prescribe that the Owner shall indemnify the Charterer against any loss, damage or expense incurred by the Charterer, including hire paid under the bareboat charter, as a direct consequence of such arrest or detention. The quoted provision particularly emphasises the obligation of the Owner to indemnify the Charterer's hire paid for the Charter Period, in case of the described circumstances. The rest of the liabilities for the Owner are defined very broadly, providing an indemnity to protect the Charterer against any loss, damage, or expense arising out of arrest or detention for which the Owner is responsible.

Unlike Barecon 2001, the previous standard form did not contain provisions for indemnity by the Owner, but only indemnity by the Charterer to the Owner. In this sense, there is no doubt that Barecon 2001 means a shift in the regulation of this matter between the contracting parties.

4. INDEMNITY PROVISIONS IN BAREBOAT CHARTER OF THE CROATIAN MARITIME CODE

The seventh section of the Croatian Maritime Code contains provisions regarding contractual maritime law. The most extensive part of this section is chapter II which includes provisions regarding the sea going vessels employment contracts.

The provisions for Bareboat Charter are regulated by a few articles, from article 658 to 672. Application of the provisions contained in the Maritime Code is valid only when the contracting parties determine the relevant Croatian law.

Analysing the same provisions of the Maritime Code, we see that the legislator does not actively interfere in the relationship between the contracting parties. It is primarily left for themselves to resolve the issue. Lacking relevant provisions in this case, one should reach not only for the sources of maritime law, but also for the sources of civil law.

Within these provisions, we can single out a provision relating to the responsibilities of the Charterer, which is related to the issue of indemnity. In accordance with Article 661, Paragraph 4, of the Maritime Code, the Charterer will not bear the loss of the Vessel due to force majeure. What the Charterer must prove in this case is that the force majeure is the immediate cause for the loss of the Vessel. It is interesting how Barecon 2001 in its provisions does not mention this case regarding Chareterer's rights.

5. CONCLUSIONS

Indemnity Clause in Barecon 2001 is designed to help and assist the contracting parties and to avoid contractual or any potential disputes. It is therefore formulated in a way to protect both parties. This type of protection is a process which

[15] Barecon 2001 contains a provision titles *Contracts of Carriage*. For details, see clause 23 in Barecon 2001.
[16] Compare clause 21, lines 427 to 429 in Barecon 89.
[17] See *supra* section 3.1.

has developed over time. We have seen it while comparing solutions on compensation for the contracting parties which is contained in Barecon 89. Although they are similar in their content, some differences between these provisions do exist. Indemnity Clause in Barecon 2001 consolidates indemnity provisions which are mentioned before in clauses dealing with *Non-lien and Indemnity* and with *Bills of Lading* of Barecon 89 into one single clause. Analysing the Indemnity Clause, we have concluded that there are two levels of compensation. The same provisions should be monitored without neglecting the content of other provisions of Barecon 2001.

In a closer study of the first sub-clause, general information regarding the indemnity on terms is provided where the Charterer must indemnify the Owner against any loss, damage or expense. Meaning, the Owner of the Vessel has the right to be indemnified against any loss, damage or expense in any case which the Charterer caused by any event that might have occurred during the Charter Period. Also, the Charterer shall indemnify the Owner against any lien of whatsoever nature arising out of an event which occurred during the Charter Period. The indemnity defined in the indicated provisions of Barecon 2001 concurs with the overall scheme of bareboat charters. In case that the Vessel is arrested or otherwise detained because of claim reasons that were caused by the Charterer, the Charterer is obliged to take all reasonable steps to make sure that the Vessel is released, including the provision of bail. The Owner should be indemnified from all possible consequences or liabilities arising from the Master, officers or agents signing the Bills of Lading.

The second sub-clause, describes the indemnity given by the Owner to the Charterer. The Owner must take all possible steps to release the Vessel from the arrest in case that the Vessel is arrested because of a claim against the Owner. In a situation when the Vessel is detained by any reason including claims against the Owner, the Owner must act in a reasonable way and consider to take all steps to release the Vessel, especially taking into consideration the inclusion of the provision of bail. In such cases, the Charterer should be indemnified by the Owner against any loss, damage or expense. This sub-clause ensures or defines that the Owner is obliged to ensure that the Charterer is financially sound, and that the Charterer will provide any kind of security in a financial way (e.g. a bank guarantee) for safe performance of their obligations for bareboat charter.

What we can safely conclude is that the provisions of the Indemnity Clause, contained in Barecon 2001 represent a clearer and stricter regime of compensation issues and regulations of the contracting parties in relation to the forms that preceded it. Although there are a few provisions of this legal problem, we think that some changes in the contents should be made. There is no doubt that Barecon 2001 means a realised shift of negotiating a compensation with the bareboat charter.

Considering possible future changes, the form should point out the amount of compensation as a suitable resolution, all for the purpose of better relations with the Bareboat Charter parties. Barecon 2001 contains no provision but just refers to the final part of the form which contains provisions regarding the settlement of disputes between the parties. When adopting a new form of contract, one should consider changing the contract with the provisions relating to the Vessel's arrest or detainment. It is necessary to determine whether the actions are related to the Charterer and if the Vessel's arrest or detainment is within the Charter Period or after the Charter Period has ended. There is no doubt that this is a reviewer's oversight.

Although the indemnification provision was not contained within the *Bareboat Charter* in our Maritime Code, it seems that it is not even necessary. The bareboat charter contract is the most important source of law for contractual relationships. The Maritime Code leaves the parties themselves to arrange all relevant issues relating to contracting. Only in the absence of indemnification provisions in the contract will other provisions of Maritime Code be applied, as well as the sources of civil law.

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SECURITY OF COMPUTER SYSTEMS ON SHIP

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ABSTRACT

Safe operation of the ship, among other things depends on the security of data and information generated by the computer systems that are embedded in the ship's systems or standalone computer systems. Security of data and information, or the safety of the ship's computer environment is a reality and needs. The building a manageable system of information systems on board the necessity of a special computer network security and industrial computers as critical components of an integrated information system. Establishment (definition, implementation, maintenance and improvement) the security of computer systems can be crucial in order to achieve and maintain competitiveness, provide material and financial profits and meet regulatory standards and ensure the business reputation of the ship. In other words, it is necessary to introduce policies and systems security to ensure information resources accordance with the defined standards.

KEY WORDS

security, standards, networks, data, information, computer system, boat

1. INTRODUCTION

Safety is a dynamic process of maintaining an acceptable level of risk. Safety and protection of information and communication systems based on a few basic postulates: Security is a process, there is no absolute security and the various methods and techniques of protection should take into account the human factor.

Initially, the application of information technology on board is not so much take account of security of information and communication systems and security of data and information. At the present time, the sudden application of information resources in marine systems, it is necessary to take account of the fact that modern information systems security policy must be carried out on board and in the ship organization. Not implementing security policies can lead to undesirable material, financial and human losses.

For now, the problem of security of information systems on the ship is not thoroughly developed or standardized by domestic and international maritime organizations. Practice shows that the infected (*infected*) general and/or industrial computer ships stood for a few hours, even a few days out operations which mean financial loss and reputation of the ship.

Information security is the protection of any data and information in order to preserve confidentiality, and ensuring that information is accessible only to those who have authorized access, integrity, which includes the protection of existence, accuracy and completeness of information and processing methods and the availability of ensuring that authorized users have access to information and associated assets when the service requires.

A safety marine information and communication system is a series of measures and actions to be taken to ensure the functionality of marine technical systems to forecast shipping conditions. The concept of information security applies only to:

- Physical measures (video surveillance ship space, protection of marine facilities, physical access control, accommodation media on which data is stored in separate rooms, restricting access to computing resources, controlling the conditions in these areas, such as temperature and humidity).
- Administrative measures (security policies, rules, procedures, controls, data access, and control procedures, training of users, define sanctions for those who fail to comply with the prescribed rules and procedures).
- Technical protection measures (access rights, user names, passwords, redundancy of critical components production, verification of user programs, data - backup).

General recommendations for the security of information systems require the implementation of multiple network layers with different levels of access to users and mandatory protection against malware. Also, should the security plan to ensure that every member of the ship's crew and the ship's organization is aware of their behavior and how it can affect safety. Information security management requires the participation of all members of the crew and ships the particular members of the technical department, and often need the help of a consultant outside of the ship (*authorized repair service and/or equipment manufacturers*).

2. TYPE OF COMPUTER AND NETWORK ON BOARD

Complexity, speed, efficiency and reliability performance of marine processes increasingly require the use of information and communication resources. Therefore on the boards in applying are the general purpose computers (PCs, laptops, servers) and industrial computers. The development of information technology has led to industrial computers in terms of hardware and software are so perfected that they became independent system and is increasingly used term industrial control system (*Industrial Control System*). At the administrative level of the ship are generally used personal computers and laptops, hardware or software servers and through them on a daily basis in communication via satellite from the shipping office on land and/or authorized service attitude to maintain the ship's systems. At this level, mainly used of the classic protection of computer systems such as antivirus, firewall, etc. On the other hand, industrial control systems on board are used for integrated system monitoring, management and control of marine processes. Historically such systems on board are isolated from the outside world, and they therefore did not need security protection that applies to standard computer systems. Today, modern industrial control systems are vulnerable to attacks from external networks and vulnerabilities that threaten the staff who operate and maintain them.

Industrial Control System is a general term that encompasses several control systems, including: SCADA (*Supervisory Control And Data Acquisition*) system to collect and monitor data in real time, DCS (*Distributed Control System*) control system and other control systems such as PLC (*Programmable Logic Controllers*) system [1,2].

Architecture SCADA system consists of the following elements: operator, man - machine interface, communication mechanisms, the main and remote terminals. SCADA system uses standard computing resources adapted marine environment. SCADA system is directly or indirectly connected with the ship's management and administrative network, an integrated information system of the ship, information system authorized service and remote access points (shipping agent, service with a laptop, etc.).

SCADA is a technology that allows users to collect data from one or more remote devices (*or set of devices*) and/or send limited control instruction to those same devices [3]. In addition, the SCADA systems apply effective mechanisms, improve plant and personnel safety and reduce operating costs.

Industrial control systems used today in nearly all graphical interface of industrial control systems on board to display information about the state of the entire system. As the SCADA systems evolve increasingly use modern complex standard hardware and software components as well as rapidly increasing connections to the internal (*administrative and shipping management network*) and external networks, including the Internet (*remote diagnostics*). All this leads to the integration of SCADA systems in the marine information subsystems. However, the integration of SCADA systems has resulted in a greater vulnerability of the entire integrated information system. Increased vulnerability of the overall system is due to the vulnerability of all the listed components. In marine environment, risk elements of SCADA systems are ordered by their importance:

- Operational availability management console on the bridge and consoles in the control room of the main machine,
- Precision data obtained in real time,
- Protection system configurations,
- Connection with managerial and administrative network,
- Availability of historical data on a local or administrative server,
- Availability of other console on the board.

The most famous manufacturers of SCADA and other industrial control systems are the following companies: Siemens, Allen Bradley (Rockwell) and Modicon. Each company has its own architecture and protocols. To connect the computer equipment almost all manufacturers are increasingly using the Internet protocol TCP/IP (*Transmission Control Protocol/Internet Protocol*), and redesigned networking protocols.
The development of microprocessor technology has enabled the development and production of electronic - computer control system called programmable logic controller (*Programmable Logic Controller, PLC*). PLC is programmed in accordance with the business process. Advantages of PLC in relation to the relay control system are reflected primarily in the reliable operation because there are no mechanical moving parts, because it is more flexible when changing applications should only be reprogrammed (*and not change the wiring*), reduced the extent of wiring and incorrect ships are based on the SCADA system. The wiring, dimensions are multiple less because the timers, counters and other relay control components resolved software. In addition, the PLC as industrial computer is resistant to a variety of adverse effects such as dust, moisture, high temperature, vibration, electromagnetic effects, because by its very structure designed to be placed close to the process operated. Because of these advantages, the PLC is widely used in the management of marine processes, especially in the management and supervision of the main and auxiliary engines on board.
At the present time there is hardly any ship in your business is not using the computer. Usually there are more computers connected to one another to form a computer network. Almost all marine (*boat*) processes are under the control and supervision of specific hardware and software support. All these computers are exchanged among certain information or create a database. At the present time, the business of the ship and the ship without Internet has become impossible. Therefore, the security of the computer network is one of the most important tasks, to ensure the protection and defense against external and internal attacks. Second critical component of an integrated information system on board is the computer network used to connect computer equipment and other electronic equipment (*measuring sensors, actuators, etc.*).
On trading ships used several types of networks, including:

- Administrative network,
- Ship management network,
- Industrial network,
- Dedicated networks.

At the administrative level networking of personal computers , servers , printers and others in the local area network (*Ethernet protocol*). The data transfer rate is 100Mbit/sec. Every computer on the administrative level has a precisely defined function that performs one or more applications.
Ship management level networking allows computers and servers that manage and monitor individual processes on the board (*e.g. cargo handling, navigation, power management of capacities, management of the main engine, etc.*). At this level is used: Ethernet protocol, and is

increasingly in use and MiTS (*Maritime Information Technology Standard*) protocol. MiTS protocol was developed as an integrated control protocol ship that can integrate NMEA (*National Marine Electronics Association*) 0183 industrial network with Profibus network that is used in marine automation gas supply criteria. Networking at the process level is consistent with the NMEA 2000 protocol and bit older NMEA 0183 protocol [4]. NMEA 0183 protocol was developed by the NMEA Association in cooperation with the U.S. Coast Guard in the early eighties of the last century and is the only uniform standard for digital data exchange between marine electronic instruments. Performances of the device and the amount of data that are exchanged devices have become replete NMEA 0183 protocol, so a NMEA 2000 protocol. The data transfer rate is 250Kbit/sec for NMEA 2000 protocol, and for the NMEA 0183 protocol is 4.8 Kbit/sec. A key factor NMEA 2000 network is the implementation of an integrated circuit network access protocols generally known as CAN (*Controller Area Network*), which is the basis for the development of two-way network with the ability of the listener/receiver. NMEA 2000 network allows connecting various electronic devices on the same bus with the aim of sharing information. At the network level are connected measuring devices, sensors, actuators in industrial control system that manages monitors and controls processes. Industrial control systems are interconnected via NMEA bus and jumpers with the computer (main station), which controls and monitors the operation of all system elements, and usually located on the control console on the bridge (Bridge) or in the control room of main engine (*Engine Control Room*).

Securing computer network is a continuous monitoring to the time spotted vulnerability and eliminates bottlenecks. It is necessary to monitor all active and passive devices and the time to protect against possible external and internal users. At the present time, the ships in the private and/or official purposes are all popular laptops and portable drives. But the use of laptops and discs brings the need to implement additional security controls. They must prevent any unauthorized activity that might endanger the safety of an integrated information system ship.

When choosing security solutions need to choose IT (*Information Technology*) tools, such as the Cisco SAFE Blueprint, applicable network and use multi-level modules that simplify security design. The advantage of this design is to ensure that in the event of failure of one of the parts of the security system does not impair the functionality of the rest of the network.

3. INFORMATION SECURITY MANAGEMENT SYSTEMS ON BOARD

Security of information systems on board is a complex dynamic process in which it is clear that without the quality of security system can't be fully protected. Security theory says that the security of information systems is always proportional to the security of its weakest (*critical*) point. A comprehensive, high-quality security program to provide security at all critical points of information systems on the board, and one of the best programs certainly define security policies. Security policy is a set of rules, guidelines, and procedures that define how the information system to make secure and to protect its resources (*hardware, software, databases, networks and people*). Security policy is a dynamic document that needs to be constantly reviewed, modified and supplemented when the opportunity arises. Security policy defined rules relating to: all information equipment (*boat, ship organization*), people responsible for operation and maintenance of information systems, all persons have the right to access and subcontractors who have the right approach.

One of the basic steps in establishing a security policy is to assess the vulnerability of the system. Security vulnerability is defined as the lack of which allows the attacker to breaches of security systems and/or information. Each hardware and software component of information system contains security vulnerabilities. Therefore, various security organizations have developed their own methods for systematic monitoring. Each method involves finding and analyzing vulnerabilities, information producers, cooperation in eliminating the public disclosure of information and the way to solve. The aim of vulnerability assessment is to identify potential risks associated with various aspects of the information system.

Practice shows two ways of defining security policies. First and cheaper way is to copy an existing security policy that implement one or a combination of two or more standard (*BS 7799, ISO/IEC 27001:27005*) and devise a security policy. The second and more expensive way of a detailed analysis and study of information systems, identifying its critical points, and deciding how it will protect the overall security testing of an integrated information system on board. In this way, all the information systems on the ship approached individually, employing a large number of experts and investment of considerable material and financial resources in the design, implementation and maintenance of security policies.

Security policy maintained an attitude of top management of the ship and the master's directions regarding security which clearly show strong support for all parties involved about the security of information resources. Top management must define the policy and expressed support in all phases of the implementation of information security resources to all ships in the fleet and ship management organizations.

4. ATTACKS ON INTEGRATED INFORMATION SYSTEM SHIPS

Essentially, attacks are actions that are aimed at endangering the security of data, information, computers and networks. Most attacks today are hidden in traffic that the end user is used as a legal and ignorance of authorized users to attack information systems. Attack on information resources on the board can be passive (*not changing attacked object*) and active (*changing attacked object*). The aim of the attack data resources, hardware and software support. General classification of attacks on information resources is shown in Figure 1.

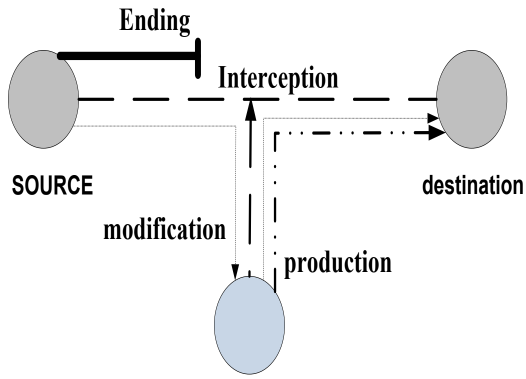

Figure 1. Graphic display attacks on information resources (source authors)

Some of the basic attacks that threaten the security of information subsystems on board with the standard software and hardware components are:

- Malware - virus (*a program that is installed on your computer and runs without our knowledge, reproduce on a computer and then running an infected program starts and virus*), trojan (a program that is pretending to be useful/entertaining. Running in the background some not desirable process that can generate erroneous data. Formally program because they can't reproduce), and worm (*programs that burden the network traffic not reproduce*. Deleting files and remotely use your computer to send mass mailings). In order to timely protect against viruses and other types of malware, follow the following precautions [22]: use antivirus software, use a firewall not open unknown e-mail senders or suspicious attachments , do not run or send other people programs by unknown authors, if using one of the operating systems of Windows family remove the option to hide extensions of known types of data to identify hide executable files, regularly update your operating system and programs you use and be aware of the dangers of using movable code (*mobile code*) in ActiveX , Java and JavaScript, and if possible, disable their use on your computer,
- Unauthorized disclosure of critical data,
- Unauthorized manipulation and modification of critical data,

- Denial of Service - is deliberately generate large amounts of network traffic and thus seeks to stifle equipment and servers. Same become so burdened that they are not able to process traffic determined what is causing the services that they provide are not available to the end user ,
- Distributed Denial of Service - is the same attack as previously described attack provided that the sources congested network traffic distributed across multiple locations. The essence of this attack is to have broken into the computer used to attack other networks or any computer on the Internet,
- An authorized access to managerial and supervisory records and their modification.

System and user programs can contain security vulnerabilities that users at risk of attack. One of the more dangerous vulnerabilities is *zero day* vulnerabilities. In other words, the developer fails in an application that individuals have discovered a manufacturer. Vulnerability of software can be shown through errors in the source code, implementation, validation, maintenance, protocols etc. For such vulnerability there is no patch that eliminates a security problem and every computer with such vulnerability is very sensitive to malicious attacks.

In June, the 2010th, antivirus security company Virus-Blok-Ada reported the first discovery of a malicious program that attacks SCADA systems (*Siemens WinCC/PCS 7 systems*). Malicious program called Stuxnet. Stuxnet's entire code has not yet been discovered, but its content targets only those SCADA configurations that meet the criteria that Stuxnet is programmed to recognize [5].

The software industry has produced and sold tools for vulnerability assessment of networks and information systems. The market can find free and commercial tools. Free software's are: Nmap who works in command mode, Zenmap with graphical user interface (*for Linux, Windows, Mac OS, BSD, etc.*), Microsoft Baseline Security Analyzer for the Windows operating system, etc. An example of a commercial tool is a Swedish Outscan [24]. Outscan the software on demand (*Software as a Service*), which means to be used directly from the Internet. The principle of operation is based on Outscana sending network packets and analyzing the replies received to determine the characteristics of the remote object. It takes place in the following steps: detecting seats, port scanning, maintenance protocols, maintaining the operating system and application maintenance.
Security of integrated information system using laptops and/or removable drives can be compromised in the following ways:

- Random procedures authorized seaman and/or an authorized service provider,
- Intentional actions authorized seaman and/or an authorized service provider,
- Intentional unauthorized procedures seaman and/or unauthorized service,
- Run infected code on a laptop,
- Theft, loss or modification of data due to improper handling of a laptop,
- Intentional or unintentional maintenance activities laptop,
- Connect an infected removable disk on-board computer.

To the security risk of using laptops and media to a minimum, each seafarer shall comply with the rules and procedures defined by the shipping organization and/or manufacturers of computer equipment.

5. THREATS TO SAFETY INFORMATION SYSTEM ON BOARD

Threat to the security of information and communication system on board is every event that can cause a disruption of the integrity, reliability and availability of data and information. Each threat and unauthorized access to information and communication system has different effects on the state of the execution process or ship the safety in its entirety.
There are several classifications of threats to information systems, but it is questionable only if each classification sufficiently full consideration to all the terms and conditions of the possibility of damage to the information and communication system in the marine environment. According to the source, the threat can be divided into:

intentional threats - people, unintentional threats - people, equipment, and natural disasters.
CSI (*Computer Security Institute*) stated a very simple classification of threats with regard to the position of threats in relation to the position of an information system that threat is divided into inner and outer. Internal threats are considered to be all intentional and unintentional actions of users who have direct access to the information system. External threats are defined as all attempts causing any form of damage to remote attacks or injecting malware into the information system from remote locations.
Below, on the possible classification of threats due to the likelihood of the ship's environment, in accordance with the classification of NIST (*National Institute of Standard and Technology*):

- Mistakes and failures - they can cause considerable damage to the information and communication system, which can be inflicted by employees or IT staff (*cruiser*). Also, errors may be present in the source code of the software package that uses system (*insufficient testing program code*)
- Loss of physical and infrastructural support - this is the kind of threats that include, e.g. interruption in the supply of electricity or a breakdown in communication caused by satellite or radio links, fire, electromagnetic radiation, interference of radio waves and other unforeseen circumstances,
- Procedures while performing maintenance activities of computer systems on board - turn off or reset the device for conducting maintenance activities,
- Not done by expert software patches on the system and/or user software,
- Malicious software (*malware*) - a kind of threat which undermines the information system by infecting malware such as worms, viruses, Trojans and other,
- Sabotage by employees - this threat is common and is mainly motivated by dissatisfaction seaman on board and/or the ship's organization. The most common examples of sabotage deletion, malicious tampering, and move data (*AMOS database*)
  - Hackers - people who have a high computer knowledge and use it to compromise the security of computers and data and information,
  - Fraud and theft - including malicious activity by which an attacker tries to realize some benefit. Can be achieved by internal (*employees*) or external (*attacker outside the organization*) activities,
- Terrorist attacks - it is known that in the last few years, pirates attacking ships at sea. Mostly likely to commit an intentional or unintentional attack on information subsystems ship
- Interdependence with other networks and systems,
- Natural disasters such as earthquakes, fires, storms, snow storms, etc.

- That the threat could affect the security of information systems on board, including the critical components, there should be a way to access the system. For marine conditions are possible following access modes:
- Internet connection (*official and non official Internet access by seafarers*)
- Connection with the ship-owner or authorized service/equipment manufacturer,
- Links between marine network,
- Unsafe satellite and radio links,
- Maliciously formatted IP (*Internet Protocol*) packets,
- Attacks fragmented IP packets,
- Vulnerability protocol SNMP (*Simple Network Management Protocol*)
- Open TCP and UDP (*User Datagram Protocol*) ports on computers ,
- Uncontrolled access to the USB port
  Weak authentication mechanisms SCADA protocols and elements
  Attacks rewriting the memory that threatens SCADA control servers.
- In case of a successful attack, the attacker aims to acquire certain powers to be able to manage all or part of the system. Degree acquired control depends on the level of protection components production integrated information systems capabilities and intentions and the attacker. In such situations, an attacker can: gain access to the information system that as a major component has a SCADA system (*propulsion information system*), access control console in the control room of the main unit and/or the control console on the bridge, insert the communication between components of information subsystems, compromise or disable

the main control station, compromise or gain access to local PLCs, shape driver, etc.

6. PROTECTION OF COMPUTER SYSTEMS ON BOARD

The protecting computer systems on board depend on the purpose of the ship, the size of the ship and the ships investment management organization. Also, manufacturers of information systems have recognized the problem of security of computing resources especially information systems that affect the safety of the ship (*propulsion and navigation information system*). For example, the company Kongsberg has produced a computer security system Kongsberg Malware Protection to protect their own information systems implemented on commercial ships.

In addition, more and more are implemented physical protection of information systems or CCTV (*Closed Circuit TV*) system. CCTV systems are implemented on modern yachts or passenger ships - cruisers, and more on other merchant ships.

Based on the analysis of several integrated information systems on merchant ships most common procedures for the protection of computer networks are:

- Daily monitoring of the system to log and store reports - continuous recording of all events from the operation of the machine to the operator's actions in real time. This monitoring mechanism of the system through a period of time provides insight into the operation of the system, and thereby help assess the security of critical points and determination of sample unforeseen events. This mechanism can be realized without problems on board because they already keep a journal of all systems, and automatic saving alerts generated by monitoring programs.
- Firewall - is a device that, according to predefined rules, permits or prohibits the establishment of connections and the flow of network traffic, and is set between two network segments with different degrees of confidentiality. For example, the board can be set up between the ship's control network (*UBM*) and industrial networks (*IM*) to filter traffic between other information systems and propulsion information system (*SCADA as a critical component*). Problems that occur in this implementation are time lags in the transmission of control information, the complexity of implementation and maintenance of such a firewall. In practice, there are several types of firewalls: *transparent firewall*, *packet filtering firewall, stateful firewall* and *proxy firewall*. Firewall agent handles network data packets at all layers of the OSI (*Open Systems Interconnection*)/ISO (*International Organization for Standardization*) model. The downside is its static firewall or filtering rules do not change according to the traffic on the network (*manual adjustment rules*). Another downside is that the firewall does not control internal network traffic. Figure 2 shows the simplified form use a firewall. It is necessary to take into account that a firewall cannot prevent viruses from e - mail (*firewall cannot determine the content of the e-mail and cannot protect against viruses that are found in the appendix*). Therefore, do not open an attachment in an e-mail until it is completely that sure) and phishing (user computers to deceit extract personal and financial data [23]. The latest versions of firewalls with graphical user interface. The first firewall with GUI (*Graphical User Interface*) was Visas and allowed users easy access and configure the firewall on computers mobile operating systems Windows and Mac OS. Israeli company Check Point Technologies has made the first widely available software firewall FireWall-1[22]. For computer systems that are running Windows operating system next firewall must do the following: turn on automatic updates of the operating system and check if you install the updates automatically and implement good anti-virus program and update it regularly downloading updates from the manufacturer's Web site.

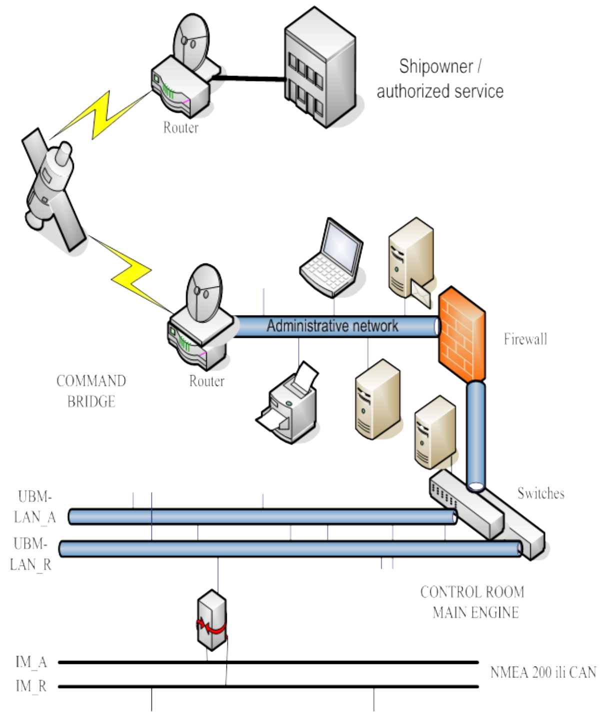

Figure 2. Firewall between administrative and ship control networks (source authors)

- To increase the security, reliability and availability of computing resources used redundant LANs (*UBM_LAN_A and UM_LAN_R*) and redundant industrial networks (*IM_A and IM_R*) and virtual private networks. Implemented firewall separates the administrative network of the zone with the highest degree of confidentiality (*marine and industrial network*). To further enhance security can be further installed a firewall between the management and the industrial network and in this way gain a high level of security of information systems on board and protecting critical component of viruses, Trojans, and other internal and external threats.
- Mechanisms for detecting unauthorized intrusions into the system - these mechanisms can be implemented on a single computer (*Host Intrusion Detection System - HIDS*), the entire ship (*Network Intrusion Detection System - NIDS*) and mixed mechanism. HIDS system is based on agent's architecture that is installed on your computer and defined access rules. In conjunction with the operating system supervises activities on the computer. If you detect potentially malicious actions, malicious process is automatically blocked in order to prevent his execution. In addition, the system has a mechanism HIDS oversight of critical elements of the system (*system files, base-registry, etc.*). NIDS system has a mechanism that monitors network traffic and analyze it in order to detect malicious content. Traffic analysis is carried out using three methodologies: the search pattern in the captured packets, monitor the frequency of occurrence of certain packages and looking for certain anomalies in the network that may be an indication that an attack is in progress. This mechanism is useful in protecting information propulsion system. Problems that occur in the implementation of which can not be implemented at all SCADA systems, it is relatively expensive and causes a deceleration of some activities SCADA system. NIDS system can be classified into several categories depending on the collection and processing of data, including: NIDS system based on pattern recognition (*signature based*), NIDS system based on a review of behavior (*behavior based*) or anomaly (*anomaly based*) NIDS and hybrid system based on pattern recognition and the recognition of anomalies.
- Access control based on user roles - this approach is based solely on the role played by certain people in the organization, not its identity. Approach is perhaps the most sensitive to the ship because the crew changes frequently and each position on the board are exactly defined in accordance with the ship's organization.
- Managing passwords - this approach can be applied to all information systems on board including the SCADA system. The working principle of this mechanism is based on blocking the entry of passwords if the operator (*sailor*) several times in a row entered the wrong password. With this need to take a number of corrective actions that the system could not accept the right password. Based on practices at the lowest levels in marine systems are passwords ejected or rather simplistic. At higher levels of the hierarchy created by the ship and

use complex passwords and complex mechanisms authorization.

- Virtual Private Network (*VPN*) - a complex concept which is usually defined as a private network that uses a public telecommunication infrastructure protecting privacy using the protocol for tunneling and other security mechanisms. VPN network to by "tunneling" traffic through the Internet or other public network in a manner that provides the same security and features as a private network. With a VPN connection over a public network can transmit data using the routing infrastructure of the Internet.

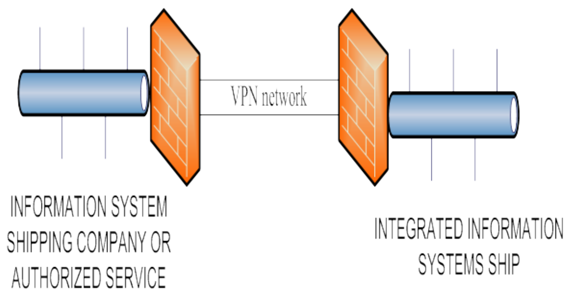

Figure 3. Example VPN Communications (source authors)

Block schematic VPN network in marine environment is shown in Figure 3. Given the connection points, VPN network is divided into: host to host, host to gateway and gateway to gateway. Also, there is a distribution with respect to the layer of the OSI/ISO model, namely: application VPN, mobile VPN, VPN network and data VPN. In the future VPN network will be increasingly used in SCADA systems.

In addition to the above procedures for the protection of the future will be used on board and care, such as biometrics, detection of malicious code and its elimination , the use of public key cryptography, symmetric cryptography and honeypot (*a fake device*).

The best way to protect the security of information systems on the ship is to use well-known methods and ways of hardening a particular computer system on board. Hardening procedure is mainly limited to modifying install the operating system and/or user programs to reduce the number of threats that may act on individual modules operating system and/or user program. There are three levels:

- Local level - is realized by setting the appropriate rights and restrictions of critical IT resources such as the implementation of appropriate restrictions on the means and tools that are used for modifying system and user data, delete all the programs and tools that are needed to operate the system, set permissions are appropriate on IT resources, saved all log files, establish procedures to regularly update your operating system and/or user data, etc.
- Network level - to establish an appropriate mechanism authentication/authorization of the use of network services, the mandatory use of passwords, pledged to block all unnecessary services, provide a control mechanism for remote access, the processor would establish regular updating of network resources.
- Application level - this level includes defining and establishing access rights, use of passwords, and establish procedures for regular updates and patches.

Based on the analysis of several integrated information systems on modern merchant ships, protection of industrial control systems is reduced to the above described security techniques with a focus on:

- Insulation industrial networks using authentication mechanisms , traffic control, firewall , cancel unnecessary connections to external networks,
- Risk assessment for each junction point that industrial control system connects with other networks on board,
- Application firewall that is compatible with an industrial control system,
- Plan in the event of a security incident,
- Use of redundant hardware and software components,
- Frequent safety analysis by the ship's organization and/or the authorized service,
- Seafarers education on information security and that the material and financial damage causing the ship and the ship's organization information uncertainty,

- Implementation of detection systems and intrusion detection in an integrated information system,
- Training procedures on- line maintenance of the ship's systems.

6.1. Kongsberg Malware Protection

Kongsberg Company develops, manufactures, implements and maintains the ship's information systems. For safe, reliable and efficient operation of information subsystems produced a security system K- IMS (*Information Management System Kongsberg*) Malware Protection for work in marine environments that it is the control system anti-virus protection. [6].

Figure 4. Kongsberg Malware Protection Systems [6]
(source: http://www.km.kongsberg.com/ks/web/nokbg0240.nsf/)

With Kongsberg Malware Protection System, the company Kongsberg has redefined antivirus and antimalware protection control systems and industrial computers on board. Characteristics Kongsberg Malware protection devices are [6]:

- There is no interaction between the program to check the equipment and critical control systems,
- Regularly update anti-virus protection,
- Network protection, ensuring the process network (*protecting process equipment*)
- USB protection,
- Supports low bandwidth satellite links with high latency,
- Through the SNMP protocol to receive alarms and notifications,
- High availability,
- Test malware in network traffic in real time,
- Automatically prevent the outbreak of a virus infection and damage control,
- Resource discovery and isolation of malicious programs,
- Automated program to check and update the signed (*certified*) files.

One of the major problems on the board is using a USB portable device by sailors in the business and private purposes. The introduction of Kongsberg Malware Protection USB devices and mandatory checks, problems with USB devices are reduced to a minimum.

6.2. Certification of computing resources on board

The application of information technology in the management, control and supervision in almost all marine processes the reasons for the introduction of the security policy of information resources able to be certified in accordance with the prescribed standards. ISO 27001 defines the establishment of a safety management system, indicated by the abbreviation ISMS (*Information Security Management System*). At the standard set out the objectives that the organization needs to achieve in order to have an effective system for the protection of their information resources.

The certificate shows that the ship's organizations for its flagship define and activate the process of protection of information resources. The certification process obliges the master or ship management organizations (*technical sector*) to continuously improve the security policy information resources through regular independent control.

The introduction of certification for information resources of the ship or boat has the following benefits:

- Reduce security risks of computer systems especially critical components (*computer networks and industrial control system*),
- Identify and reduce security risks to the desired level,
- Increase the reliability and availability of computer systems,
- Improve marine processes (*greater security in the exchange of information and data between information subsystems*),

- Process control security data and information on the ship and the ship's organization,
- Increase the reputation of the ship and the ship's organization in the global maritime market.

According to [7] the company awarded certificates are: International Information System Security Certification Consortium, Sysadmin, Audit, Networking and Security, International Council of E-Commerce Consultants, Computing Technology Industry Association, Information Systems Audit and Control Association, Institute for Security and Open Methodologies, Council of Registered Ethical Security Testers, Cisco. Also, in Croatia there are several institutions that carry out certification such as: College Algebra, Net- academy, Teleconferencing, Edu-net academy etc. Almost all Croatian institutions are based on licenses Cisco training and certification.

7. CONCLUSIONS

Safety of modern integrated information system on board is much higher than it was a decade or more years, especially the security of industrial control systems. The reason for the sudden application of distributed and open architecture of information systems in the management, control and monitoring of almost all marine processes. Safety of the ship depends on the security of computer systems. Therefore, international maritime organizations, local authorities and shipping companies need to think about applying security policy of computer systems such as on the mainland.

In the era of global informatization almost there is no marine organizations and ship that at least one of its segments doesn't use a computer. Computers are usually connected to a computer network. To ensure uninterrupted and reliable operation it is necessary to protect IT resources and important marine processes that are or are driven via a computer network.

The development of information technology has led to industrial control systems, in particular SCADA systems have moved to the open network architecture and increasing integration into the ship's information subsystems. Increasingly SCADA protocols are open and adaptive to other communication protocols in marine environment. Therefore, it is necessary to further invest in the development of existing and new measures and techniques to protect the security of industrial control systems.

Today, the vulnerability of standard hardware and software components at the same time became the vulnerability of industrial control systems. Therefore, security solutions, IT industry are exactly the same. However, the problem is you cannot be so easily implemented in all computer subsystems.

Certification of the elements of computer system in accordance with the standards set by an independent institution has an increasingly important role in the management and conduct of the ship. The share of services provided by merchant ships is constantly growing in the global market, the activities related to data and information to reach a high added value.
Establishment and maintenance of a safety management information system provides the conditions for continuous, efficient and effective operation of the ship or the acquisition of financial gain shipping company.

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APPLICATION OF THE VECTOR QUANTIZATION COMPRESSION METHOD IN THE VIDEO SUPERVISION OF MARITIME SYSTEMS

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ABSTRACT

Video supervision represents important feature in a maritime systems, especially in the aspect of navigation security and control. In the age of internet there is a need for video supervision systems to be network based, allow online monitoring of different processes and enable fast transmission of quality image and video signal. This paper presents custom software solution of the image compression using vector quantization and Matlab programming language. Advantages of this compression method in terms of data transmission rate improvement and memory saving will be presented through a video supervision of a maritime systems. Grayscale images of a different vessels and maritime systems are taken as an input data for testing of the proposed method. As a result, quality of the compressed images is retained, while the data transmission rate over network is significantly increased, which is of great importance for the safety of navigation. Practical results are presented in the paper.

KEY WORDS

maritime video supervision, signal compression, vector quantization

1. INTRODUCTION

With the development of Internet, network based video supervision systems are taking control over classical video supervision systems [1]. Maritime systems are particularly affected because of the nature of the system itself. Video supervision takes important place in maritime systems, especially in terms of security and efficiency. That is the reason why video supervision systems were implemented in many ports of Republic of Croatia in the last decade. Another example is USA – protecting port operations is one of the most critical challenges faced by the United States Homeland Security Department, and crucial part of port security is video supervision system [15]. Therefore it is obvious that quality solutions are required. Video supervision takes its place in different situations, such as monitoring of important points in ports, access control of vessels, vehicles and persons in ports, monitoring of passenger ship decks, iris recognition methods for human identification on vessels, monitoring of lighthouses etc. Video and image data take up a large amount of memory. Since the memory and data transfer rate are limited resources, there is a need for compression of the data which are stored and sent over Internet. Main goal of video data compression is to reduce the bit rate for transmission or data storage while maintaining acceptable image quality. This paper presents vector quantization (VQ) method as a solution for video supervision of maritime systems that meets the quality requirements very well. VQ has become well known and studied since Shannon first established the merits of quantizing vectors rather than scalars [9]. It has been applied in many areas, especially in data compression field. VQ is a lossy compression method [2], [14] based on block coding. In other words, data blocks are replaced by code words (approximation is done). Purpose of VQ is to reduce a large number of input levels or a continuous function to a smaller number of finite output levels. Crucial point of vector quantization is a choice and optimization of a codebook (contains code words which are used to replace original blocks of data). In 1980, Linde, Buzo and Gray presented an algorithm for vector quantization with the usage of training sequences (LBG - VQ algorithm) [3]. This algorithm is used for generation of codebook in proposed VQ method. In the second section, VQ general method description is given. In third section, a short description of custom developed Matlab scripts is presented along with obtained results and analysis. Conclusion and discussion about future work is given in the last section.

2. VECTOR QUANTIZATION METHOD

VQ is actually an approximation method [9]. The idea is similar to rounding the numbers to the nearest integer. Example of 1 – dimensional VQ is given: Let straight line contain set of numbers (-3, -1, 1, 3). All numbers less than -2 are approximated by -3. Numbers between -2 and 0 are approximated by -1. Numbers between 0 and 2 are approximated by 1, and finally, numbers greater than 2 are approximated by 3. Hence, codebook (-3, -1, 1, -3) and 2 bits for the representation (storage) of each codeword is used.
Basic steps of VQ [2] are:

– Generation of codebook: Training sequence of blocks (vectors) of data is extracted from input data in order to get representative blocks of data. Representative blocks of data are obtained from training sequence with the usage of one of the algorithms designed for those purposes. Codebook consists of these representative blocks of data.
– Coding: Data selected for compression are first divided into blocks of data. Each block of data is then replaced with the most similar representative block of data from codebook. Block from codebook with minimum distortion compared to original is selected as a representative (approximate) block. Mean squad error (MSE) is the most commonly used method for calculation of distortion [10]. After this procedure, coded (quantized) data are sent or stored. Coded data are actually simple indexes that point on corresponding representative blocks of data contained in codebook. Instead of transmitting real data over channel (e.g. internet channel), only indexes of representative blocks of data from codebook are transmitted.
– Decoding: Sent indexes are replaced again with representative blocks of data contained in codebook. The same codebook is used for coding and decoding (both sides of channel have the same codebook.)

VQ method is illustrated on the Figure 1.

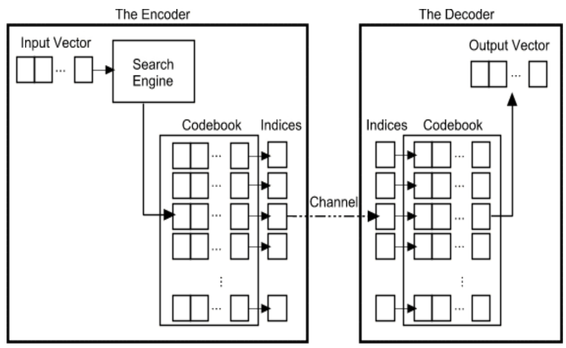

Figure 1. Illustration of vector quantization method

Source: Gersho, A., Gray, R.M., Vector Quantization and Signal Compression, Kluwer Academic Publishers (USA, 2001), pp. 5-16, 236-310.

2.1. LBG algorithm

The most important part of VQ is generation of codebook. One of the algorithms used for design of codebook is LBG algorithm.
Basic steps of LBG algorithm [3] are:

1. Determine the number of codewords C (representative blocks of data), or the size of the codebook.
2. Select C codewords at random, and let that be the initial codebook. The initial codewords can be randomly chosen from the training sequence of blocks of data.
3. Using the Euclidean distance measure [12], clusterize the vectors (original blocks of data) around each codeword. This is done by taking each original input vector and finding the Euclidean distance between it and each codeword. Original input vector belongs to the cluster of the codeword that yields the minimum distance.
4. Compute the new set of codewords. This is done by obtaining the average of each cluster. Add the component of each vector and divide by the number of vectors in the cluster:
$$y_i = \frac{1}{m}\sum_{j=1}^{m} x_{i,j} \qquad (1)$$
where i is the component of each vector (x, y, z, ... directions), and m is the number of vectors in the cluster.
5. Repeat steps 2 and 3 until the either the codewords don't change or the change in codewords is too small.

2.2. Measure of the quality of coding

Most commonly used method for measurement of coding quality in VQ is *Mean Squared Error* (MSE). MSE is defined as follows [10]:

$$MSE = \frac{1}{M}\sum_{i=1}^{M} (\hat{x}_i - x_i)^2 \qquad (2)$$

where M is the number of pixels in image, $\hat{x}_i$ is the value of *i-th* pixel of the compressed image, and x_i value of *i-th* pixel of the original image.

3. APLICATION OF THE VECTOR QUANTIZATION IN MARITIME SYSTEMS

Proposed VQ method, implemented as Matlab programming code placed in scripts, was applied to some maritime systems and tested many times at different compression levels and with different coodebok designs. In order to achieve better representation of maritime systems and get better results of compressed images, training sequence of blocks (vectors) of data should be at least thousand times greater than number of codewords in codebook [2], [4]. Two different maritime systems were taken as test examples. First test case refers to general maritime example consisted of different vessels and port objects. Second test case deals with iris recognition methods used for safety of navigation. Training sequence of blocks of data is extracted from 15 grayscale training images separately for each test case (15 training images for first, and 15 training images for second test case were taken). Dimension of each training image is 480 x 320 pixels. Dimension of each extracted block of data is 4 x 4 pixels (a vector of 16 elements). Thus, each image contains 9600 blocks of data, or the entire set of 15 images contains 144 000 training blocks of data. Special Matlab script is designed in order to extract blocks of data from training images. Training images are selected so that they better represent all possible inputs of particular maritime system. Examples of training images for each test case are shown in Figure 2 and Figure 3.

Figure 2. Examples of training images for first test case

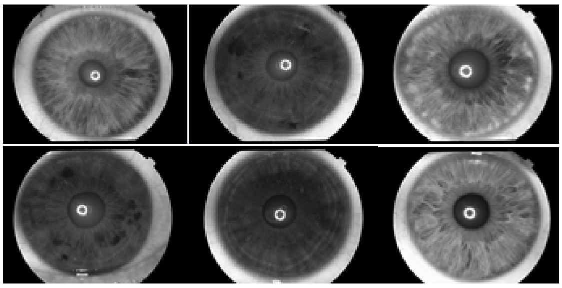

Figure 3. Examples of training images for second test case

Source: Phoenix iris database [13]

Another script with custom software realization of LBG algorithm (described in previous section) is used for the generation of two different types of codebook from extracted blocks of data for each of these two cases. Size of the codebook is arbitrarily selected.
Coding script takes original images selected for compression as input data, and codes those images using a given codebook.
Decoding script takes coded images (cluster of indexes described in previous section), and decodes those images based on a same given codebook. Decoded image is of lower quality compared to the original image. Quality of decoded images is measured with *Mean Squared Error* (MSE) criteria.
Since the proposed method uses grayscale images (256 different levels), 8 bits are required to represent each and every pixel with one of those levels. Thus, 16 x 8 = 128 bits are required to represent single block (vector) in the image.
As mentioned before, each block of data from original image is replaced with the most similar representative block of data from codebook. Therefore, number of bits required for replacement depends on the size of the codebook (number of codewords in a codebook). For example, 5 bits are required in order to code an image with codebook containing 32 codewords (5 bits for indexing each of the 32 representative blocks of data). Therefore, 5 bits is required for replacement of single block of data (block consisted of 16 pixels), i.e. 0,312 bits is required for replacement of single pixel.

3.1. Test results and analysis

In the first test case, VQ method is tested over the original image from maritime system shown in Figure 4.

Figure 4. Original test example 1

Testing image is coded with a codebook type designed from images shown in Figure 2. Codebooks of size 8 (3 bits required), 32 (5 bits required), 256 (8 bits required) and 1024 (10 bits required) were used. Results evaluated through *Mean Squared Error* (MSE) are shown in Table 1. Comparison between original image (Figure 4), image coded with 3 bits (Figure 5) and image coded with 10 bits (Figure 6) is shown below.

Table 1. Coding results 1

number of bits for coding	bits per pixel	MSE
3	0,187	186,78
5	0,312	104,49
8	0,5	63,58
10	0,625	47,87

Figure 5. Image coded with 3 bits

Figure 6. Image coded with 10 bits

From the obtained results it is easy to notice that increasing the number of bits used for coding reduces the *Mean Squared Error* (MSE). In other words, quality of coded image increases. From the human perspective, quality of the image coded with 10 bits is not far behind the quality of original image. Transmission of indexes through channel (e.g. internet) is significantly faster and negligible compared to transmission of real data (images), and also quality of compressed images is preserved relatively good. Discrete Cosine Transform (DCT) is the standard used in majority of video and image compression methods [5], [11], [7]. VQ offers more compression (while retaining the quality) than DCT, especially at high compression rates [2], [8].

Image from Figure 4 was compressed with both methods, and the results are shown in Table 2 and Figure 7 below.

Table 2. Comparison of VQ and DCT methods

bits per pixel	MSE (VQ)	MSE (DCT)
0,312	104,49	106,62
0,187	186,78	230,94
0,125	393,49	510,9
0,062	1328,59	3450,85

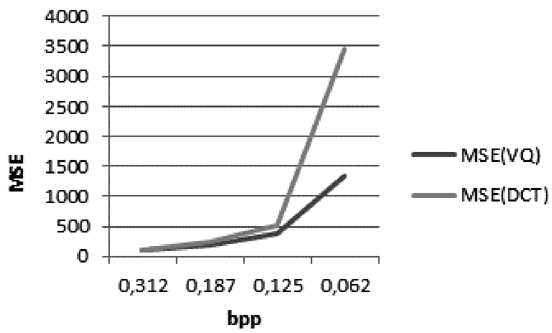

Figure 7. Performance comparison among VQ and DCT

Results show that on higher compression rates (less bits used), MSE grows exponentially in case of DCT. At lower compression rates, results are approximately the same or slightly in favor of VQ. Effectiveness on higher compression rates is desirable property when transmitting data over network (internet) and it can be used in network based video supervision of maritime systems. In the second case study, VQ method is tested over the original iris image taken from Iris Database [13] shown in Figure 8.

Due to the rise in terrorist attacks, biometric technology has become a vital aspect in providing viable solutions to port security and this is already being adopted in other areas of the transport sector. Iris recognition is one of the important techniques and compared with other biometric features (such as face, voice, etc.), the iris is more stable and reliable for identification [6].

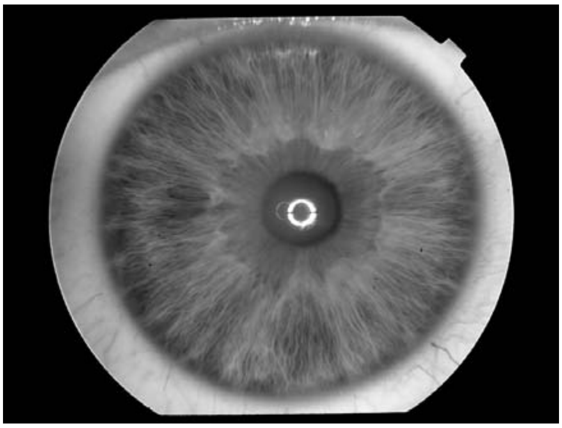

Figure 8. Original test example 2

Source: Phoenix iris database [13]

Testing iris image is coded with a codebook type designed from images shown in Figure 3. In this case results obtained through VQ are even better then results obtained through VQ (in terms of MSE) of the first test case due to homogeneity of the system (difference between images in Figure 3 is less than difference between images in Figure 2). This property is not the case when compressing image with standard DCT method. Results are shown in Table 3.

Table 3. Coding results 2

number of bits for coding	bits per pixel	MSE
3	0,187	79,10
5	0,312	38,81
8	0,5	18,29
10	0,625	13,40

As it can be seen from results, image coded with just 0,625 bits per pixel is nearly identical to original image, and the MSE of the overall results is reduced.

Advantages of VQ method and LBG algorithm over conventional and widespread compression methods (such as DCT – discrete cosine transform) are already experimentally proven [6] – Iris recognition accuracy increased for 15% on average due to increased image quality. The results, presented in this paper, contribute to that thesis as well.

Another feature that came out from these tests and analysis is proposal that codebook must be adapted to the maritime system which it will represent. It means that images from a particular environment (maritime system) which is observed should be taken as input data for codebook generation, not images from other environments.

To demonstrate the statement, simple test was made: Image from Figure 4 coded with 4 bits and codebook type designed from images in Figure 2 results with MSE = 140,24. The same image from Figure 4 coded with 4 bits and codebook type designed from images in Figure 3 results with MSE = 157,09.

4. CONCLUSIONS

Video and image data often require large amounts of storage space and transmission bandwidth. Since resources are limited (storage spaces and bandwidth), it is essential to compress the video and image data. In order to do so, VQ realization through Matlab is used. Main goal of this paper is development of the method, and presentation of its effectiveness on maritime system examples. The video is actually sequence of images, so in order to simplify the illustration of method, grayscale images of marine systems were considered. Proposed VQ method is very adoptable, and can be implemented into different maritime video supervision systems. Depending on the system, results of VQ can vary. Paper also highlights the importance of proper codebook selection, depending on the system. Method offers high compression ratio and preserved image quality. The amount of data needed for transmission of the quality information over internet is reduced (when compared to standard DCT), which is of great importance for the safety and efficiency of maritime systems. VQ is relatively new technique with a lot of place for improvement. Generation of the codebook is a long process, but it's not an issue – once generated, can be used all the time for the particular marine system. On the other hand, coding procedure does take time, so in order to reduce that time future work will deal with that segment of VQ (e.g. VQ with classification, VQ with variable blocks of data, etc.).

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POSSIBILITIES AND LIMITATIONS OF MEGA YACHTS REPAIR IN BOKAKOTORSKA BAY

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ABSTRACT

Repair of yachts and mega yachts in the Bay of Kotor is a subject that is very topical in recent times. By the construction of the port of Porto Montenegro in Tivat, and future construction of luxury hotels in Kumbor and tourist resort Lustica Bay that will include two modern marinas with 170 berths, the issue becomes even more actual. It is already clear that in the Bay will stay a large number of yachts of various sizes and thus appears a need for their maintenance or repair.
In this paper, entitled "Possibilities and limitations of mega yachts repair in Bokakotorska Bay" are described abilities i.e. advantages and limitations or disadvantages of this type of activity in the Bay. The biggest advantage is definitely the stay of an increasing number of vessels in such close proximity and the need for their survey, docking, etc., in accordance with requirements of Classification Societies. In addition, the existence of shipbuilding port in Bijela with its facilities opens up the possibility for these activities with much less investment than it would be if there is no such shipyard. Natural beauties of the region as well as a quick and safe arrival up to it certainly will attract a large number of yachts and mega yachts in the Bay.
Is it possible a repair of ships, which involves grit blasting, painting, noise, etc. in the vicinity of luxury hotels, villas, yachts, etc that is a question that arises in itself and the same represents the biggest constraint for implementation of this plan.
The paper describes all major sources of pollution and environmental protection measures during repair of vessels in Bijela.

KEY WORDS

repair, mega yachts, shipyard, Bay, limitations

1. INTRODUCTION

Boka Kotorska Bay is the ideal place for repair and maintenance of yachts and mega yachts in terms of geographical location and climate. The Mediterranean climate, high temperature, a little cold days and similar are excellent prerequisites for quick and efficient performance of repair works, especially painting of vessels exterior hull. In addition, the increasingly popular Adriatic coast is one of the fastest-growing cruise destinations in the Mediterranean and is located near the traditional yachting destinations in Greece and Turkey in the eastern Mediterranean. However, the fact that since 1997, Boka Kotorska Bay is also officially listed in the Association of 28 most beautiful bays in the world, leads to the dilemma of whether this activity is desirable. There is a clear question whether in such a bay is to allow cleaning, degreasing, grit blasting, painting and other activities that are necessary during repair and maintenance of ships.

2. ANALYSIS OF THE CURRENT SITUATION

2.1 Adriatic Shipyard Bijela

Adriatic Shipyard Bijela is the largest ship repair yard in the southern Adriatic. It is located in Boka Kotorska Bay, one of the safest natural harbors in the world. It is widely known the ancestral shipbuilding and maritime tradition of this region. Shipyard was established in 1927, so that today it has tremendous experience, exceptional human and technical capacities. Modern management ensures reliable performance of contracted projects with uncompromising quality, competitive prices and terms, in accordance with regulations of international classification societies. This attitude towards work allows to clients significant savings in time and money, by extending the service life of the vessel. Top quality work is confirmed by international certificates ISO 9002 and ISO 14000. The shipyard is fully equipped for repair and reconstruction of ships and other vessels of all types and purposes, regardless of the size of the damage and the extent of reconstructive operation. It disposes of two floating docks in the length of 250 meters and 184 meters, it has the wharfage in the total length 1120 meters, three tugboats, a large number of different types of cranes in the capacity from 2.5 to 50 tons, various and diverse energy facilities, modern communication tools, as well as all necessary workshop documents and equipment. In addition, the shipyard is also equipped for construction of smaller vessels such as barges for various purposes with or without own propulsion, pontoons, working platforms etc. [3]
In Adriatic Shipyard Bijela are carried out the following technological processes:
Works on vessels in dock: propellers, shaft lines, stern tubes, rudders, sea valves, suction wells, cathodic protection, tank testing, renewal of shell plate and hull structure.
Washing, grit blasting and painting of vessels in dock: high pressure water cleaning, chipping with rotary wire brushes, grit blasting using grit under pressure as abrasive, painting by use of spray nozzles under pressure
Pipelines with mounting: renewal of vessels pipelines, steel, galvanized steel and copper pipes, repair and replacement of valves and gate valves of all types.
Steel work: fairing of shell plate and elements on board and in the workshop, design and renewal of hull steel elements (4-6 tons per day), welding, control of welded joints (defectoscopy and ultrasound).
Works on engines and equipment: inspection and repair of marine engines, steam and gas turbines, boilers, steam engines, separators, compressors, pumps, coolers, condensers, filling and replacement of bearings
Deck installations and equipment: inspection and repair of rescue equipment, repair, renewal of spares and testing of cargo handling equipment, cargo winches, mooring winches and repair of anchor winches and renewal of spares.
Electrical works: repair of electric motors and generators on board and in the workshop, replacement of windings in electric motors and generators, cleaning and varnishing on the site and in the workshop, renewal of electrical installations and electrical fittings, inspection and replacement of components in electronic auto parts of marine equipment.
Carpentry: replacement of linings, bilge covers protection in storages, deck coverings, linings and insulation of storage spaces, furniture and floors.
Cleaning and take over of waste: cleaning of ships bilges and tanks from oily waste, cleaning of ballast and other tanks of mud and similar sediments, taking over of various solid industrial waste resulting from repair (scrap metal, insulation, rubber, plastic, etc.). Takeover of ship's liquid sanitary waste, take over of communal ship waste.
Adriatic Shipyard Bijela signed in 2010 with the Government of Montenegro a Concession Agreement for the period of 30 years. Under this Agreement, the shipyard is shipbuilding port carrying out activity of ship repair in the area that is the subject of the concession. Shipbuilding port is the port whereby ship or other vessel is built as well as the port intended for docking, anchoring and protection of ships and other vessels for repairs and modifications.

2.2 Geographic location

Boka Kotorska is located on the southern Adriatic and is one of the most beautiful bays in the world. Valuable historical heritage and fascinating natural

beauty of the region provide visitors and crews an opportunity for relaxation , leisure and recreation with an unforgettable experience : the famous Mimosa Festival in Herceg Novi, city of eternal greenery , sun and stairs , the old town of Kotor, one of the jewels of the UNESCO list of world cultural heritage, historically significant Cetinje, the former through out centuries capital of Montenegro ; well-known hotel - town Sveti Stefan , unavoidable Budva , city which according to legend was founded by the Phoenicians , the oldest sailors of the Mediterranean ; proud Lovcen on the top of which , at a height of 1600 meters , is located the mausoleum where was buried the famous Montenegrin poet-philosopher , bishop and ruler Petar II Petrovic; fascinating natural beauties of Boka Kotorska Bay, surrounding mountains , bay islands and the blue sea, wonderful evenings in many taverns with excellent service , exquisite food , wine and Mediterranean music. Visa free regime in Montenegro enables to all visitors, tourists or business partners, fast safe and enjoyable coming to Boka Kotorska Bay by air, sea or land routes . There are even three airports, located at a distance of less than a hundred kilometers from the Bay , such as the airport in Tivat , which is located in the Bay itself , Podgorica and Dubrovnik. [4]
Boka Kotorska has a typical Mediterranean climate with mild winters and hot, dry summers. Along the coast, sheltered from the interior by high mountainous hinterland, on one side and the bay on the other, climatic conditions are more lenient, more convenient and more enjoyable. There are no extremely large temperature differences, extreme precipitations and wind power and thus, the climatic conditions are more uniform than in neighboring areas. Hot days are with temperature higher than 31,0 ° C and cold days in January are dominated by about 4 º C. Water temperature in Boka Kotorska Bay in February is about 11,6 º C in August and to 24,8 º C. The swimming season begins in mid-May and lasts until the beginning of November i.e. nearly 180 days. This allows the water temperature to be warmer than 20 ºC during the season.

2.3 Market analysis

According to data from 2013, in the world there are 4433 super yachts and this number is steadily increasing over time. As of 26th October 2012, there were ordered 441 yachts and 150 yachts have been delivered (data from 2013). As far as the material is concerned, approximately 50% of super yachts were made of steel, steel / aluminum or aluminum. The research conducted by the magazine *Superyachtintelligence* from 2011 has shown that the super yacht fleet is predominantly based in Europe (48%), 40% is based in North and South America and only 12% in the rest of the world. According to this research, 21, 5 weeks per annum is the average time that yacht spent in home port, while the remaining time during the year, the yacht goes on a cruise. Most of yachts cruise along the Mediterranean and the average yacht spends almost 70% of her time in the Mediterranean. Findings of the above magazine have been confirmed by results of a recent report on the cruise and yachting in the Mediterranean, saying that approximately 50% of the world's super yacht fleet spends eight months per year in the Mediterranean. [7]
As the most attractive cruise destinations in the Mediterranean, in general, yacht owners, charter companies, captains and crews, state the Western Mediterranean, whereby weather conditions, scenery, popular marinas, culture, luxury shops, hotels, restaurants and transport links are to the great extent available as well as infrastructure for maintenance of yachts and their repair. However, continued lack of berths for super yachts in the Western Mediterranean (particularly acute problem for mega yachts over 80 meters in length), which resulted in very high prices of berths and very expensive costs for electricity and water supply, remains further on a major problem for this industry. As response to this situation, the construction of new marinas outside the western Mediterranean is increasing in recent times. Marinas and cruising destinations in the Adriatic and Eastern Mediterranean provide new values to captains, yacht owners and charter companies that are tired of usual hustle and bustle of the Cote d'Azur, in order to arrive at a very expensive, overcrowded marinas in that area. The increased interest was shown for the Eastern Mediterranean,

particularly in Croatia and Turkey. Sector of super yachts repair had a constant demand in 2011. In addition to routine maintenance and works on the control of yachts that are happening throughout the year, some large projects have been completed and provided by the facility for repair of yachts. However, the market remains volatile, as the constant demand for repair of yachts is faced with increased number of competitors in the form of newly built shipyards that are struggling to survive and transit in the sector of repair and maintenance of yachts. Due to increasing competition in the sector yachts maintenance, in other words the existence of alternative, yacht owners and their managers when making decisions about repair have a strong bargaining position and can choose from many more shipyards than ever.

Potential market primarily includes a marina Porto Montenegro. Porto Montenegro marina, the largest luxury marina for mega-yachts in the Eastern Mediterranean, after the completion of phase 3, in 2018 will have at disposal 850 berths. In addition to the marina Porto Montenegro, a limited number of small marinas exist in Montenegro, although they tend to focus on smaller yachts. Nevertheless, these marinas have approximately 12 berths for super yachts in the segment of 30 to 50 meters in length. This could be considered as the “potential market” for the company for future repair of yachts in Boka Kotorska Bay, given the current lack of infrastructure for maintenance of yachts. Besides the existing marinas in Montenegro, the comprehensive Resort Lustica Bay, that will cover 6.8 million square meters and is to include two modern marinas with 170 berths, is under construction on the Peninsula Lustica. There are other projects that are planned in and around Boka Kotorska Bay which, after their successful completion, will increase the “potential market”.

In Montenegro, there is almost no base for supply of super yachts in relation to their repair. Infrastructure of yachting in Montenegro is in an early stage. Basically, all that is needed is supplied from abroad. This means long-term procurement procedure at a high cost. The fact that Montenegro is not yet an EU member means additional difficulties due to the absence of free movement of goods and persons.

When analyzing the current offer, the company for repair of super yachts, the exact number of active shipyards in repair of super yachts is very difficult to determine. However, two of the main sources of information on super yacht market, companies: *superyachttimes.com* and *superyachtintelligence.com* give specific details that help to determine assumptions based on facts of the present offer for repair of super yachts. These two sources are saying that there are 850 to 900 yards in the world in the field of construction of new yachts or repair of existing ones. Among these companies, about 135 are companies for repairs (15%) and 155 are companies for building of new and repair of existing yachts (17%). Remaining number represents shipyard that only build new yacht (68%). Given its proximity, the greatest threat, i.e. the competition would be a shipyard in Sibenik (Croatia) and Ancona (Italy).

3. LARGEST SOURCE OF POLLUTION AND MEASURES FOR ENVIRONMENTAL PROTECTION DURING SHIP REPAIR

3.1 Main sources of pollution during ship repair

Works on anticorrosion protection of the ship in repair, potentially are the greatest threat to environmental pollution. These activities include: washing, degreasing, grit blasting and painting of exterior hull’s shell plate. [1]

Washing

From vessel’s shell plate by washing are removed marine growth and partially old paint and rust. Washing is performed by high pressure pumps water up to 500 bar.

Degreasing

Greased parts of the hull, shell plate and deck have to be degreased before grit blasting. Degreasing can be done manually, by application of chemicals for degreasing, brushes and / or rags, or by applying chemicals using special air pumps.

Grit blasting and generation of waste grit

Grit blasting is a process for anticorrosion preparation of marine steel surfaces by abrasive treatment under air pressure from 6 to 12 bar, whereby are removed old paint and rust. By the method of grit blasting, steel surfaces are prepared for application of paint coatings. In Adriatic Shipyard Bijela as abrasive is used grit on the basis of metal slag, which in terms of quality, granulation and presence of hazardous substances meets applicable standards and legislation. For each shipment of purchased (stored) grit are provided certificates and approvals. In treatment of metal surfaces by the grit, it comes to formation of fine micron dust, which is mainly formed by the grit and partly from corrosion and previous "old" paint (if it is not in question a new steel plate, where the dust is created only out of grit . Used grit for blasting may contain a variety of pollutants originating from the surface which is subjected to grit blasting, which gives to the same the hazardous characteristics. The most common contaminants of the grit are heavy metals from paint (coating). The pollution of grit by particles of paint (coatings) can be in sizes from fine dust to small chips. Coatings that are removed from vessels, often include metals which are used in these coatings such as:

- antifouling, such as copper oxide;
- pigments, such as titanium dioxide;
- corrosion, such as zinc chromate.

These metals are usually in the inorganic form, but in coatings there are also some organic ingredients, among which the most famous is antifouling Tributyltin (TBT). Antifouling paints (coatings) on ships and marine structures used to prevent adhesion and to control the growth of organisms such as balanidae (limpets), seaweed and algae. Some antifouling components (such as TBT) can have a lethal effect on species of organisms which are not adhesive organisms. Tributyltin in low concentrations is very toxic to fishes, crustaceans, mollusks and other forms of marine life. It is of great importance the proper management of paints containing TBT and painting of ships by jet spray of paints containing TBT. In the shipyard there are several possible paths that pollutant can reach the recipient (seawater). Abrasive blast cleaning releases a dust directly into the air, where it falls in the sea water or land. If the accumulation of grit is allowed on the deck or on the surfaces of docks, the same can be carried off by wind or precipitation into the sea.

Painting

Upon removal by grit blasting from metal surfaces of grease and remains of previous old paint and corrosion, it is accessed to application of protective coatings. The paint is applied in several layers. The usual method of application of protective coating is the process of applying the paint by spray, using "airless' devices. In this method, the paint is not mixed with compressed air, but the air is the pushing medium by which the air pump compresses the paint through the hose to the nozzle. The thickness of a dry paint film depends on the type of protective coating and goes between 200 and 2000 microns and the number of layers is from 2 to 6.The basic ingredients of coating are paint and paint thinner. When applying protective coatings in air evaporate volatile organic substances contained in paint and thinner and are sprayed as well paint aerosols.

3.2 Other significant potential sources of contamination

Uncontrolled discharge of various wastes from ship

The uncontrolled discharge of various wastes from the ship also poses a potential threat to the pollution of sea water. Aggravating circumstance is that it has not yet been adopted the Law on Prevention of Pollution from Ships. From the ship in repair can occur an uncontrolled or intentional release of oil, oil products and oily water from bilge and from ships' tanks, contaminants from ballast tanks and sewage and sanitary waste. [5]

Oily liquid waste from separator station unit

In the shipyard as a potential pollutant of the environment are often found separator stations used for treatment and disposal of oily liquid waste from ships.

Workshop for cleaning and degreasing of parts

In Adriatic Shipyard Bijela, as in all shipyards, there is a workshop for cleaning and degreasing of parts whereby the sane are washed and degreased using various chemicals.

3.3 Measures to protect the environment during cleaning and degreasing hull

Degreasing of ship's hull using chemicals

On degreasing it should take the following measures to protect the environment:
- chemical degreasing agent that are in use must be biodegradable and not to contain Trichlorethylene or other materials that are hazardous to human health and the environment;
- during degreasing, protective devices to prevent the spill from decks of the dock must be put into operation;
- at degreasing, in the immediate vicinity of the place of work there are not allowed other simultaneous works (washing, grit blasting, hot works etc.);
- used rags and packaging from degreasers, immediately upon completion of works must be removed from dock's deck or ship and disposed of in a special waste containers;
- if a degreasing agent is applied by pump, then comes to spraying of chemicals into the air and falling to dock's deck and in this case it is necessary to set up protective curtains at the dock, and to collect chemical residues from the deck by rags or to sprinkle a sawdust that must be removed on time.

Washing of vessel's hull

When performing this operation, it is necessary to implement the following measures:
- before and during performance of works there must be carried out technical inspection high pressure pumps;
- before start of washing, from dock's deck or from the ship, all the waste must be removed, especially greased and oiled, as well as the remains of grit, paint, corrosion etc.;
- during washing of the hull at the bow and stern of the dock there should always set a protective curtain, except when it is not allowed byweather conditions due to the increased intensity of the wind;
- during washing of the hull, safety devices to prevent the spill from dock's deck must be placed in service.

3.4 Environmental protection measures during grit blasting of the hull and confined vessel's spaces

In order to reduce emissions and the negative impact of grit blasting on the environment (air, sea and land), it is necessary to take the following measures:
- before starting work, and at runtime, it is necessary to carry out continuous control and technical checks of appliances for grit blasting;
- during grit blasting, it is obligatory the application of the system of wet blasting, which reduces emissions of dust particles for 90% compared to dry abrasive blasting. This grit blasting technology shall be necessarily applied to all positions of work, except in confined narrow spaces;
- during dry blasting in vessels cargo hold, open hatches must be covered with protective sheath of nylon or other suitable material. While grit blasting of the ship in dock, at the bow and stern of the dock it should always set a protective curtain, except when it is not allowed due to weather conditions because of increased intensity of wind;
- at stable meteorological conditions-no wind and precipitations, it is to avoid working outdoors with more than 10 blaster at the same time, because in these conditions, developed cloud of dust dilutes relatively low and acts directly on receptors that are located in the plane of the source. Then is possible occurrence of dust concentration of risk level;
- safety devices on docks that are in function of preventing s grit spills from dock's deck into the sea, shall always be in good condition and put into operation during grit blasting. [2]

3.5 Measures to protect the environment during painting of the ship

In order to reduce emissions and negative impact of ship's painting in the environment (air, sea and land), it is necessary to take the following measures:

- undertake all prescribed previous security and safety measures that are foreseen by paint and thinner manufacturer's instructions;
- avoid painting in extremely adverse weather conditions, or on excessive wind speed;
- coordinate activity in painting of ships at docks in such way to avoid painting vessels external shell plate in two docks at the same time;
- during painting of the ship on dock at the bow and stern it should always set a protective curtain;
- safety devices on docks that are in function of preventing spills of paint from dock's decks into the sea must always be in good condition and put into operation during painting;
- it is necessary to provide continual technical checks of equipment for applying protective coatings. [2]

4. CONCLUSIONS

Boka Kotorska is one of the world's safest harbors.Centuries shipbuilding and maritime tradition, facilities that are located within Adriatic Shipyard Bijela, geographical position and harbor Porto Montenegro speak in favor of the fact that this place is ideal for future repair of yachts and mega yachts. However, the fact that Boka Kotorska Bay is ranked among 28 the most beautiful bays in the world leads at the consideration that goes in the opposite direction. Degreasing, grit blasting, painting, washing of ships, yachts and mega yachts and other activities that are listed in this paper, which are unavoidable in this type of activity are classified in so-called , "dirty industry" and certainly do not go along with the construction of luxury hotels and marinas. Taking all this into account, it is difficult to answer whether in Boka there should be one such company or not. If the answer was positive, the first thing that would be necessary to do for sure would be the purchase new equipment for anticorrosion protection or transition to water blasting .

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ASSESSMENT OF TRAFFIC ENVIRONMENT ON BOATMASTERS

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ABSTRACT

Global industrialization and traffic density raise the level of subjective impediments on personnel operating in the traffic environment of inland navigation. A study on ergo-assessment of traffic environment aims to propose measures in order to reduce damage risks on boatmasters caused by subjective disturbances. Survey techniques used as part of research for the targeted group of boatmasters which operate on Rhine-Main-Danube inland waterway network E-80-104 have found that primarily noise and other mental and physical disturbances damage health and cause a number of diseases. Due to increased influence of transport environment in circumstances of increased traffic after the construction of multipurpose channel Danube-Sava E-80-10, boatmasters on Croatian inland waterways will be subjected to similar structured psychophysical complex disorders. With regard to survey results authors propose technical and economically feasible measures to reduce the workload risk of boatmasters to minimum level.

KEY WORDS

transport environment, measures, boatmasters, subjective disturbances

1. INTRODUCTION

The problem of noise, which is increasingly present in the living and working environment is progressively coming to its peak. It reduces work productivity, increases the number of defects and injuries at work in all industries. Noise can cause permanent hearing loss and reduce the overall quality of life and an increased level of health of the individual physical, psychological and social burdens.
If the noise is, for example, from 66 dB levels of activity, blood vessels are constricted, thereby extending the response time, which is very important for staff working in the transport system, particularly for drivers, pilots and machinists: naval, train, etc.

According to studies of Simonović, Kalić and Pravica (1982) the most influential factors are the length of the period of exposure to noise, and exposure to frequent and intense sounds. During night, noise, according to many authors, is up to 10 times a bigger factor of stress compared to daytime. The range from 0-140 [dB] means "threshold", and 140 [dB] is the threshold of "pain". Expected results of the scientific paper is to determine technical and economic proposals for measures to reduce the impact of noise on boatmasters of vessels in the transport environment of the Danube river basin.

2. METHODOLOGY FOR EXAMINATING THE IMPACT OF NOISE ON BOATMASTERS IN THE TRANSPORT ENVIRONMENT OF THE DANUBE RIVER BASIN

Survey techniques used as part of research for the target group of vessel boatmasters on inland waterway network Rhine-Main-Danube have found that noise as well as other mental and physical disorders damage health and cause a number of diseases.

2.1 Survey-based techniques for investigating the impact of noise

Survey techniques are usually carried out in parallel with the measurement of noise inside or outside the house, at the level of buildings where people live so there are certain disabilities with noise level estimation. Nowadays, this technique is used specifically to examine the effect of noise, not only because of the ease of application, but also for grasping a larger target group (all stakeholders in the transport environment) within the total population of people whose opinions are important to study the effects of noise, to take protective measures and for planning and designing new roads and airports.
Subjective factors of interference according to Simonović, Kalić and Pravica (1982.):

- mood alterations;
- loss of concentration,
- impact on the senses;
- eye closure, muscle contraction, bending the body, head convulsions;
- disorders during sleep and/or increasing the time required for rest, the impact of noise on the quality and/or length sleeping, a feeling of continuous fatigue and inability to rest;
- mental disorders and neurotic disorders reduce performance or cause a complete loss of working capacity;
- syndrome "adaptation" to the noise. In fact it is known that the human body can not adapt to life in the noise because the so-called "adaption" causes irreversible disturbance; (mental, physical, nervous)

2.2 Analysis of the scientific research project results "Cognitive Ergonomics at increasing traffic safety“

Traffic audible noise does not have its own cause to any subjective interference from Tables 3 and 4 due to the deviation of the respondents from the natural biological rhythm irregularity of sleeping and nutrition, and the simultaneous action of a number of related factors of ergoassessment all with very similar subjective disturbances. Traffic noise will be audible as a stressor (enhancer), partially contribute to enhancing the intensity and/or extension of time interval incidence of subjective complaints. Simonović, Kalić and Pravica connect subjective disturbances from Table 2, with exposure to traffic noise. Respondents were boatmasters of vessels which navigate in the form of navigation B (Table), and on vessels reserved for class Vb navigability for the entire length of the waterway Rhine-Main-Danube. Boatmasters on inland waterways in the Republic of Croatia in the near future will be identically structured to load of psycho-physical complex due to the increased influence of the transport environment in circumstances of increased traffic, but after the construction of multipurpose channel "Danube-Sava", which is foreseen as a new E waterway mark „E-80-104“.

Table 1. Incidence percentage of PP (%) to subjective complaints of 12 boatmasters

Offered subjective disturbances to surveyed respondents:	**P(%) I**
mood changes and / or occurrence of feelings:	100,00
sleep disturbance during holiday on board:	50,00
mental fatigue and / or job saturation:	66,67
poorer audibility of colleague speeches:	66,67
partial loss of hearing after leaving from work:	50,00
difficulty in communication:	66,67
inability to rest during navigation:	25,00
poorer audibility of audio messages (PA, beep):	58,33
sleep disturbance during holiday on shore:	25,00
reduction of concentration by accomplishing official work tasks:	50,00
headache:	33,33
disorientation in work:	16,67
permanent hearing loss:	0,00
inability to perform work assignments:	16,67

Based on the results represented with most subjective disturbance is a change of mood and/or occurrence of feelings (100.00 %). With less intensely, there is a problem of difficult communication (66.67 %), and mental fatigue and/or job saturation, poorer audibility of colleagues (66.67 %). These subjective disturbances can be considered as the most frequent disorders to boatmasters in inland navigation.

Table 2. Incidence percentage of P (%) changes in mood and / or the appearance of feelings to boatmasters during rest and / or work on board during navigation in the form of navigation „B“

12 boatmasters	
Subjective disorder	P (%)
Fatigue	83,33
Tension	66,67
Irritation	41,66
Exhaustion	91,66
Sleepiness	66,67
Disturbance	41,66
Anger	41,66
Aggressiveness	8,33
Discomfort	25,00
Frustration	0,00
Apathy	25,00
Freightness	-
None of the proposed	-

Results in Table 2 indicate that exhaustion (91.66%) and fatigue (83.33%) are the main reason for the change of mood and/or appearance of feelings to boatmasters during rest and/or work on board during navigation in „form B“.

Table 3. Grouped subjective disturbances by scale from 1-20

Rating the intensity of subjective disturbances			
Subjective disturbance	1 - 4	5 – 9	10 – 20
Noise and vibration during operation on a vessel in navigation	6	5	-
Noise and vibration during the holiday on a vessel in navigation	3	4	1
Navigation at night	4	7	-
Navigation in unfavorable weather conditions	8	3	1
Crossing the lock at night	3	3	1
Entering the lock around the bend	3	2	1
Entering the lock around the bend, at night and in unfavorable weather conditions	9	3	1
Navigation 24 hours a day in the form of „B“	6	3	1
The sense of deprivation and frustration of separation from family	6	4	2
A lot of unused time for resting on board	-	3	2
Lack of society and limited choice of extracurricular activities on board	2	2	2

Physical demands at my workplace	-	-	-
Psychological burdening at my workplace	5	4	1
Difficult to integrate in the daily lives after arriving home	-	5	2
Psychosis and tension due to the approaching of departure after the rest	3	5	1
Intense traffic entire day (eg. Maine)	3	2	-
Passing at night (eg, Maine)	1	5	1
Professional diseases (hearing loss, rheumatism, high blood pressure)	-	3	3
Change of bed (vessel-home)	-	3	6
Navigation by night via narrow curving river	6	3	3
TOTAL:	68	69	29

Table 3 demonstrates that the most subjective disturbances affect boatmasters during navigation. According to the survey „Entering the lock around the bend, at night and in unfavorable weather conditions“ (9) proved to be the most represented disturbance ranging score of 1-4. Maximum of times selected disturbance "mid-level" is navigation by night (7), while the change of bed (vessel-home, 6 times) causes the least load at boatmasters who navigate in the form of navigation „B“. Answering the question on subjective complaints of respondents during navigation or rest at home, more or less they indicated that they feel all listed disturbances. 29.41%, or five of respondents indicated that the highest intensity noise (rank 1) felt vibration and noise while working on a vessel during navigation. The following disturbance is entering the lock around the bend, at night and in unfavorable weather conditions. Somewhat less than a quarter of respondents (23.53%) with lesser intensity (rank 2) feel interference during navigation in unfavorable weather conditions. In general, the distribution of answers is dispersed making it difficult to interpret the survey results and suggest grouping its subjective complaints.

3. PROPOSED MITIGATION MEASURES OF NOISE IMPACT ON BOATMASTERS IN DANUBE RIVER BASIN TRANSPORT ENVIRONMENT

3.1 Technical measures

Table 4 analyzed current situation in Croatian shipping sector for implementation of Directive 2006/87/EC of the European Parliament and of the Council laying down technical requirements for inland waterway vessels (hereinafter referred to as Directive 2006/87/EC - including amendments) and repealing Council Directive 82/714/EEC (hereinafter referred to as Directive 2006/87/EC – including amendments).

Table 4. Compared requirements from directive (87/2006) to fleet condition

Chapter	Chapter topic	IW vessels condition
3	Shipbuilding requirem ents	70 % units was built under the classification society requirements, i.e. the hull, equipment, machinery, and other vessel`s systems are designed, verified, constructed and arranged satisfactory to international requirements and in good shipbuilding manner. However, with regard to average age of vessels, the hull requirements to plate thickness seem to be hard to satisfy.
4	Safety clearence, freeboard and draught marks	Freeboard and safety clearance matches recent requirements although the marks and navigation zones

		do not follow Directive provisions within the meaning of marks or positions.
5	Manoeuvrability	Concerning the steering and anchor equipment and appliances as well as propulsion plants it is expected that vessels will satisfy prescribed manoeuvrability tests requirements.
6	Steering system	Due to the good shipbuilding practice performed during the building of the majority of units, steering systems are in good condition.
7	Wheelhouse	The wheelhouse design and equipment could be the next critical point, comparing the condition of old units and these Directive requirements.
8	Engine design	It is expected that the engine design will not fully meet requirements according the noise emitted.fuel systems, control systems, oily waters and used oil storage.
9	Electrical equipment	Electric equipment condition meets the requirements. A part of distribution systems are to be renewed and some electronic systems are to be added.
10	Equipment	Anchors and other equipment condition meets the requirements, as well as the portable fire extiguishers, permanently installed fire-fighting systems and lightbuoys/lifejackets. Some of the ships`s boats are to be modified or replaced.
11	Safety at work stations	Safety at work stations requirements in generally are satisfied.
12	Accomodations	Design requirements for accomodation generally are included; sanitary and potable water installations are to be renewed.
13	Fuel-fired heating, cooking and refrigerating equipment	Fuel-fired heating, cooking and refrigerating equipment in good condition
14	Liquefied gas installations for domestic purposes	Liquefied gas installations for domestic purposes to be tested and repaired

As a summary of above mentioned fleet condition ratings and fleet condition compared with Directive 87/2006 requirements, following critical points were set:

1. Hull plating and stiffeners (due to the years from building; areas and parts to be replaced);
2. Wheelhouses (are to be redesigned and provided with additional equipment);
3. Engine design (noise and environmental requirements; fuel and control systems as well as the oily water systems are to be renewed);
4. Accommodation (sanitary and potable water systems are to be renewed);
5. Liquefied gas installations for domestic purposes (to be tested and repaired – renewed);
6. Critical points – fleet maintenance
7. Due to the existing state in field of shipowner's managements and vessel's maintenance workshop's capacities according to skills and lifting appliances, additional critical points in IW vessels fleet are:
8. Operators (shipowners) maintenance managing insufficiency;
9. Shipyards (maintenance workshops) and slipways lack.

Identified critical points are classified and transformed into Program of measures to overcome the technical gaps for implementation of the Directive (fleet modernization requirements) technical measures:

- Replacement of vessel components,
- Renewal of existing vessel parts according to new EU technical requirements,

- Installation of additional equipment to comply with new technical requirements,
- Improvement of fleet maintenance management,
- Improvement of quality performance and skills of work force in ship repair and maintenance workshops.

These measures require support from the government in the form of certain type of administrative and financial instruments. Identified critical points and proposed measures have impact on improvement of vessel safety and protection from the vessel pollution.

3.2 Economic measures

Outdated fleet of inland navigation is a problem in all European countries and in Croatia the situation is more than alarming. According to data from Central Bureau of Statistics in 2011, Croatian national carriers fleet consist of 50 vessels, approximately 40-50 years old. So, Croatia has a relatively small but very old fleet, which cannot meet the environmental standards of the EU. It is therefore an urgent need to take the initiative at the national level for adapting existing vessels to EU standards and the purchase of new vessels with state subsidies. The problem is that there does not exist a program of development and innovation in the inland waterway sector. However, general conclusion is that inland navigation fleet require significant innovation in the field of reducing emissions, adapting to the changing water levels, energy efficiency and new technologies for vessel supply.

- Activation of inland navigation fund in Croatia should consider stimulating replacement of old units with new ones under controlled situation. To get financial support from the Government, the owner would have to scrap certain capacity of the vessel that could not be repaired.
- Manual for shipping operators – This manual shold be focused on concepts for maintenance of IW vessels. (For example in order to apply to the government program for technical improvement of IW vessels, ship owner should present the maintenance program verified by competent Ministry)
- Establishment of company technical inspectors (persons in charge for technical condition of the company fleet). This can be prerequisite for application to the government program for technical improvement of IW vessels.

4. CONCLUSIONS

After the completed survey „Ergo-assessment of transport environment on boatmasters“ we can conclude that almost all subjective disorders are present at boatmasters which operate on European inland waterways. Engine noise is a major stressor for respondents which navigate on Rhine corridor that extends from the North Sea to Basel, between channel "Canal de Aire" (Dunkerque-Lille), river Weser (Bremenhafen-Minden) and Danube corridor (Corridor Main-Danube canal) which extends to the South-East of the river Main to the Black Sea.
Engine noise is closely connected with the fact that surveyed merchant fleet is outdated, with an average age of just over forty years. Subjective nuisance “noise and vibration during operation on a vessel in navigation” (5) is therefore most represented among the respondents. However, a major drawback of the survey results is dispersed distribution of other respondents' answers, which indicate on the expansion of the sample or the grouping of subjective complaints. A large number of answers that are related to the same/similar subjective disturbance caused by indecision and confusion among respondents when filling out the survey. Taking into account the results of these surveys it can be concluded that it is necessary to systematically invest in shipping throughout policy documents: Medium-Term Development Plan of Ports and Waterways 2009 - 2016, River Transport Development Strategy in the Republic of Croatia 2008-2018, and aid programmes through joint projects of innovation in shipping and shipbuilding, research and development, and environmental protection which would jointly participate by private investors and the Croatian government.

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A STUDY ON THE CAPABILITY OF THE MOTORWAYS OF THE SEA OF BEING COMPETITIVE TO ROAD TRANSPORT

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ABSTRACT

The Motorways Of the Sea (MOS) have been defined by the European Commission as follows: "existing or new sea-based transport services that are integrated in door-to-door logistic chains and concentrate flows of freight on viable, regular, frequent, high-quality and reliable short sea shipping links". The European Commission strongly supports the Motorways of the Sea policy: the 2001 White Paper considers intermodal transport based on MOS as a transport mode which can develop an effective competition compared with all-road transport. Several authors strongly outline the competitiveness of MOS. On the other hand, MOS show some disadvantages. Firstly, the target characteristics of MOS: frequent, fast, reliable, short sea shipping link, are not often achieved, specially because of the high transit times at ports. In this paper a comparison between intermodal transport based on MOS and all-road transport is carried out with reference to the applicative case of the trips from the Italian mainland to Sicily.. The paper tries to determine the critical reasons affecting the competitiveness of intermodal transport based on MOS respect to all-road transport. Different strategies have been considered: all-road transport; intermodal transport based on MOS, with the driver accompanying the cargo; intermodal transport based on MOS, in which cargo travels unaccompanied. Intermodal unaccompanied transport registers lower monetary costs, but higher travel times than all-road transport. Furthermore intermodal unaccompanied transport registers lower total costs (monetary cost directly incurred plus the monetized cost of time) basing on a monetary value of time taken from the literature.

KEY WORDS

Motorways of the Sea, road transport, EU Commission's White Paper, Competitiveness

1.INTRODUCTION

Motorways of the Sea (MOS) are ro-ro Short Sea Shipping services aimed at: constituting a valid alternative to all-road transport, and integrating inland transport where geographical constraints exist. According to the definition proposed by the European Commission (1999), Short Sea Shipping (SSS) is "*the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe. Short Sea Shipping includes domestic and international maritime transport, including feeder services, along the coast and to and from the islands, rivers and lakes. The concept of Short Sea Shipping also extends to maritime transport between the*

Member States of the Union and Norway and Iceland and other States on the Baltic Sea, the Black Sea and the Mediterranean".

Motorways of the Sea (MOS) can be defined as follows: "*existing or new sea-based transport services that are integrated in door-to-door logistic chains and concentrate flows of freight on viable, regular, frequent, high-quality and reliable short sea shipping links*". Therefore MOS are particular SSS links which have the attributes above defined. MOS, combined with other forms of transport, with which they must be integrated, offer a door-to-door service. The Article 12a of the TEN-T Guidelines of 29 April 2004 (European Parliament, 2004) has stated the main objectives of the Motorways of the Sea as follows: "*The trans-European network of Motorways of the Sea (MOS) is intended to concentrate flows of freight on sea-based logistical routes in such a way as to improve existing maritime links or to establish new viable, regular and frequent maritime links for the transport of goods between Member States so as to reduce road congestion and/or improve access to peripheral and island regions and States. Motorways of the Sea should not exclude the combined transport of persons and goods, provided that freight is predominant*".

In this paper, the competitiveness of intermodal transport based on MOS respect to all-road transport is studied. Firstly, the main policies performed by the European Union for the development of MOS are described. After, the strengths and weaknesses of MOS are reported. Finally, a quantitative analysis of the competitiveness of intermodal transport based on MOS is performed, with reference to the applicative case of the trips from the Italian mainland to Sicily. The freight movements have been considered from some representative cities in the Italian mainland: Turin, Milan, Verona, Venice, Udine, Trieste, Bologna, Ravenna, Genova, Firenze, Perugia, Ancona, Rome, Pescara, Bari, Napoli; to three representative cities in Sicily: Palermo, Messina and Catania. Conclusions follow.

2. THE EUROPEAN POLICIES AIMED AT SUPPORTING THE MOTORWAYS OF THE SEA

The development of Motorways of the Sea is highly supported by the European Union policies (Aperte and Baird, 2013).

The European Commission's White Paper "European Transport Policy for 2010: Time to Decide" (European Commission, 2001) considers intermodal transport based on MOS a viable competitive alternative to all-road transport.

The main drawback of road transport, pointed out in the White Paper, is the saturation of traffic in some regions of the European Union, such as Germany, The Netherlands, south-eastern UK and northern Italy. Therefore, existing infrastructures are overcrowded, and the high level of urbanization makes it impossible to build new roads or improve the capacity of existing ones. On the other hand, the modal shift is still in favour of road mode: in 2011, 45.3% of total freight transport in Europe took place by road (source: European Commission, 2013).

Actually, as stated in the White Paper, the capacity of railways is limited and in several countries they have been optimized for passengers transport. Moreover some bottlenecks exist, specially in the biggest cities, where the same line is shared by slow and high speed trains, by cargo and passenger trains.

Instead not only the sea has a virtually unlimited capacity, but also the capacity of the inland waterways is considerably underused in terms of infrastructure and vessels. The White Paper recommends European Countries to invest in this field rather than in other transport modes.

In fact, despite the high fuel emissions related to maritime transport, especially regarding $SO2$ (Martinez and Sanabra, 2009), SSS incurs in lower external costs than road transport. A study by Grimaldi, cited in the White Paper (note (36) pag.41), demonstrated that, on any given link, the intermodal option based on SSS produced 2.5 times less pollution, in the form of $CO2$ emissions, than the all-road option. A comparison analysis for the Genoa (IT) - Preston (UK) corridor points out that the external cost is about 0.14 euro/km for SSS compared to 0.24 euro/km for all-road transport (table 4.23 of Black et al. 2003). Furthermore, as stated in European Commission White Paper (2001), road transport registers a high accident rate: therefore the modal shift of at least some part of freight transport to Short Sea Shipping is desirable.

3. THE COMPETITIVENESS OF MOS RESPECT TO ROAD TRANSPORT

Statistical data clearly show that much effort still has to be done to implement the MOS European policy. In EU-27, in 2011, MOS account for only 2% of road freight traffic: the total MOS traffic in Europe is equal to 234.3 million tons, while the road freight traffic is equal to 12286.2 million tons (source: Eurostat). In Italy, in 2011, MOS account for 4,2% of road freight traffic: the total traffic of MOS is equal to 55.7 million tons (33.9 accompanied and 21.8 unaccompanied), while the road freight traffic is equal to 1339.7 (source: Eurostat). Italian data are better than the European average. These data clearly show that a relevant reduction of road traffic connected to the development of MOS is not yet achieved and much more effort should be spent by the European Union in this field.

Several studies have been carried out on whether intermodal transport based on MOS can realistically compete with all-road trans-port. Ng (2009) analyses the capability of intermodal transport based on SSS of attracting some part of road freight traffic coming from Belgium and directed to Eastern Baltic countries. Four ports have been taken into account: Tallinn, Riga, Klaipeda and Gdynia. Generalized costs, made up only of monetary costs and time required, are considered. The author supports the importance for ports of having a considerable inland catchment area in order to successfully develop in the SSS field and, basing on simulated results, concludes that: "SSS would become more competitive when the use of vessels occupies a higher proportion of the multimodal transportation route and serving coastal (and their immediate surroundings) regions, while road haulage is likely to continue its dominance for inlands regions" (Ng, 2009, p. 349).

Fusco et al. (2012) have developed a quantitative model to compare monetary costs and time spent, in intermodal transport, based on SSS with ro-ro ships, with all-road transport. The model proposed by these authors actually considers three scenarios: all-road; road combined with accompanied SSS (i.e. the driver travels on board with the tractor and the semi-trailer); road combined with unaccompanied SSS (only the freight, on a semi-trailer, is carried). The authors have also evaluated the variation of the cost of transport in the three scenarios according to the maritime distance between the two port terminals and according to the road distances between each port and the origin or the destination of the trip. The authors conclude that: "In short, to make the most of the SSS option, it is necessary to promote policies to coordinate and consolidate the cargoes, to adapt the offers to the needs, temporally and in terms of frequency, and to control the freight price of the maritime link" (Fusco et al., 2012, pag.10).

MOS have still to overcome several shortcomings: to complete a door-to-door service, MOS require the collaboration of rail or road modes for collection and delivery, and a network of well-located inland terminals. Nowadays the efficiency of ports, sea side port services and land side port services, that is port-hinterland connections, is still too low (Paixao and Marlow, 2002). As shown in Fusco et al. (2012) this can badly affect the competitiveness of intermodal transport based MOS with respect to all-road transport. The most critical aspect regards the complexity of administrative procedures in ports (administrative procedures in ports are hugely longer than in all the other transport terminals), which leads to high transit times and therefore to a severe decrease of the efficiency of MOS services. Moreover, despite all the efforts made in this field, MOS services are still characterized by a low frequency and also low reliability (Medda and Trujillo, 2010). In addition, fuel prices are too high: bunkering costs account for more than a half of the overall shipping cost (Fusco et al., 2012).

The approach adopted by the European Commission in developing the policy of Trans-European Networks (TEN-T) is an important step towards the integration of MOS in intermodal transport systems. But other three aspects are fundamental: firstly, proper rail and road accessibility to ports; secondly, the implementation of an organizational culture by shipping companies and port authorities, in order to reduce the overall transit time of cargoes, especially regarding port operations; thirdly, the performances of MOS in terms of punctuality, flexibility, availability and frequency of services.

4. THE MOTORWAYS OF THE SEA IN ITALY

Italian MOS routes mainly integrate existing inland links such as motorways and railways, in order to connect places which can be accessed only by sea or whose accessibility by sea is far more convenient than by road. In particular, the majority of Italian MOS routes connect: Italian Tyrrhenian ports with ports of Sardinia, Sicily and western Mediterranean countries; and Italian Adriatic ports with ports of Croatia, Montenegro, Albania and Greece. This is clearly shown in Lupi et al. (2013), where Motorways of the Sea routes to/from Italian ports are extensively reported. Instead only a few routes exist which connect ports in the mainland, and these connections are almost always part of a longer international route and often register a low frequency: Genoa – Livorno and Salerno – Genoa (both one way), Genoa – Napoli (two ways), Livorno – Savona (two ways), and Trieste – Ancona (two ways). Moreover only in the connection Trieste – Ancona, which is part of the route Trieste – Ancona – Igoumenitsa – Patras, cargo having both origin and destination in Italy is accepted. Instead there are several routes connecting Tyrrhenian ports of the mainland with Sicily, such as Genoa, Livorno, Civitavecchia, Napoli and Salerno, while only one connection exists between the Adriatic ports of the mainland and Sicily, which consists on the route Catania – Ravenna. These data refer to November 2012.
However, in the last months, Grimaldi has developed a new route connecting Ravenna with Brindisi and Catania, with a frequency of 3 services/week, where freight having origin in Ravenna and destination in Brindisi, o vice versa, is accepted. But, as stated in Lupi et al. (2013), until 2012 no connections between ports of the mainland belonging to domestic routes existed.

5. THE COMPETITIVENESS OF MOTORWAYS OF THE SEA IN ITALY

In order to quantify the competitiveness of MOS respect to all-road transport, the few routes connecting ports in the mainland cannot be significant. Therefore, it has been decided to consider the trips from the Italian mainland to Sicily, where MOS are alternative to a “nearly all-road” transport, which takes place by road despite the crossing of the Strait of Messina.
We took as origins some representative cities in the mainland: Turin, Milan, Verona, Venice, Udine, Trieste, Bologna, Firenze, Perugia, Ancona, Rome, Pescara, Bari, Napoli; we took as destinations three representative cities in Sicily: Palermo, Messina and Catania.
The two cases of accompanied and unaccompanied intermodal transport have been taken into account. A 16.50 m long track and trailer is considered in the first case, and a 12.5 m long semi trailer in the second.
The road network and maritime links have been represented through a graph: cities, ports, motorway junctions are represented through nodes, while portions of motorways and highways, and maritime routes, are represented through links. Also paths from city centres to motorways, e.g. from Milano centre to the beginning of the A1 motorway, are represented through links.
Given the costs on the links, the best path between each couple of origin-destination cities has been calculated through the Dijkstra algorithm: for example, the best path from Torino to Catania, from Torino to Palermo, from Torino to Messina, from Milano to Palermo, etc.
The cost of a link *l*, i.e. c_l, is equal to the monetary cost c_m plus the monetized cost of time: i.e.:

$$c_l = c_m + t \cdot VOT \qquad (1)$$

Where *t* is the travel time on the link and *VOT* is the value of time. There is disagreement about the value of time for freight transport. According to Feo et al. (2011), we assumed a value of time of 6.82 €/h for each shipment, considering an average weight for each shipment equal to 15 tons. Monetary costs and travel times are calculated as follows.

5.1 The calculation of the cost of links representing MOS routes

Firstly, MOS routes between the Italian mainland and Sicily have been updated (table 1) as they have resulted quite different from those determined in November 2012 and reported in a preceding study (Lupi, Farina, Volpi, 2013).
After, the travel time and the monetary cost of each link have been calculated.
Regarding the voyage time, it is provided by the companies websites and is reported in tab. 1. To the voyage time, however, we added the time required for loading and unloading the road transport vehicle (semitrailer or tractor+semi-trailer) and the waiting time (the time for loading the trailer can be included in the waiting time).
The waiting time is the average time the customer has to wait for the ship. For its calculation, it has been decided to take the same approach used for the calculation of the waiting time of scheduled flights in air transport (Ghobrial and Kanafani, 1995).
Calling O_{pw} the programming time by week of ship departures, where O_{pw} = 168 hours (because we have 24 operating hours per day, 7 operating days per week); and calling f_a the weekly frequency of the route, the average time interval between two successive departures, i.e. h, is equal to:

$$h = \frac{O_{pw}}{f_a} \quad (2)$$

The average waiting time has been assumed equal to 0.25 h, i.e.:

$$0.25\frac{O_{pw}}{f_a} \quad (3)$$

Table 1. Domestic ro-ro routes between the Italian mainland and the Sicily. Data refer to January 2014 (Source: ramspa website and shipping companies websites).

Route	Operator	Weekly frequency	Travel time
Ravenna – Brindisi – Catania	Grimaldi	3	39h
Ravenna – Catania	Tirrenia	4	36h30'
Genova – Catania	Grimaldi	4	28h
Livorno – Catania	Grimaldi	3	25h
Napoli – Catania	TTT Lines	7	11h30'
Salerno – Catania	Grimaldi	6	14h
Genova – Palermo	Grimaldi	4	29h
Genova – Palermo	Grandi Navi Veloci	6	20h
Livorno – Palermo	Grimaldi	4	19h
Salerno – Palermo	Grimaldi	2	9h
Civitavecchia – Termini Imerese	Grandi Navi Veloci + SNAV	2	13h
Napoli – Palermo	Tirrenia	7	10h45'
Napoli – Palermo	Grandi Navi Veloci + SNAV	6	10h30'
Civitavecchia – Palermo	SNAV	1	15h
Salerno – Messina	Caronte & Tourist	12	9h

In the event of frequency f_a is too low, e.g. one service per week, the result of formula (3) is not considered reliable and consequently a maximum value it is assumed. A maximum value equal to 4 hours has been considered in this paper (i.e. if the calculated waiting time, with formula (3), is greater than 4 hours, it is assumed equal to 4 hours).

Regarding the time required for loading the road transport vehicle, shipping companies require that the vehicle arrives at the gate at least 2 hours before the scheduled departure time. Therefore the loading time has been considered 2 hours. However, we incorporate the loading time into the waiting time, therefore we do not add it to the waiting time, but we fix a minimum value of 2 hours for the waiting time i.e. if the results of the

formula (3) is less than 2 hours waiting time it is assumed equals to 2 hours. Instead we assumed 1 hour as the unloading time, according to Rossi and Rubino (2010); moreover we don't incorporate the unloading time in other quantities, therefore we add it to the voyage time and the waiting time.
The application results show that in nearly all routes the average waiting time is equal to 4 hours.
Regarding the monetary cost of the link, the total fare is composed of: the cost of the ticket and, only in case of accompanied transport, of the cost of the driver. Regarding the cost of the ticket, it is determined in a different way from an operator to another; however it comprises:

- The cost for the vehicle, which depends on the length of the vehicle (the tractor and the trailer in case of accompanied transport, only the trailer in case of unaccompanied transport) and on whether the trailer is full or not.
- The bunkering cost, imposed apart by the shipping company, to cover the further costs due to fluctuation in the petrol price.
- The cost for the driver's cabin, in case of accompanied transport.
- The insurance.
- The cost for loading/unloading operations of the semitrailer, in case of unaccompanied transport.
- The inspection service, again in case of unaccompanied transport.

The ticket price must be discounted, where available, of the Ecobonus contribution. The Ecobonus is an initiative supported by the Italian government to perform a modal shift from road to MOS offering a 30% discount for the ticket. The only routes not covered, yet, by the Ecobonus are: Catania – Salerno and Catania – Brindisi – Ravenna.
In case of accompanied transport, it is necessary to determine the cost of the driver. This cost is due to the working hours lost by the driver on board. The number of lost working hours is calculated as follows.
Firstly, there are constraints by European law (European Parliament, 2006) on the maximum number of hours which can be worked by the driver each day: therefore, some hours spent by the driver on board can be considered as driver's rest hours and are not paid. But not all hours spent on board can be considered as rest hours. In particular, if the voyage lasts for more than 24 hours, an entire working day is lost. In their master thesis, Rossi and Rubino (2010) have proposed the following formulas to calculate an average value of the number of lost working hours T_w, according to the duration of the voyage.

If the voyage time T_t is:

$$24(d-1) \le T_t < 24(d-1) + 11.5 \qquad (4)$$

where d are the days at sea, then the average number of working hours lost by the driver on board, T_w, is:

$$T_w = T_t - 12.5(d-1) \qquad (5)$$

where the voyage time T_t is expressed in hours. For example, if the maritime connection duration is 30 hours, T_t = 30 hours and d = 2 days, therefore T_w = 17.5 hours.

If the travel time T_t is:

$$24(d-1) + 11.5 \le T_t < 24(d-1) + 24 \qquad (6)$$

then the number of working hours lost is:

$$T_w = 11.5 + 11.5(d-1) \qquad (7)$$

For example, if the maritime connection duration is 19 hours, T_t = 19 hours and d = 1 days, therefore T_w = 11.5 hours.
The hourly cost of the driver (i.e. the cost of each working hour lost) has been assumed equal to 17.60 €/h (Francardi, 2011): a reduced value is taken (the full value for the hourly cost of the driver is 26 €/h) because during the voyage the driver is not working.

5.2 The calculation of the cost of road links

The travel time on road links has been calculated by dividing the distance by the speed. Two typologies of road links have been considered:
- motorway and highway links
- links representative of the path from the city centre to the closest motorway exit.

Regarding motorway and highway links, the considered speed is 10 km/h less than the maximum allowed speed on a given portion of motorway or highway. A different maximum speed has been considered for those road portions where congestion often occurs, for example the Bologna-Firenze motorway and the highways of Milano. Regarding the paths to/from city centres, an average speed of 30 km/h has been considered.
The monetary cost of road links is composed of the following costs:

- the motorway toll if applied,
- the kilometric cost of the vehicle,
- the cost of the driver.

The motorway toll in Italy usually depends on the amount of kilometers travelled and on the company managing each part of motorway. All motorway tolls are available in the website of the "Autostrade per l'Italia" company (www.autostrade.it). A 5-axes tractor + trailer has been considered for the calculation of the motorway toll.
The vehicle cost for each kilometer has been calculated by considering a 5-axes tractor + trailer. This cost is equal to 1.06 € per kilometer (Francardi, 2011) and comprises not only petrol but all the other costs associated to the operation of the vehicle, i.e.: amortization cost, tyres, brakes, etc.
The cost of the driver has been assumed equal to 26 €/h.
The MOS link across the strait of Messina is considered as a road link because of the high frequency of services (about one service every 20 minutes). The cost of the ticket and the travel time are taken from the website of the maritime operator (Caronte&Tourist).

Given the costs of all links, the best paths have been calculated through Dijkstra algorithm separately for the case of accompanied intermodal transport., tab.2, and for the case of unaccompanied intermodal transport, tab.3.

6. THE RESULTS OF THE ANALYSIS

The Dijkstra algorithm provides in output the shortest path between each OD pair. The optimum paths are displayed in tab. 2 regarding accompanied intermodal transport and in tab. 3.regarding unaccompanied intermodal transport. In the table, the travel times for each OD pair and the monetary costs are also reported. In the path column of tab. 2, the maritime part of the path is written in italic.
The algorithm also takes into account the maximum driving hours of drivers, which, according to the European Parliament law 561/2006 (2006), is equal to 9 hours; 10 driving hours are accepted in maximum 2 days per week. The same law states that maximum 4.5 continuative driving hours are allowed. After them, a break of at least 45 minutes is necessary. Moreover, between one day and another at least 8 hours of rest are necessary. Therefore:

- if the travel time is greater than 4.5 hours and less than 9, it is increased by 45 minutes,
- if the travel time is greater than 9 hours and less than 10, it is increased by 90 minutes,
- if the travel time is greater than 10 hours, it is increased by 10 hours)

Table 2. The optimum paths between each OD pair and their relative costs. Accompanied transport. The costs and travel times of the road and the MOS parts are explicitly reported.

Origin	Destination	Path	Monetary cost (€)			Travel time		
			road	MOS	total	Road	MOS	total
Milano	Catania	Milano-Tortona-*Genova-Catania*	235	1490	1725	2h 21'	33h	35h 21'
	Palermo	Milano-Piacenza-Parma-La Spezia-Pisa-*Livorno-Palermo*	475	1090	1565	3h 29'	24h	27h 29'
	Messina	Milano-Piacenza-Parma-La Spezia-Pisa-*Livorno-Palermo*-Messina	847	1090	1937	7h 6'	24h	31h 29'
Torino	Catania	Torino-Alessandria-*Genova-Catania*	268	1490	1758	2h28'	33h	35h 28'
	Palermo	Torino-Alessandria-Genova-La Spezia-Pisa-*Livorno-Palermo*	583	1090	1673	4h 11'	24h	28h 11'
	Messina	Torino-Alessandria-*Genova-Catania*-Messina	370	1490	1860	3h 53'	33h	36h 53'
Verona	Catania	Verona-Modena-Bologna-Firenze-*Livorno-Catania*	484	1240	1724	3h 35'	30h	33h 35'
	Palermo	Verona-Modena-Bologna-Firenze-*Livorno-Palermo*	484	1090	1574	3h 35'	24h	27h 35'
	Messina	Verona-Modena-Bologna-Firenze-*Livorno-Palermo*-Messina	690	1090	1780	7h 11'	24h	31h 11'
Trieste	Catania	Trieste-Venezia-Padova-Bologna-Firenze-*Livorno-Catania*	750	1240	1990	6h 30'	30h	36h 30'
	Palermo	Trieste-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*	750	1090	1840	6h 30'	24h	30h 30'
	Messina	Trieste-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*-Messina	965	1090	2055	9h 7'	24h	33h 7'
Udine	Catania	Udine-Venezia-Padova-Bologna-Firenze-*Livorno-Catania*	713	1240	1953	6h10'	30h	36h 10'
	Palermo	Udine-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*	713	1090	1803	6h 10'	24h	30h 10'
	Messina	Udine-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*-Messina	923	1090	2013	8h 46'	24h	32h 46'
Ravenna	Catania	Ravenna-Bologna-Firenze-*Livorno-Catania*	396	1240	1636	3h 27'	30h	33h 27'
	Palermo	Ravenna-Bologna-Firenze-*Livorno-Palermo*	396	1090	1486	3h 27'	24h	27h 27'
	Messina	Ravenna-Bologna-Firenze-*Livorno-Palermo*-Messina	605	1090	1695	6h 3'	24h	30h 3'
Venezia	Catania	Venezia-Padova-Bologna-Firenze-*Livorno-Catania*	521	1240	1761	3h 50'	30h	33h 50'
	Palermo	Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*	521	1090	1611	3h 50'	24h	27h 50'
	Messina	Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*-Messina	732	1090	1822	7h 27'	24h	31h 27'
Bologna	Catania	Bologna-Firenze-*Livorno-Catania*	291	1240	1531	2h 34'	30h	32h 34'
	Palermo	Bologna-Firenze-*Livorno-Palermo*	291	1090	1381	2h 34'	24h	26h 34'
	Messina	Bologna-Firenze-*Livorno-Palermo*-Messina	503	1090	1593	6h 10'	24h	30h 10'
Firenze	Catania	Firenze-*Livorno-Catania*	155	1240	1395	1h 22'	30h	31h 22'
	Palermo	Firenze-*Livorno-Palermo*	155	1090	1245	1h 22'	24h	25h 22'
	Messina	Firenze-*Livorno-Palermo*-Messina	364	1090	1454	3h 58'	24h	27h 58'
Genova	Catania	*Genova-Catania*		1490	1490	24'	33h	33h 24'
	Palermo	Genova-La Spezia-Pisa-*Livorno-Palermo*	327	1090	1417	2h 22'	24h	26h 22'
	Messina	*Genova-Catania*-Messina	148	1490	1638	1h 51'	33h	34h 51'
Livorno	Catania	*Livorno-Catania*		1240	1240	13'	30h	30h 13'
	Palermo	*Livorno-Palermo*		1090	1090	12'	24h	24h 12'

	Messina	*Livorno-Palermo*-Messina	215	1090	1305	2h 49'	24h	26h 49'
Perugia	Catania	Perugia-Roma-*Napoli-Catania*	530	990	1520	4h 16'	16h 30'	20h 46'
	Palermo	Perugia-Orte-Viterbo-*Civitavecchia-Palermo*	420	964	1384	2h 35′	18h 40'	21h 15'
	Messina	Perugia-Roma-Salerno-Reggio Calabria-Messina	1375		1375	10h 28'		10h 28'
Pescara	Catania	Pescara-Foggia-Nola-*Napoli-Catania*	557	990	1547	5h 30'	16h 30'	22h
	Palermo	Pescara-Foggia-Nola-*Napoli-Palermo*	557	740	1297	5h 29'	15h 30'	21h
	Messina	Pescara-Foggia-Taranto-Reggio Calabria-Messina	1290		1290	10h 6'		10h 6'
Roma	Catania	Roma-Caserta-Napoli-Reggio Calabria-Messina-Catania	1315		1315	10h 27'		10h27′
	Palermo	Roma-Caserta-*Napoli-Palermo*	310	740	1050	2h 28'	15h 30'	18h
	Messina	Roma-Salerno-Reggio Calabria-Messina	1202		1202	9h 2'		9h 2'
Ancona	Catania	Ancona-Perugia-Roma-Caserta-*Napoli-Catania*	726	990	1716	7h 11'	16h 30'	23h 41'
	Palermo	Ancona-Perugia-Orte-Viterbo-*Civitavecchia-Palermo*	690	964	1654	4h 30'	18h 40′	23h 10'
	Messina	Ancona-Perugia-Roma-Caserta-*Salerno-Messina*	754	920	1674	7h 27'	14h	21h 27'
Napoli	Catania	*Napoli-Catania*		955	955	12'	16h 30'	16h 42'
	Palermo	*Napoli-Palermo*		740	740	11'	15h 30'	15h 41'
	Messina	Napoli-Salerno-Reggio Calabria-Messina	885		885	7h 20'		7h 20'
Bari	Catania	Bari-Taranto- Reggio Calabria-Messina-Catania	1072		1072	9h 12'		9h 12'
	Palermo	Bari-Foggia-Nola-*Napoli-Palermo*	370	740	1110	3h 43'	15h30'	19h 13'
	Messina	Bari-Taranto-Reggio Calabria-Messina	887		887	7h 45'		7h 45'
Brindisi	Catania	Brindisi-Taranto- Reggio Calabria-Messina-Catania	1066		1066	9h 17'		9h 17'
	Palermo	Brindisi-Taranto- Reggio Calabria-Messina-Palermo	1178		1178	10h12′		10h 12'
	Messina	Brindisi-Taranto-Reggio Calabria-Messina	882		882	7h 50'		7h 50'

Table 3. The optimum paths between each OD pair and their relative costs. Unaccompanied transport. The costs and travel times of the road and the MOS parts are explicitly reported.

Origin	Destination	Path	Monetary cost (€)			Travel time		
			road	MOS	total	Road	MOS	Total
Milano	Catania	Milano-Tortona-*Genova-Catania*	235	910	1145	2h 21'	33h	35h 21'
	Palermo	Milano-Piacenza-Parma-La Spezia-Pisa-*Livorno-Palermo*	475	690	1165	3h 29'	24h	27h 29'
	Messina	Milano-Piacenza-Parma-La Spezia-Pisa-*Livorno-Palermo*-Messina	847	910	1757	7h 6'	24h	31h 29'
Torino	Catania	Torino-Alessandria-*Genova-Catania*	268	910	1178	2h28'	33h	35h 28'
	Palermo	Torino-Alessandria-Genova-La Spezia-Pisa-*Livorno-Palermo*	583	965	1548	4h 11'	24h	28h 11'
	Messina	Torino-Alessandria-*Genova-Catania*-Messina	370	910	1280	3h 53'	33h	36h 53'
Verona	Catania	Verona-Modena-Bologna-Firenze-*Livorno-Catania*	484	795	1279	3h 35'	30h	33h 35'
	Palermo	Verona-Modena-Bologna-Firenze-*Livorno-Palermo*	484	690	1174	3h 35'	24h	27h 35'
	Messina	Verona-Modena-Bologna-Firenze-*Livorno-Palermo*-Messina	690	795	1485	7h 11'	24h	31h 11'
Trieste	Catania	Trieste-Venezia-Padova-Bologna-Firenze-*Livorno-Catania*	750	795	1545	6h 30'	30h	36h 30'
	Palermo	Trieste-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*	750	690	1440	6h 30'	24h	30h 30'
	Messina	Trieste-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*-Messina	965	795	1760	9h 7'	24h	33h 7'
Udine	Catania	Udine-Venezia-Padova-Bologna-Firenze-*Livorno-Catania*	713	795	1508	6h10'	30h	36h 10'
	Palermo	Udine-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*	713	690	1403	6h 10'	24h	30h 10'
	Messina	Udine-Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*-Messina	923	795	1718	8h 46'	24h	32h 46'
Ravenna	Catania	Ravenna-Bologna-Firenze-*Livorno-Catania*	396	1040	1436	3h 27'	30h	33h 27'
	Palermo	Ravenna-Bologna-Firenze-*Livorno-Palermo*	396	690	1086	3h 27'	24h	27h 27'
	Messina	Ravenna-Bologna-Firenze-*Livorno-Palermo*-Messina	605	690	1295	6h 3'	24h	30h 3'
Venezia	Catania	Venezia-Padova-Bologna-Firenze-*Livorno-Catania*	521	795	1316	3h 50'	30h	33h 50'
	Palermo	Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*	521	690	1211	3h 50'	24h	27h 50'
	Messina	Venezia-Padova-Bologna-Firenze-*Livorno-Palermo*-Messina	732	795	1527	7h 27'	24h	31h 27'
Bologna	Catania	Bologna-Firenze-*Livorno-Catania*	291	795	1086	2h 34'	30h	32h 34'
	Palermo	Bologna-Firenze-*Livorno-Palermo*	291	690	981	2h 34'	24h	26h 34'
	Messina	Bologna-Firenze-*Livorno-Palermo*-Messina	503	795	1298	6h 10'	24h	30h 10'
Firenze	Catania	Firenze-*Livorno-Catania*	155	795	950	1h 22'	30h	31h 22'
	Palermo	Firenze-*Livorno-Palermo*	155	690	845	1h 22'	24h	25h 22'
	Messina	Firenze-*Livorno-Palermo*-Messina	364	795	1159	3h 58'	24h	27h 58'
Genova	Catania	*Genova-Catania*		910	910	24'	33h	33h 24'
	Palermo	Genova-La Spezia-Pisa-*Livorno-Palermo*	327	965	1292	2h 22'	24h	26h 22'
	Messina	*Genova-Catania*-Messina	148	910	1058	1h 51'	33h	34h 51'
Livorno	Catania	*Livorno-Catania*		795	795	13'	30h	30h 13'
	Palermo	*Livorno-Palermo*		690	690	12'	24h	24h 12'

	Messina	*Livorno-Palermo*-Messina	215	795	1010	2h 49'	24h	26h 49'
Perugia	Catania	Perugia-Roma-*Napoli-Catania*	530	530	1060	4h 16'	16h 30'	20h 46'
	Palermo	Perugia-Orte-Viterbo-*Civitavecchia-Palermo*	420	611	1031	2h 35'	18h 40'	21h 15'
	Messina	Perugia-Roma-Caserta-Salerno-Reggio Calabria-Messina	1445	575	2020	4h 32'	16h	20h 32'
Pescara	Catania	Pescara-Foggia-Nola-*Napoli-Catania*	557	530	1087	5h 30'	16h 30'	22h
	Palermo	Pescara-Foggia-Nola-*Napoli-Palermo*	557	405	962	5h 29'	15h 30'	21h
	Messina	Pescara-Foggia-Nola-*Salerno-Messina*	613	575	1188	5h 33'	14h	19h 33'
Roma	Catania	Roma-Caserta-*Napoli-Catania*	310	530	840	2h 29'	16h30'	19h
	Palermo	Roma-Caserta-*Napoli-Palermo*	310	405	715	2h 28'	15h 30'	18h
	Messina	Roma-Caserta-Nola-*Salerno-Messina*	402	575	977	2h 58'	16h	18h 58'
Ancona	Catania	Ancona-Perugia-Roma-Caserta-*Napoli-Catania*	726	530	1256	7h 11'	16h 30'	23h 41'
	Palermo	Ancona-Perugia-Orte-Viterbo-*Civitavecchia-Palermo*	690	611	1301	4h 30'	18h 40'	23h 10'
	Messina	Ancona-Perugia-Roma-Caserta-*Salerno-Messina*	754	575	1329	7h 27'	14h	21h 27'
Napoli	Catania	*Napoli-Catania*		530	530	12'	16h 30'	16h 42'
	Palermo	*Napoli-Palermo*		405	405	11'	15h 30'	15h 41'
	Messina	Napoli-*Salerno-Messina*	85	575	660	1h 3'	16h	17h 3'
Bari	Catania	Bari-*Brindisi-Catania*	108	690	798	1h 33'	23h	24h 33'
	Palermo	Bari-Foggia-Nola-*Napoli-Palermo*	370	405	775	3h 43'	15h30'	19h 13'
	Messina	Bari-Taranto-Reggio Calabria-Messina	887		887	7h 45'		7h 45'
Brindisi	Catania	*Brindisi-Catania*		690	690	14'	23h	23h 14'
	Palermo	*Brindisi-Catania*-Palermo	230	690	920	2h 34'	21h	23h 34'
	Messina	Brindisi-Taranto-Reggio Calabria-Messina	882		882	7h 50'		7h 50'

The results of the analysis clearly show that MOS are really competitive with all-road transport, but they are rather an integration with road transport rather than an alternative which minimizes the road transport part of the intermodal path. For example, given the OD pair Trieste – Catania, the path that minimizes the road transport part of the intermodal is by road from Trieste to Ravenna, then by MOS from Ravenna to Catania. Instead, the result of our studies show that, in both cases of accompanied and unaccompanied transport, the best path is Trieste – Livorno by road, and Livorno – Catania by MOS.
In tab. 4 it is shown in detail: a comparison between all-road transport and intermodal transport based on MOS, accompanied and unaccompanied. In tab. 4 the case that drivers do not respect the law 561/2006 (about the maximum number of driving hours) is also taken into account. To get an idea of the sensitivity of the results, of all-road mode, respect to this.
In the table, the most convenient mode of transport is underlined in bold. We have considered, separately, the optimum (that is the minimum) for: travel times, monetary costs, and total costs (where travel times have been monetized through the value of time, and summed to monetary costs).
When the most convenient mode of transport is the illegal all-road, i.e. it does not respect the law 561/2006, the "illegal" most convenient mode is pointed out in grey italic bold characters. In this case, also the "legal" most convenient mode is pointed out in underlined black, non-italic, bold.
The monetization of travel times through the value of time (VOT) is essential in order to determine the best path. However, there is a high disagreement about the best VOT to assume for freight transport, as shown in Feo et al. (2011, p. 65). Again Feo et al. (2011) calculated a VOT equal to 6.82 €/h considering shipments of 15 tons, which is the value that we assumed in our calculations.
As shown in tab.4, for all the considered origin - destination pairs, the lowest travel times are shown by "illegal" all-road transport; while the lowest "legal" travel times are usually shown by the "legal" all-road transport. Travel times in "legal" all-road transport are usually much lower than in intermodal transport: intermodal accompanied and unaccompanied transport have the same

travel time (they only differ in the monetary cost as stated in paragraph 5.1).
The lowest values for the monetary cost are usually shown by intermodal unaccompanied transport; moreover they are usually much less than those registered in all-road transport.
The monetary cost in the two cases of „legal" and „illegal" all-road transport is the same. In fact, also the cost of the driver is the same in both cases: the number of hours driven is the same, and the higher travel time in the „legal" scenario is due to the driver legal rest hours (in which the driver is not paid).
Unaccompanied transport is always more convenient than accompanied transport. Actually not only the cost of the driver, and the cabin for the driver, does not exist in the unaccompanied transport, but also the cost of the vehicle is less as it depends on the length of the vehicle (in fact in the case of accompanied transport the articulated vehicle is made up of the trailer plus the tractor).
From the tab. 4, unaccompanied intermodal transport has resulted the most convenient mode for nearly all origin-destination pairs considered, as far as total costs are concerned.
However, as stated above, "legal" all-road transport is the best from the point of view of travel times. Moreover, for several types of freight, specially perishable ones, and for the development of "just-in-time deliveries", time is the fundamental aspect. Furthermore, in literature very different values for the VOT have been proposed. Therefore, if we assume a different value from that proposed in Feo et al. (2011), the results of our calculations may change.
Moreover, because of the assumed VOT, the difference between total costs in "legal" and "illegal" all-road transport is not very high, despite the travel time is quite different. Actually, the contribution of the monetized travel times to total costs is much lower than the contribution of monetary costs directly incurred because of the VOT assumed
Anyway it is important to point out that the intermodal transport based on MOS is usually convenient on longer distances, because of the economy of scale of maritime transport respect to the route length, therefore the kilometric cost of MOS transport decreases as the route length increases. Instead, the kilometric cost of road transport keeps always the same. Furthermore, the time spent in intermodal transport is highly more than all-road for short distances; instead, because of the law 561/2006, the time required for all-road transport highly increases for long distances and becomes similar to that of intermodal transport.

Table 4. A comparison between all-road and intermodal transport based on MOS in the two cases of accompanied and unaccompanied transport. Also the case that drivers do not respect the law No 561/2006 is taken into account.

Origin	Destin.	Intermodal					All-road				
			Accompanied		Unaccompanied			Respecting law 561/2006		Non respecting law 561/2006	
		Travel time	Mon. cost (€)	Total cost (€)	Mon. cost (€)	Total cost	Mon. cost (€)	Travel time	Total cost (€)	Travel time	Total cost (€)
Milano	Catania	35h 21'	1725	1966.09	**1145**	**1386.09**	2181	**25h22'**	2354.00	***15h22'***	2285.80
	Palermo	27h 29'	1565	1752.44	**1165**	**1352.44**	2354	**26h32'**	2534.96	***16h32'***	2466.76
	Messina	31h 29'	1937	2151.72	**1757**	**1971.72**	2009	**23h49'**	2171.43	***13h49'***	2103.23
Torino	Catania	35h 28'	1758	1999.88	**1178**	**1419.88**	2340	**26h37'**	2521.53	***16h37'***	2453.33
	Palermo	28h 11'	1673	1865.21	**1548**	**1740.21**	2513	**27h47'**	2702.48	***17h47'***	2634.28
	Messina	36h 53'	1860	2111.54	**1280**	**1531.54**	2168	**25h4'**	2338.96	***15h4'***	2270.76
Verona	Catania	33h 35'	1724	1953.04	**1279**	**1508.04**	2079	**24h38'**	2247.00	***14h38'***	2178.80
	Palermo	27h 35'	1574	1762.12	**1174**	**1362.12**	2252	**25h48'**	2427.96	***15h48'***	2359.76
	Messina	31h 11'	1780	1992.67	**1485**	**1697.67**	1907	**23h5'**	2064.43	***13h5'***	1996.23
Trieste	Catania	36h 30'	1990	2238.93	**1545**	**1793.93**	2357	**26h26'**	2537.27	***16h26'***	2469.07
	Palermo	30h 30'	1840	2048.01	**1440**	**1648.01**	2530	**27h36'**	2718.23	***17h36'***	2650.03
	Messina	33h 7'	2055	2280.86	**1760**	**1985.86**	2185	**24h53'**	2354.70	***14h53'***	2286.50
Udine	Catania	36h 10'	1953	2199.66	**1508**	**1754.66**	2307	**26h5'**	2484.89	***16h5'***	2416.69
	Palermo	30h 10'	1803	2008.74	**1403**	**1608.74**	2480	**27h15'**	2665.85	***17h15'***	2597.65
	Messina	32h 46'	2013	2236.47	**1718**	**1941.47**	2135	**24h32'**	2302.32	***14h32'***	2234.12
Ravenna	Catania	33h 27'	1636	1864.13	**1436**	**1664.13**	1904	**24h7'**	2068.48	***14h7'***	2000.28
	Palermo	27h 27'	1486	1673.21	**1086**	**1273.21**	2077	**25h17'**	2249.43	***15h17'***	2181.23
	Messina	30h 3'	1695	1889.94	**1295**	**1499.94**	1732	**22h34'**	1895.91	***12h34'***	***1817.71***
Venezia	Catania	33h 50'	1761	1991.74	**1316**	**1546.74**	2115	**24h55'**	2284.93	***14h55'***	2216.73
	Palermo	27h 50'	1611	1800.82	**1211**	**1400.82**	2288	**26h5'**	2465.89	***16h5'***	2397.69
	Messina	31h 27'	1822	2036.49	**1527**	**1741.49**	1943	**23h22'**	2102.36	***13h22'***	2034.16
Bologna	Catania	32h 34'	1531	1753.10	**1086**	**1308.10**	1888	**23h29'**	2048.15	***13h29'***	1979.95
	Palermo	26h 34'	1381	1562.18	**981**	**1162.18**	2061	**24h39'**	2229.11	***14h39'***	2160.91
	Messina	30h 10'	1593	1798.74	**1298**	**1503.74**	1716	**21h56'**	1865.58	***11h56'***	1797.38
Firenze	Catania	31h 22'	1395	1608.92	**950**	**1163.92**	1731	**22h20'**	1883.31	***12h20'***	1815.11
	Palermo	25h 22'	1245	1418.00	**845**	**1018.00**	1904	**23h30'**	2064.27	***13h30'***	1996.07
	Messina	27h 58'	1454	1644.73	**1159**	**1349.73**	1559	**20h47'**	1700.74	***10h47'***	1632.54
Genova	Catania	33h 24'	1490	1717.79	**910**	**1137.79**	2085	**24h49'**	2254.25	***14h49'***	2186.05
	Palermo	26h 22'	1417	1596.82	**1292**	**1471.82**	2258	**25h59'**	2435.20	***15h59'***	2367.00
	Messina	34h 51'	1638	1875.68	**1058**	**1295.68**	1913	**23h16'**	2071.68	***13h16'***	2003.48
Livorno	Catania	30h 13'	1240	1446.08	**795**	**1001.08**	1792	**23h6'**	1949.54	***13h6'***	1881.34
	Palermo	**24h 12'**	1090	1255.04	**690**	**855.04**	1965	24h16'	2130.50	***14h16'***	2062.30
	Messina	26h 49'	1305	1487.89	**1010**	**1192.89**	1620	**21h33'**	1766.97	***11h33'***	1698.77
Perugia	Catania	**20h 46'**	1520	1661.63	**1060**	**1201.63**	1547	21h16'	1692.04	***11h16'***	1623.84
	Palermo	**21h 15'**	1384	1528.93	**1031**	**1175.93**	1720	22h26'	1872.99	***12h26'***	1804.79
	Messina	22h 16'	1692	1843.75	**1232**	**1383.75**	1375	**10h28'**	1446.38	***9h43'***	1441.27
Pescara	Catania	22h	1447	1597.04	**1087**	**1237.04**	1462	**20h54'**	1604.54	***10h54'***	1536.34
	Palermo	**21h**	1297	1440.22	**962**	**1105.22**	1635	22h4'	1785.50	***12h4'***	1717.30
	Messina	23h 30'	1619	1779.27	**1188**	**1321.33**	1290	**10h6'**	1358.88	***9h21'***	1353.77
Roma	Catania	19h	1200.1	1331.04	**840**	**969.58**	1315	**10h27'**	1386.27	***9h42'***	1381.15
	Palermo	**18h**	1050	1172.76	**715**	**837.76**	1488	20h52'	1630.31	***10h52'***	1562.11
	Messina	20h 30'	1372.1	1511.91	**977**	**1106.58**	1143	**8h54'**	1203.70	***8h9'***	1198.58
Ancona	Catania	23h 41'	1716	1877.52	**1256**	**1417.52**	1740	**23h11'**	1898.11	***13h11'***	1829.91

	Palermo	**23h 10'**	1654	1812.00	**1301**	**1459.00**	1913	24h21'	2079.07	***14h21'***	2010.87
	Messina	**21h 27'**	1674	1790.29	**1329**	**1475.29**	1568	21h38'	1815.54	***11h38'***	1647.34
Napoli	Catania	16h 42'	955	1068.89	**530**	**643.89**	1012	**8h32'**	1070.20	***7h47'***	1065.08
	Palermo	15h 41'	740	846.96	**405**	**511.96**	1185	**9h42'**	1251,15	***8h57'***	1246.04
	Messina	18h 15'	1127	1251.47	**660**	**775.94**	840	**7h 20'**	887.63	***6h14'***	882.51
Bari	Catania	24h 33'	943.7	1110.78	**798**	**965.43**	1011	**8h57'**	1072.04	***8h12'***	1066.92
	Palermo	19h 13'	1110	1240.94	**775**	**905.94**	1184	**10h7'**	1253.00	***9h22'***	1247.88
	Messina	26h 15'	1115.7	1296.43	970	1149.03	**839**	**7h24'**	**889.47**	***6h39'***	***884.35***
Brindisi	Catania	23h 14'	825.5	984.06	**690**	**848.57**	1005	**9h2'**	1066.61	***8h17'***	1061.49
	Palermo	23h 34'	1252	1412.72	**920**	**1080.72**	1178	**10h12'**	1247.56	***9h27'***	1242.45
	Messina	24h 45'	997.5	1169.71	862	1030.80	**833**	**7h29'**	**884.04**	***6h44'***	***878.92***

7. CONCLUSIONS

Intermodal transport based on MOS are strongly supported by European policies as it is seen as a viable alternative to all-road transport. Actually, railways congestion exists, in particular in correspondence of nodes, where different typologies of train, with different speed, share the same portion of line. Furthermore road transport congestion is very high: it causes the necessity to build new roads or motorways lanes. High investments are required also for ports; however, the environmental impact of MOS is much better than road transport. In fact, despite the high fuel emissions related to maritime transport, especially regarding S02, MOS incurs in lower external costs than road transport: as stated in European Commission White Paper (2001). Moreover road transport registers a high accident rate: therefore the modal shift, of at least some part of freight transport, to MOS is desirable.
On the other hand, MOS show some disadvantages. Firstly, the target characteristics of MOS links: frequent, fast, reliable, often are not achieved, specially because of the high transit times at ports. This situation is worsened by the current trend on MOS routes, that can be observed for example in the Italian MOS network: (Lupi et al., 2013): increase in the number of port calls and decrease in the frequencies.
In Italy, despite its geographical advantage respect to the other European countries, MOS routes are not very developed as one could have expected . In particular, connections between ports in the mainland are only a few and, apart from Ravenna – Brindisi – Catania, are part of international routes. But there are several routes connecting the Italian mainland and Sicily, and their competitiveness is increased by the fact that the „all-road" transport is part of a broken chain because of the Strait of Messina. Therefore, a survey has been performed on the competitiveness of the MOS between the Italian mainland and Sicily.
The results show that MOS are integrative to road transport rather than competitors, therefore the best path is not the one which minimizes the road transport part of the intermodal path, but the one which integrates, in the best way, road transport and MOS. Unaccompanied intermodal transport has resulted the most convenient mode of transport , as it provides the lowest cost for the majority of the origin-destination pairs: as far as total cost is concerned (total costs: travel times have been monetized, through the value of time, and summed to monetary costs). However it can be observed that intermodal transport based on MOS registers lower monetary costs, but higher travel times than all-road transport. Travel time is particularly important for perishable goods and for just in time organized production and distribution (reduction of inventory costs). We tried to take account of that through the monetization of cost (VOT) in order to assess the best path. The problem is that there is much disagreement in literature about the VOT to assume. It depends on the type of freight shipped and on the type of logistic chain in which the transport is integrated. Actually, as the value of time increases, the all-road alternative may result more convenient.
A future work could be a sensitivity analysis on the variation of the costs of each alternative (i.e. intermodal accompanied, intermodal unaccompanied, all-road respecting the law 561/2006, all-road non respecting the law 561/2006), under different values of time and a much in depth analysis of logistics costs to be taken into account (see for example Parker, 1995, about this).

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STRUCTURE, ORGANISATION AND OPERATION OF THE VTS CENTRE IN MALMÖ

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ABSTRACT

The study of the organization and efficiency of the VTS services is an important part of the sea traffic safety research. The performance of the VTS staff as well as the impact of various engineering and technological factors exercise a major influence on the efficiency of the VTS service. The study of the organizational structure of and the technology applied in the VTS centres as well as the study of the working conditions of the VTS operators give an insight in the circumstances in which a VTS service operates. By observing the interaction between the VTS operators and the participants (in the sea traffic) over a period of time, it becomes possible to introduce desirable practices and by experience sharing to improve the work of other VTS centres. The main goal of this study is to present the work of the VTS Centre in Malmö in order to gain a deeper insight into the functioning of that VTS service and to acquire new knowledge and practice. The role played by the VTS staff in advancing the seafaring safety and the preservation of the marine environment is also stressed, being the main purpose of the VTS service. Additionally, the information and communication technologies applied in the surveillance system are described in the paper along with the given geographical and hydrographical characteristics of the areas under surveillance.
The conclusions on the performance of the VTS Centre Malmö have been made analysing the application of the modern IT technologies to the given area and by analysing the interaction of the VTS operators and participants.

KEY WORDS

Vessel Traffic Service (VTS), VTS centre, VTS staff, maritime safety, analysis

1. INTRODUCTION

Due to its intensity and importance the maritime traffic plays the major role in the world trade activities. In spite of the fluctuations and inevitable economic cycles of the maritime market, it has grown steadily throughout its history; this growth has caused the maritime traffic to become the most efficient way of transporting goods and commodities.

Because of high traffic density the navigation has become difficult in some areas and the congestion of the maritime traffic has led to an increase in the number of accidents with all the adverse consequences to human life and environment.
Therefore the coastal states have established a Vessel Traffic Service (VTS) which is a shore- side

service provided by a "competent authority to improve the safety and efficiency of vessel traffic and to protect the environment" [6]. The VTS operates through VTS centres from which operators monitor the traffic, assist in navigational matters, and provide information to the maritime community in specific areas [6]. Earlier studies in the VTS domain were concerned with the safety-related issues; the operators work load, situation awareness and performance were also analysed.

This article takes a different approach, i.e. it is primarily focused on the qualitative analysis of the operation of the VTS centre in Malmö. The structure and organization of that centre are also discussed.

The placing of that centre into operation on 1 September 2011 meant that all vessels of 300GT deadweight or more, navigating in *Øresund* strait area, had to provide the VTS centre with their navigational information as well as information about their vessel just before entering the surveillance area. In addition, the ship has to submit a written report by e-mail, substantiating the verbal communication; finally, such data as draft, defects and deficiencies or other limitations and the air draft when exceeding 35 metres had to be confirmed in verbal communication at VHF frequencies.

The VTS centre in Malmö has a total of 20 employees. Three trained operators in a shift provide a continuous vigilance service. In addition to ensuring safe and fluent traffic movements, they provide information about specific and emergency situations as well as other information concerning safety of navigation (weather, current, water level, ice and other hazards).

2. VTS REGULATION AND OPERATION

The VTS system is established by coastal states to control maritime traffic movements in confined waters or in areas of high density traffic with the principle objective to minimize the risk of maritime accidents. Accordingly, the main task of the service is to keep the traffic movements safe and to intervene in situations when, due to human or technical error, adverse weather conditions, unforeseen developments etc., human life and environment are at risk.

2.1 The legal framework of VTS

VTS is rather loosely regulated by international legislation. In general, coastal states are directed by the guidelines to establish a VTS but they are not legally obliged to do so.

On the other hand the European Union in its directive 2002/59/EZ of 27 June 2002 makes the system of vessel traffic monitoring mandatory; the objective is to collect and disseminate information among the coastal states of the Union in order to monitor vessel traffic movements as well as cargo transport in the territorial seas of the EU member states. The European Union legislation, however, plays a minor role in creating the structure and organisation of a VTS. Member states are referred to international institutions and organisations. An umbrella organisation is International Maritime Organisation (IMO) whose duty it is to draw up regulations on maritime issues, including VTS. IMO has issued four vital legal documents whose provisions pertain to VTS; those are: UNCLOS, SOLAS, IMO Resolution A.857(20) and MSC/Circ1065 [1].

The coastal states sovereignty over the sea is established by the United Nations Convention on the Law of the Sea (UNCLOS 1997), which has been crucially important to the establishment of VTS. It follows from that international convention that a VTS can only be established within the boundaries of national waters.

Chapter V, regulation 12 of the Safety of Life At Sea (SOLAS 1974) convention is considered the most important document with regard to the implementation of regulation on VTS in member (signatory) states. In the part 12.3 of the regulations it is prescribed that "Contracting Governments planning and implementing VTS shall, whenever possible, follow the guidelines developed by the Organisation. The use of VTS may only be made mandatory in the sea areas within the territorial seas of a coastal state".

The IMO Resolution A.857(20) provides the guidelines which should be followed by the member states.

The MSC/Circ 1065 (IMO 2002) is a brief circular issued by the Maritime Safety committee (MSC) advising member states to use IALA (International Association of Lighthouse Authorities) recommendations as guidelines when organizing

VTS. Like IMO, IALA too, provides various guidelines and gives advice on how to establish a VTS and train the future VTS operators. According to IALA the purpose of a vessel traffic service is to improve the safety and efficiency of navigation and protect the marine environment and the adjacent shore area work sites and offshore installations from possible adverse effects of maritime traffic [3].

In addition to international regulations VTS can be separately regulated by national legislation issued by a competent authority as it has been called by IALA. In the Kingdom of Sweden the Competent Authority (CA) are the Swedish Transport Agency and the Vessel Traffic Service Authority which are both government institutions. Swedish Maritime Administration (SMA) acts within the framework of the VTSA and is responsible for establishment and operation of all VTS centres in Sweden. In the Swedish national legislation there is only one law that applies to the interaction of vessels with a VTS centre in the VTS area. Since the VTS organization and operation are not established by that law, the VTS staff has to comply with the international legal regulations, guidelines and advice.

2.2 VTS and related domains

The activities of a VTS centre are similar to those of an Air Traffic Control service. Up to the present moment only a small number of studies have been concerned with the comparative analysis of those two services, although even a superficial analysis of VTS and ATC activities would show the differences between those two systems caused by the very nature of the transportation vehicles under their surveillance. For example, while ships move along a horizontal plane, the aircraft move along both horizontal and vertical plane. Further on, there are considerable differences in the commercial speed of these two transportation vehicles. For example, average commercial and passenger ships can reach the speed of 15 to 30 knots, while passenger aircrafts can reach the speed of 500 knots. The differences in operation between VTS and ATC are defined by a number of factors, the two most important being the nature of transportation vehicles (subject to control) and the consequences of traffic accidents. On principle, the ship is considered to be a more “flexible” transportation vehicle than the aircraft, because of its technical and technological properties, such as its good manoeuvrability and the capability to reduce speed or even stop in order to avoid an accident. On the other hand the speed of the aircraft should not fall below the speed at which the lift occurs and maintains the cruising height. Finally, the consequences of an aircraft accident are nearly always tragic, while in sea-fairing they vary from minor incidents to major accidents having catastrophic consequences to human life and the environment.

Operationally, a difference between an ATC and a VTS is that the information passed between an ATC and an aviator is bound by protocol [2]. In a VTS system, however, only some information is usually bound by protocol, whereas other information may be communicated using no protocol or even in an informal manner [1]. This depends on the requirements of each national CA and VTSA respectively [3]. VTS does not necessarily have any judicial (legal) responsibility for the safety of the vessels within its operational area and there is no international regulation governing the design and operation of a VTS [3]. Traditionally, ship masters are free to take decisions on navigational matters, but regardless of whether they implement the instructions from ashore, or act upon their own judgment, they are always legally responsible for the consequences of their actions. For that reason masters are often reluctant to use a VTS and do not believe in the safety provided by that service, except in the situations of imminent danger of collision, when VTS is often greatly instrumental in avoiding the worst.

VTS centres operate locally in areas of coastal states sovereignty over the sea, whereas ATC services operate globally, covering the whole world. Because it has been introduced in shipping domain relatively late, VTS has not been completely integrated in maritime traffic, whereas ATC has become a fully established service indispensable in air traffic.

2.3 How VTS works

The main task of a Vessel Traffic Service is to increase the safety and efficiency of maritime traffic by providing relevant information and navigational assistance to maritime community as well as by controlling and organizing the vessel traffic.

Generally, there are three different types of on-shore services connected to VTS: information service (INS), navigational service (NAS) and traffic organization service (TOS) [3].

Information Service (INS) is a service that provides the vessels within the surveillance area with all relevant information, such as meteorological and hydrographical data, traffic density in the area, whether forecast etc.

Navigational Assistance (NAS) is a service provided to facilitate the navigational decision making on board, by giving navigational information and navigational advice.

Traffic Organization Service (TOS) is aimed at keeping the vessel traffic safe, fluent, and efficient within the boundaries of its domain.

However, not every VTS centre has all three types of service. In Sweden, for example, VTS is solely an information service [4]. It is aimed at giving result-oriented advice to ship captains within the VTS surveillance area.

In practice, VTS is a monitoring system where VTSOs monitor vessel movements within a VTS area and inform vessels of any dangers or other information relevant for the safe and efficient passage of a vessel within the VTS area [1]. In monitoring vessel traffic movements, VTSOs use a number of different sensors. These may include such technological equipment as radar, Very High Frequency Radio (VHF), Closed – Circuit Television (CCTV), Automatic Identification System (AIS) and meteorological and hydrographical sensors [1]. The data obtained by these sensors are then fed into a single VTS console.

When a ship is moving into the surveillance area, the Officer of the Watch, using the assigned VHF channel, announces the entering of the ship to a VTS operator. The VTS centre operator checks and confirms the entering of the ship and records the relevant data about the ship, such as the call sign, planned route, the amount of dangerous cargo and fuel, the number of crew and passengers, vessel's draught, the port of destination etc. Further on, the VTS operator advises the ship on traffic movements in the VTS area: what the crew should expect during the navigation, whether other vessels will be passing their ship and if so, where and at what safe distance. The VTS operator also informs the ship of any malfunction of maritime objects, such as lighthouses and buoys. When navigating through the surveillance area, it is a common practice for the ship to report continuously on its progress to the VTS centre, so that the VTS centre will have free use of the updated information at any time; on its part, the VTS advises the ship of all changes on the fairway route, if any. Apart from that, there may be specific geographical spots (i.e., shallow waters) on a fairway route from where the ship must call in order to announce its manoeuvre to the VTS centre. When the ship leaves the surveillance area the communication is ended by the usual message to the VTS operators: "VTS have a good watch", to which the VTS operators reply: "Have a good voyage, stand by on emergency channels."

3. VTS SERVICE MALMÖ AND THE AREA OF ITS SURVEILLANCE

The surveillance area of the VTS centre in Malmö covers the *Øresund* strait, extending from the North Sea in the west to the Baltic Sea in the east. Although not the only traffic route connecting those two seas, the *Øresund* strait is among the most important ones. This is indicated by the figure of nearly 40,000 vessels navigating annually along that fairway. Out of that number approximately 50 to 70 vessels cause various incidents [8] which, without the VTS centres operating in the area would amount to serious threats to the safe traffic movement.

3.1 Geographical location and characteristics of the VTS surveillance area

The *Øresund* strait is the natural border between the two Kingdoms: Sweden and Denmark. The area of VTS surveillance covers the *Øresund* strait and is divided into two sectors, as shown in the Fig. 1. Sector 1 is located on the west end of the strait; the radio communication in that sector uses the VHF channel 73. Sector 2 is located at the east end of the strait where the radio communication uses the VHF channel 71. The border between the two sectors is located at φ=55° 50′ latitude (marked with 1 in the Fig.1).

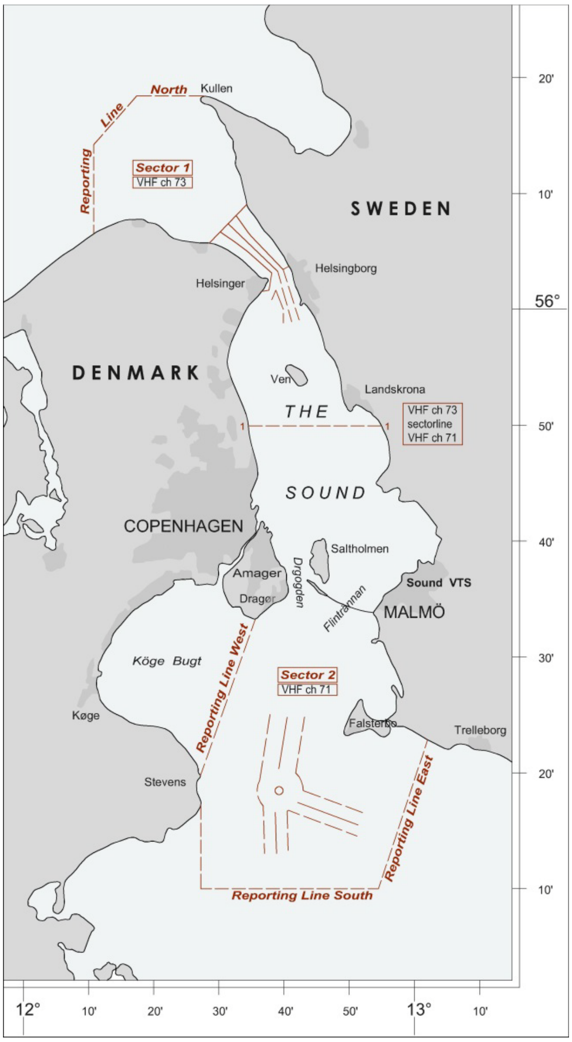

Figure 1. Overview of the surveillance area
Source: Authors according to [8]

The vessels are required to change the radio channel (working channel) when they have crossed the border between the two sectors, but they are not required to report that fact, nor are they required to report the change of the sector of navigation. Nevertheless the majority of vessels report to the VTS operator on duty both, the change of VHF channel and the change of sector.
Before the construction of the motorway and railway connections between the two Kingdoms, they were connected only by the sea. There were ferry lines between the towns *Dragør* and *Limhamn* and the towns Copenhagen and Malmö. (The ferry crossings were ended when the motorway/railway connection was built.) The only ferry crossing still in use is the one between *Helsingør* and *Helsingborg*. It is that crossing that is most hazardous for the safety of the whole traffic movement through the *Øresund* strait. Because there are regular and frequent *Helsingor* – Helsingborg ferry crossings, their courses intersect with the general direction of the traffic flow. That is why the rule 15[1] of Collision Regulations is so often violated. To avoid this, the ferries on local crossing lines are instructed to give the right of way to commercial vessel regardless of COLREG rule 15. In the VTS surveillance area there are two natural islands, *Ven* and *Saltholm*. The Kingdom of Sweden has the sovereignty over *Ven*, and the Kingdom of Denmark over *Saltholm*. There is also an artificial island called *Peberholm*, connected to the Swedish coast by a two story bridge. The road traffic flows on the upper story and the railroad traffic moves on the lower story. At its highest point (above the *Flint* passage) the bridge rises 55m over the sea surface. From that point on the bridge gradually descends towards the island of *Peberholm*. When it reaches the island the bridge infrastructure ends and the traffic moves along the motorway and the railway on the island towards two tunnel tubes, which lead further to Denmark under the sea bed. The vessel traffic passage above the tunnel tubes is used by 95% of all vessels navigating through the *Øresund* strait [8] and is called *Drogden*. It has the maximum depth of 8m at which the concrete barriers are placed for the safety of the tunnel traffic. The air draught of the vessels moving through the *Drogden* passage is not limited, but the vessels must nevertheless report that information to VTS centre. Namely, the aircrafts landing on a particular runway at the international airport *Kastrup* in Copenhagen, have to fly over the *Drogden* passage; if the air draught of a vessel navigating through the passage is higher than 35m, that particular runway is temporarily closed for the safety reasons. The maritime traffic in this part of the *Øresund* strait also moves along the *Flint* passage, located below the middle part of the bridge. The Kingdom of Sweden has the sovereignty over it. Only 5% of the total vessel traffic uses this passage because of the many challenges of the fairway (Fig. 5)

[1] When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

Notwithstanding the different states sovereignty over the passages, they are only controlled from the VTS centre in Malmö (Sweden).
The *Flint* passage is most frequently used by ferries of the Malmö – Travemünde line.
The maximum draught allowed in the *Flint* passage is limited to 7.2 m and is valid only for vessels whose air draught is nor higher than 55m.

3.2 Structure and organization of the VTS

The VTS centre in Malmö has been established by the joint efforts of the Swedish Maritime Administration and the Danish Maritime Safety Administration. At the head of the organization is the Coordination Committee (Fig. 2) which is made up of three representatives from SMA and DMSA respectively. There are two managers in the VTS centre. Each of them is appointed by the National Maritime Administration. There are 20 VTS operators in total. Ten are appointed by Swedish, and ten by Danish Maritime Administrations. There are always three operators in a shift who are continuously 24 hours on duty. There can be two Danish and one Swedish operator in a shift and vice versa. The team work and mutual cooperation are encouraged by that way. Each operator has control over one sector (they are called primary operators) while the third operator (he is called secondary operator) in the shift assists or performs additional tasks.

Figure 2. Organizational structure of VTS
Source: Authors according to [8]

Primary operators must have a continuous situation awareness regarding traffic movements in the VTS area. If there is an emergency in the VTS area, the handling of that situation remains with VTSO1 or VTSO2 pending the area [5]. In that case VTSO3 takes over standard reporting, communication and directing the general traffic movements in the VTS area.
All data and recordings such as VHF communications, VTS surveillance system (RADAR tracks, AIS tracks etc.) is stored for a minimum of 30 days on a two different memory units. Recorded incidents can be used for educational purposes or distributed for other reasons only if the VTS manager on duty approves such action.
At the end of his shift the VTSO on duty is not allowed to leave his place of work, until the VTSO who has come to replace him, is not thoroughly informed of the traffic situation and feels capable of taking over the watch.

4. ANALYSIS OF VTS OPERATION

The VTS centre can achieve its purpose only if the appropriate control equipment is available and the operators are professionally trained. Depending on the experience the operators can often anticipate events so that the more experienced ones take shorter time to act.

4.1. Sensor use in the VTS surveillance area

The VTS surveillance system contains various sensors. The sensors primarily used in the VTS centre Malmö are: VHF radio, the radar, Closed Circuit Television (CCTV), Automatic Identification System (AIS). The VTS surveillance system in Malmö is shown in Fig. 3; the technologies used by the VTS operators are marked in the picture.
Primary tool used for the monitoring task is operator's own experience. Sensor, such as AIS is viewed as an important tool since it makes identifying individual vessels easier. Radar is preferred to AIS (there are 10 radar stations in the surveillance area), even though AIS has a faster update frequency on vessel movements as compared to radar [1]. Finally, the VHF radio is a very important piece of equipment because it makes the communication between the vessels and VTS operator possible.
Just before entering the surveillance area the ship sends a report to the VTSO via e-mail which contains information about the ship, crew, cargo,

its destination and all other relevant data. After entering the *Øresund* strait the vessels confirm the reported data, especially draught, air draught and amount of dangerous cargo if any.

The operator than compares the confirmed data with the ones the ship had e-mailed previously. If they agree and there is no doubt about the trustworthiness of the data, the operator asks about the planned route of the ship through the *Øresund* strait. It is important to define at that, whether the ship will be passing on the east side of the island of *Ven* i.e. through the *Flint* passage, or it will pass on the west side of the *Ven*, i.e., through *Drogden*.

During the navigation the operator keeps the master advised on the maritime traffic movements, weather conditions and, if needed, gives advice to the master on a better course or speed for ship to take.

4.2. The analysis of the accidents in the surveillance area of the VTS centre in Malmö

In analysing the accidents that have occurred in the *Øresund* area, only the data from Sector 2 have been taken into account. Namely, there are less unforeseen and potentially hazardous developments in Sector 1 because it is a natural passage with less challenging fairway. Sector 2 is more demanding for navigation especially in the area of entering the separation scheme or Flint passage from its western side.

In this paper it has been determined which accidents that happened in the period between 2009 and 2012, are statistically significant at the level of 5%. After applying x^2 test to determine the probability of occurrence for each incident, the following statistically significant results, shown in the Tab. 1, have been obtained.

Figure 3. Overview of the VTS working place
Source: Authors

Table 1. Distribution of the number of incidents in the period between 2009 and 2012 for Sector 2
Source: Authors according to [8]

	DEN		SWE	
Incident	fi	fi/r	fi	fi/r
COLLISION	5	2,46	1	1,28
COLLISION COURSE	13	6,40	3	3,85
GROUNDING	6	2,96	4	5,13
HEADING TOWARDS SHALLOW WATER	73	35,96	20	25,64
EXCEEDING DRAUGHT LIMITS	12	5,91	17	21,79
VIOLATION COLREG 10	7	3,45	12	15,38
CONFLICTING TRAFFIC MOVEMENTS	37	18,23	10	12,82
NO CONTACT	25	12,32	8	10,26
COLLISION WITH BUOY	7	3,45	0	0,00
ENGINE FAILURE	5	2,46	3	3,85
NOT UNDER COMMAND	10	4,93	0	0,00
BLACKOUT	3	1,48	0	0,00
	203		78	

The statistically insignificant incidents are: man over board, suspicion of intoxication and damage in port. It is important to point out that not a single pollution incident was recorded on the period of observation.

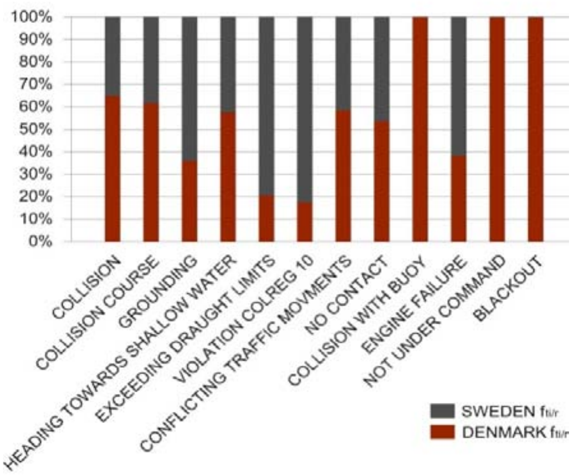

Figure 4. Overview of the incidents in Sector 2 according to territorial sovereignty
Source: Authors according to [8]

The results in Fig. 4 show in which part of Sector 2 a particular incident occurred. The results show that most of the incidents occur in the Danish part of Sector 2 except for: grounding, exceeding draught limits, violation of COLREG 10 and engine failure (which does not depend on the navigational area). The reason for that is the fact that 95% of vessels choose to navigate along the Danish coast, i.e. through the *Drogden* passage, which is easier to navigate and at no point demands a significant change of course. On the other hand, passing through the *Flint* passage takes a long navigational experience and good manoeuvrability of the ship due to course change at nearly 90° at the entrance are of *Flint* passage, in front of the Port of Malmö (Fig. 5).
The error of ill-timed (too early) change of the course which nearly caused the grounding of ship is clearly shown in the Fig. 5. In the given case, the rapid reaction of the VTS operator was decisive in avoiding the accident. The area shown is the entrance to the *Flint* passage.

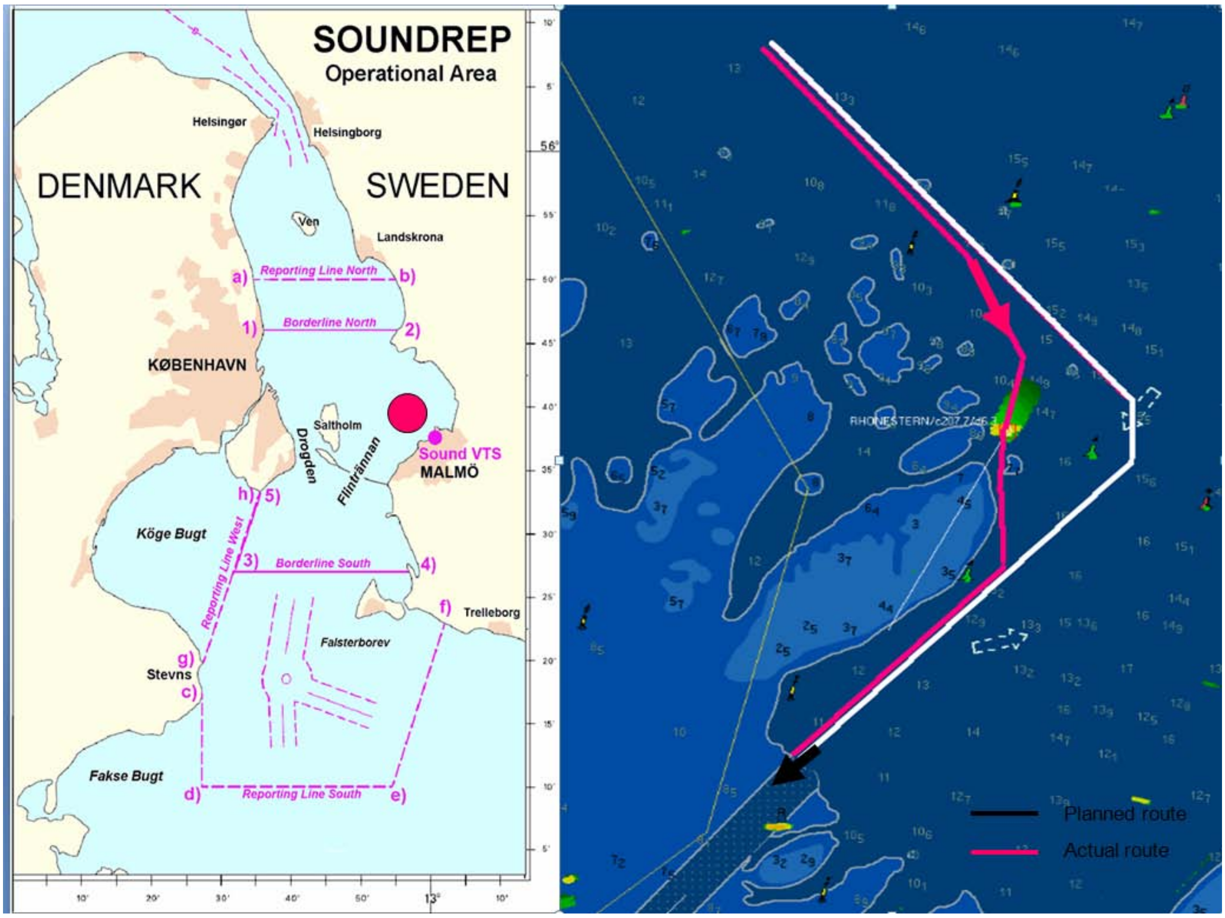

Figure 5. Planned and actual ship movement
Source: Authors according to [8]

5. CONCLUSIONS

The VTS system is established by coastal states to control maritime traffic movements in confined waters or in areas of high density traffic with the principle objective to minimize the risk of maritime accidents.
The structure, organization and operation of the VTS centre in Malmö are presented in the paper as well as the analysis of the accidents in the surveillance area after the VTS centre was established. It is shown that the frequency of incidents is small and there are no incidents which present the threat to marine environment.

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ISSUE ENTRY CONTROL OF ILLEGAL IMMIGRANTS IN THE REPUBLIC OF CROATIA BY SEA

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ABSTRACT

The aim of this paper is to address the problem of controlling the entry of illegal immigrants to Croatian territory by sea and to discuss the consequences of that act. Avoiding entry at official border crossings is done in secrecy and contrary to the laws of the state. The information gathered about these events is compared with their future expected frequency. This paper also describes the European Union's directive on the supervision of state borders, organization centers for violating persons, navigation routes and land migration. This paper also discusses the structure and water service units, personnel, statistical data, and tangible benefits to participating organizations of such criminal activity.

KEY WORDS

control, illegal, borders, waterway, EU organization

1. INTRODUCTION

Migration (Latin: *migratio*: moving) represents a change of residence of the individual or people. Emigration is the emigration of the population to settle permanently else where. Causes of the migration of people are natural (epidemics, natural disasters, catastrophes), social (wars, political instability, religious intolerance) and economic (hunger, poverty, the pursuit of a better life). Irregular migrations are migrations contrary to the immigration law of the state whose territory the immigrants approach. The types of irregular migration by foreigners to Croatian territory can be summed up in the four basic types of offenses: ilegall border crossing, illegal residence, ilegall work and lack of travel documents. The condition of irregular migration in the region have been directly affected by the war time and post-wartime events in Central Asia (Afghanistan and Iraq) along with the conflicts in the countries of North Africa (Libya, Tunisia, Egypt).

The basic document in the international legal system to protect human rights is the Universal Declaration of Human Rights [19]. Adopted and proclaimed by the General Assembly of the United Nations, 10. december 1948, determined by Article 13. which states that everyone has the right to freedom of movement and residence within the border of any country. The result of this document is a large increase in illegal residences and consequently an increase in the number of asylum seekers. The fact that they often abuse the system is also evident from the statistics [18] on the number of suspended proceedings on claims for asylum, given that these asylum seekers leave Croatia before the approval to implement the asylum is granted. The smuggling of migrants by sea is only recently defined by true international protocols [14] as an offense of assisting individuals in their attempt to enter the territory of the country by sea, secretly and contrary to the laws of that state, by avoiding border controls. The International Organization for Migration [3] was established in 1951.

2. EUROPE IMMIGRANTS

2.1 EU Law

Due to economic and political instability in the countries of the African continent, there has been an increased the flow of migration of people (Figure 1.) and requests for asylum in the southern EU member states which are located on the geographical periphery of the EU, such as Greece, Italy, Spain, Malta and Cyprus.

Figure 1. Split between land and sea border migration, second quarter 2013 [4].

The objective of the Union's policy in the field of external borders of the EU's security monitoring and surveillance crossings is to prevent illegal border crossings. Border control is not limited to the detection of illegal border crossing already has procedures such as intercepting suspicious vessels trying to enter the EU without being subjected to border control.

Regulation of Dublin from 2003 [2] obliges the state to provide accommodation for immigrants, handle requests for asylum and allow the return of people to their home country. Italy, Greece and Cyprus are seeking greater solidarity in this, but the majority of member states opposed the amendments to this rule.

Data from Lisbon [1] specifies the powers of the EU in this area which are shared with the Member States, in particular in relation to the number of migrants who are allowed legal entry into a Member State in order to seek work. Furthermore, in case of a sudden influx of third country nationals into the member state, provisions are included to implement measures to help the member state.

The European Council adopted the *European Pact on Immigration and Asylum* on the 15. october 2008. (Presidency Conclusions 14368/08). The pact defines the commitment to the common immigration policy and asylum policy of the Union.

The *European area of freedom, security and justice* the EU has defined common rules on border management and adopted an integrated approach to border management, which includes not only the control of external borders, but also cooperation with third countries.

During 2006. and 2007., the so-called *Border rapid intervention teams* (RBIT), *European Patrol Network* (EPN) and the *European Register of Available Technical Equipment* (CRATE) were established. They provide assistance to fell on members who face urgent and exceptional pressure on its borders. The European Patrol Network is a permanent joint operation that deals with the problem of illegal migration facing the Mediterranean.

Directive deportation (2008/115/EC) for the EU states share common standards and procedures for the EU and for returning third-country nationals.

For better control of external borders the *Schengen border rules* (Schengen Borders Code) were adopted in 2004. The Schengen regime allows greater mobility of citizens of the countries within the Schengen area. As for crossing the external borders, the EU applies common rules by which border control is carried out on behalf of all Member States and the government has tightened the control regime recently.

Regulation of the *European Council* 2007/2004 from the 26th October 2004. established the European Agency for the management and operational cooperation at the external borders of the EU Member States (*FRONTEX*). It began operations in 2005.

Directive 2009/50/EC deals with the conditions of entry and residence of third country nationals for the purpose of hiring highly qualified staff. It introduces the EU blue card, which speeds up the process of issuing special permits for workers to stay and work under more attractive conditions.

It is designed for simplifying the employment of highly skilled workers from third countries in EU member states.

The *European System of Border Control* (*EUROSUR*) allows the exchange of information and operational cooperation among national authorities of the Member States and *FROTEX*, in order to detect, prevent and combat illegal immigration and cross-border crime and contributions to ensuring the protection of migrants lives and saving their lives at sea.

Since 2009., almost all sea operation are organized under the program of the *European Patrol Network*, which supports the coordination of national security, such as patrolling the southern sea borders and their integration in to common European activities.

2.2 Routes

In 2012 there were 72,437 illegal crossings of borders in the EU, while in the first half of the 2013 there were 34,552 recorded illegal border crossings [5]. Figure 2. show main irregular routes to EU.

Illegal crossings by immigrants have strongly increased in the *Western Balkan route*, presented in Graph 1. Most immigrants were detected crossing the border between Hungary and Serbia.

In 2012 there were a recorded 6,391 illegal crossings, while in the second quarter of 2013 8,937 illegal crossing.

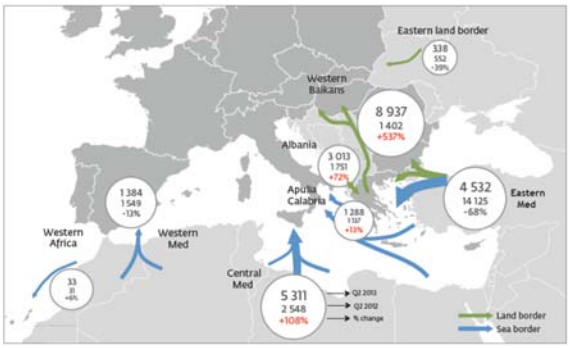
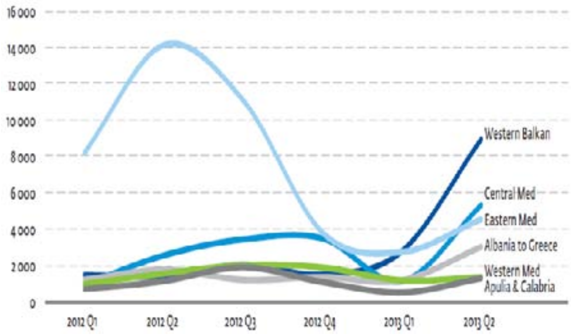


Figure 2. Detections of illegal border-crossing in second quarter 2013 by route and percentage change in relation to second quarter 2012.

This shows a clear motivation for illegal migrants crossing the land border between Hungary and Serbia. The largest number of migrants comes from Kosovo, Pakistan and Algeria.

Irregular migrations in the *Central Mediterranean* route significantly increased 2011 (59,002 transitions), mainly due to political and civil unrest across North Africa. In the first quarter of 2013 there were 1,124 recorded illegal border crossings, while in the second quarter of 2013 there were 5,311. In the second quarter of 2013, the majority of arrivals were recorded in Lampedusa and Sicily. The majority of immigrants are from Tunisia and Somalia.



Graph 1. Comparison of migration flows in EU

Most of the detected immigrants in the area of Apulia are associated with flows from Greece to Italy, while most detected in Calabria are associated with migrants who had departed from Turkey or Egypt. In 2012 there were 4,772 transitions, as in previous quarters detected transitions in the second quarter of 2013 in Apulia (288) were much lower than transitions in Calabria (1,000). As in previous years, the majority of immigrants were nationals from Asian and Middle Eastern countries that have previously entered Greece with departures from Turkey and Egypt.

Eastern Mediterranean route was the main point of irregular migration in the EU, mainly associated with illegal border crossings from Turkey. In the second quarter of 2013 there were 4,532 detected illegal border crossings. Detections in the eastern Mediterranean route represented 18% of total EU in the second quarter of 2013. Most detected immigrants come from countries such as Syria, Afghanistan and Somalia.

In the *Western Mediterranean* routes in the second quarter of 2013 there were 1,348 illegal crossing of customs in the western Mediterranean region. Since 2012, transitions on this route have remained relatively stable-between 1,500 and 2.000 crossings per quarter. Countries from which immigrants mostly come from are Algeria and Mali.
Along the *Eastern land border,* at a length of more than 4,000km from Romania to Finland, in the second quarter of 2013 there were only 338 illegal border crossings. Since 2009, illegal border crossing is in the range between 100 and 600 per quarter. Countries which mostly serve for transitioning are Georgia, Moldova and Vietnam.
The waters of the Mediterranean, according to the web site Fortess Europe, have seen the deaths of 6.825 people since 1994 who were attempting illegal crossings. If you take into account the entire length of the European borders of the Canary Islands to Turkey, the number of fatalities since 1988 until today rises to 19.142 people.

2.3 Visa and asylum

The procedure for issuing visas is determined by chapter 4 of the *Treaty of the European Union* with which grants the Council of the EU the authority to make the rules and regulations in this area and if need be to edit the relations between the EU Member States and third-party countries and their citizens.
The EU Member States apply common rules for the stay of foreigners within the Schengen area (up to three months). Figure 3. show significant increase entries to EU states.
The new and revised *Common European Asylum System* (CEAS) [17] intend to establish clearer rules and ensure fair and adequate protection of refugees in need of international protection.

FRAN indicator	2012 Q1	2012 Q2	2012 Q3	2012 Q4	2013 Q1	2013 Q2	2013 Q2 % change on prev. year	2013 Q2 % change on prev. qtr
1A Illegal entries between BCPs	13 636	23 095	22 093	13 613	9 717	**24 805**	7.4	155
1B Clandestine entries at BCPs	103	126	167	203	130	**118**	-6.3	-9.2
2 Facilitators	2 105	1 785	1 712	2 118	1 622	**1 705**	-4.5	5.1
3 Illegal stay	88 461	84 891	86 759	84 817	77 127	**80 104**	-5.6	3.9
4 Refusals of entry	24 826	28 237	31 993	31 036	27 911	**33 216**	18	19
5 Applications for asylum	56 857	59 576	73 721	86 158	72 864	**85 362**	43	17
7A Return decisions issued	69 904	67 891	71 129	61 025	55 285	**53 586**	-21	-3.1
7B Effective returns	38 644	40 431	38 258	42 157	38 219	**39 741**	-1.7	4.0

Figure 3. Migrants operations in 2012.

3. CROATIA IMMIGRANTS

3.1 Croatia in numbers

Due to its geographical position, Croatia has a very important role in securing the external borders of the EU, see Figure 4.The Republic of Croatia is situated at the cross roads of Western countries, Central and Eastern Europe and the Mediterranean. The area of the Croatian Republic is 56,549km^2, the length of the state border of Croatia is 3,322,9km, of which 2,374,9km is of land and 948km is of sea.
The territorial waters and inland waters is 31,067km^2 total, and protected economic fishing zone (hrv. ZERP) 23,870 km^2 (2) The number of passengers that cross the Slovenian-Croatian border, which makes most of the passenger traffic through border crossings EU, number 25 million crossings in 2012 [6].
The Republic of Croatia has not yet joined the Schengen area and border control operations continue between Croatia and Slovenia.
The Republic of Croatia is part of the so-called *Balkan Route* of irregular migration involving the transit of irregular migrants and the smuggling of goods in the direction of the European Union, with the first entry through the Greek-Turkish border then through Macedonia, Serbia and Croatia and finally into Hungary and Slovenia.

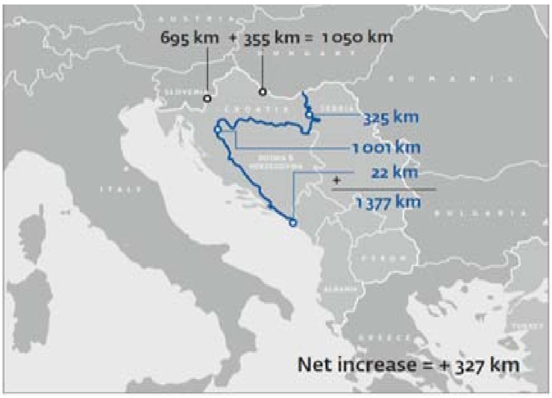


Figure 4. New EU border

Table 1. Illegal border crossing on Croatian Police stations

Police station	Illegal crossing of the border						
	2012.	2013.	+ - %	border crossing	near border	in territory	returned from aboard
zagrebačka	2.079	**1.091**	-47,5	102	103	732	132
splitsko-dalmat.	213	**211**	-0,9	65	9	34	
primorsko-gor.	1.130	**874**	-22,7	39	373	132	315
osječko-baranj.	61	**21**	-65,6	7	1	5	2
istarska	475	**448**	-5,7	10	244	7	152
dubrovačko-ne.	378	**347**	-8,2	67	17	197	
karlovačka	106	**83**	-21,7	3	39	19	13
sisačko-moslav.	389	**151**	-61,2	1	1	144	
šibensko-knin.	10	**23**	+130,0	4	3	14	
vukovarsko-srij.	1.194	**993**	-16,8	203	445	335	
zadarska	30	**36**	+20,0	26	5	5	
bjelovarsko-bilo.							
brodsko-posav.	235	**41**	-82,6		9	26	
koprivničko-kriż.	13	**24**	+84,6	11	1	2	3
krapinsko-zag.	230	**194**	-15,7	56	40	8	82
ličko-senjska	15	**23**	+53,3		21	1	
međimurska	89	**63**	-29,2	6	11		36
požeško-slav.							
varaždinska	185	**109**	-41,1	3	41	3	5
virovitičko-podr.	7	**2**	-71,4				
TOTAL	**6.839**	**4.734**	**-30,8**	**603**	**1.363**	**1.664**	**740**

Illegal border crossing in Croatia are presented in Table 1 and Figure 5. Compared with 2012 [11], which recorded 6,839 irregular crossing of the state border, the number of irregular crossings in 2013 decreased to 4,734, representing a decrease of 30.8% [15].

In relation to the country of origin of migrants arrested in 2012, most citizens were from Afghanistan (1,618) and Algeria (648). In 2013 the trend is declining in relation to nationals of Afghanistan (611), while the second largest group is made up

citizens of Syria (720). Most of the irregular migrants are men [9].

3.2 Croatian Law

Like all member states of the European Union, the Republic of Croatia has among other adjustments to the legal system of the EU to accept the *Schengen acquits*, which refers to the abolition of internal borders of the EU, while at the same time provides for tightened super vision on limits to non-member countries. This is in the framework of the accession negotiations for EU membership.

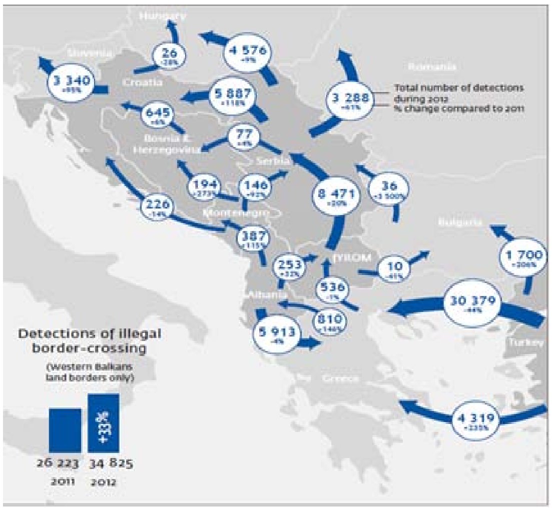


Figure 5. Detections of illegal border-crossing.

The migration policies for the period 2013 to 2015 were adopted in February 2013 [8] and to ensure acceptable migratory movements in Croatia. Regulations were made setting out the measures in the following areas: visa policy, status of foreigners, acquiring Croatian citizenship, asylum, integration policies, irregular migration and measures regarding the Croatian diaspora.

The Interior Affairs Ministry is exclusively responsible for migration policies in Croatia. The decision of the Croatian government to establish the National Committee for Combating Trafficking in Human Beings [12] was made and their task is to create a national plan to combat human trafficking.

The law on state border control [22] regulates the state border control, the border police in the interior of the country, the international border police cooperation and cooperation in the service of the State Border.

According to the Criminal Code [7] of the Republic of Croatia, human trafficking is a modern form of slavery and as a crime can be subsumed under Article 175 relating to the establishment of slavery and transportation of slaves and Article 177 which deals with illegal cross state borders.

The right to prosecute is regulated by Article 23 of the Geneva *Convention on the open sea*. The Croatian law for prosecution is governed by the provisions of the Coast Guard, the Maritime Code, the Police Act [24] and regulations on police procedures. Article 15 of the Republic of Croatia Law of the Coast Guard is in accordance with international regulations and standards prescribe actions against off ending transportation vessels.

The provisions of Article 46 of the Maritime Code [13] define the prosecution procedure for foreign vessel in Croatian waters. On the 26th of May 1999, the Republic of Croatia signed the *Agreement on Combating Trans-border Crime Initiative for Southeast European Cooperative Initiative* (SECI Agreement) in Bucharest, which the Croatian Parliament ratified on the 27th of August 2000. The agreement provides for cooperation between countries in southeast Europe.

In order to control illegal immigration by sea, the Croatian Republic implemented the Development Strategy for Maritime Police [16], namely the concept of performing the protection of the state border at sea.

The strategy is the result of the completion of the *twinning* project *Blue Border Surveillance*, in which representatives of the German and Croatian police and the Italian coast guard carried out he six components.

The Croatian Parliament passed the Regulation on the Organization and Operation of central coordination, Professional bodies and regional units on October 3rd 2007. This became the coordination body responsible for monitoring and protecting the rights and interests of Croatia at sea [20].

The adoption of the Law on Amendments to the *Law of the State Border* [22] as well as the new *Foreigner Act* provisions [25], relating to the treatment of border police when crossing the external borders, are now harmonized with the EU acquits.

In order to efficiently control the state border, the Croatian border police introduced system of risk analysis that is aligned with the *RAM* (*Risk Analysis Model*) which includes an early warning system and notification.

In order to successfully prevent human trafficking, a series of goals and activities was established which were intended to prevent, educate and promote international cooperation.

3.3 Croatian sea

In the Republic of Croatia:

• internal waters and territorial sea monitors maritime police included surveillance of the state border (according to the law of the State Border, not the law of the police),
• the *Coast Guard Act* [23] regulates the protection of sovereignty, the sovereign rights and the jurisdiction of the Republic of Croatia at sea, as well as the protected economic fishing zone (hrv. *ZERP*),
• the *Port Authorities Act* [21] provides for technical, administrative and inspection supervision in internal waters and the territorial sea of the Ministry of Maritime Affairs, Transport and Communications [28].

The Ministry of Sea, Transport and Infrastructure provide access to the data that goes through:

• AIS (*Automatic Identification System*),
• VTS (*Vessel Traffic Service*),
• LRIT (*Long Range Identification and Tracking*),
• VTMIS (*Vessel Traffic Management and Information System*),
• communication in connection with the provisions of ChapterXI-2 of the International Convention for the *Safety of Life at Sea* (SOLAS Convention) and other important information about the crew and passengers on board,
• VMS (*Vessel Monitoring System;* system for monitoring fishing vessels).

The concept of the ways of performing the protection of the state border at sea, which found that the manner of the protection of the state border at sea, should be based on two main elements:

• a technical protection system (a system for the monitoring of space) based on the technical resources developed by the Ministry of the Interior, the data from the Croatian system of supervision and management of maritime transport-VTMIS, a system that is being developed under the Ministry of Sea, Transport and Infrastructure; the data from the radar system of the Ministry of Defence and other relevant information obtained through other government departments (Ministry of Agriculture, fisheries and rural development, the Coast Guard, Customs, etc.),
• the presence of police boats at sea-depends on the risk analysis for each part of the operational areas and the effectiveness of security systems.

Currently the maritime police have three type-*A* patrol boats, at a length of more than 20m, 22 patrol boats of type-*B* length up to 15m, and 25 sails type-*C* length 8m. According to the development strategy of the State Police from 2010 [10], the maritime police should dispose of seven patrol ships type-*A*, a length of more than 20m, 16 patrol boats type-B length up to 15m, and 31 sails type-C length 8m.
The concept is clearly defined by the presence of the different types of police vessels in land waters and coastal areas, in other words the presence of police vessels in the territorial sea. The Coast Guard provides support to other relevant government bodies in the implementation of the laws and regulations of their jurisdiction.

The Coast Guards' duties include combating terrorism and piracy, search and rescue, technical support, centralized co-ordination of surveillance and the protection of the rights and interests of the Republic of Croatia at sea. The Croatian Navy has four classes of vessels named *Mirna*, two larger ships named *Faust Vrančić* and *Andrija Mohorovičić*, and two harbour tug boats. The Coast Guard is working closely with the Air Force and Air Defence, from whose fleet they use transport helicopters, air planes Pilatus PC-9 and 117 FP, S-radar system for surveillance of airspace if need be. In accordance with the needs of the tasks the Coast Guard will be added to the Armed Forces and drones. The major equipment which was purchased includes 31 thermal imagers for use on vessels, 12 hand held thermal imaging cameras, 64 ballistic vests, 30 stereo microscopes, 7devices to control documents sent to the printer (*Docu-Boxes*) and 18 of the endoscopes along with unmanned air craft systems with integrated surveillance of sea borders and water ways [2].
Figure 6. show the approximate radius of the operational capacity of the police vessel type-*A* stationed in these ports for periods of 30, 45, 60 and 75 minutes after receiving alert and

responding by travelling at a speed of 25 knots [10].

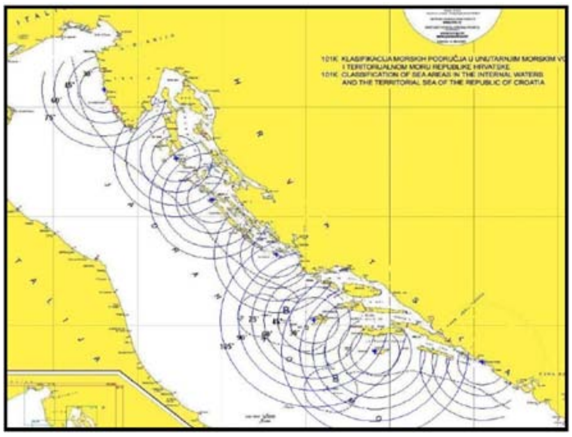


Figure 6. Radius *A* type vessels range

The Curriculums Professional Development of the Maritime Police based on the *Common Core Curriculum (CCC) - FRONTEX* program for the education of the border police in the European Union - Maritime Border Police knowledge.

Specialization courses for border police ended with 393 graduating police officials within the system of professional training through modules: EU law, combating forged travel documents, combating the smuggling of vehicles and second-line control.

Training was successfully completed by a total of 4.995 police officers. In addition, there were 40 lecturers /multiplier trained for teaching jobs for maritime police. After entering the European Union and after the accession to the Schengen area, the required number of border police officers will increase to 5825.

In order to establish a proper system of technical protection, the Ministry of the Interior will establish a *National Maritime Centre* to collect data from all government bodies involved in the conduct of the maritime area of Croatia.

3.4 Case of illegal crossing via Adriatic sea

Rijeka, 1st July 2010.

The Co-ordination Search and Rescue Centre (*MRCC*) received a distress call via the 112 number from the Dubrovnik headquarters which reported boats on which 66 people, originally from Syria, Afghanistan, Somalia and Egypt, were travelling on. According to information received by the headquarters, the flag ship of unknown origin sailed from Greece to Italy. There was an engine failure and the ship floated for two days 47 miles south of Dubrovnik. This was the first case of acceptance and care for immigrants who arrived by sea in Croatia. A boat was towed from international waters by the ship *Faust Vrančić*. After entering Croatian territorial waters the 66 people were taken to the Interior Ministry by the police boat *Josip Jović*. The immigrants were transferred to a reception centre for asylum seekers in Kutina and later some were sent to other reception centres for asylum seekers [27].

3.5 Asylum politics in Croatia

Croatia has an existing reception centre *Ježevo* which currently has two reception centres of a temporary character: a shelter for asylum seekers in Kutina (capacity of 100 people) and temporary accommodation within the Zagreb Hotel *Porin* (capacity 150 people). It is expected that by the end of 2014 the opening of two new reception centres in Trilj and Tovarnik will take place.

The number of asylum seekers in the Republic of Croatia in 2011 was 686, in 2012 it was 1,036 people with 47 resolved cases and in 2013 it was 1,004 persons with 105 resolved cases. During 2013 a total of 534 people were in the *Ježevo* centre, mostly from Albania, Syria and Kosovo. According to the statistics from the Ministry of Interior, the vast majority of them leave Croatia before their claim for asylum is made final. This fact confirms Croatia as merely a transit country to a Western European country for illegal immigrants.

The Republic of Croatia has signed agreements on the re-admission of persons (*Readmission Agreements*) with 27 countries.

Those agreements make contracting states obligated to request the other contracting party to accept back into its territory a third country national or a stateless person caught in irregular border crossing and illegal stay if it was established or reasonably assumed that the person entering the country directly from the territory of the first state.

4. CONCLUSIONS

After the Croatian accession to the European Union on the 1st July 2013, the migration policy in the region was altered. The Republic of Croatia became a transit country with increasing living standards and represents a desirable destination of illegal migrants and asylum seekers. The increasing numbers of illegal immigrants and asylum seekers will lead to a more restrictive interpretation of the regulations. This means the refusal of issuing visas, the refusal of foreigners or limiting entry into the Republic of Croatia and limiting the freedom of movement of foreigners inside Croatia. The migration policy of the Republic of Croatia is synchronized with that of the European Union, resulting in the strengthening of the state border surveillance and increased security measures at the south- eastern borders of the EU.

Statistical indicators of 2011 and 2012 in the so-called *Balkan route* predict that in the coming period migratory movements through Croatian territory will continue to rise. Croatia is expected to establish a coordinating body to cover several ministries, Non Government Organizations and the scientific community.

Immigrants coming by sea represent a larger problem because the state into which they come must comply with the laws of accession and surveillance of suspicious vessels, which further complicates the acceptance of illegal immigrants. Creating protocols contributes to the proper treatment of persons who find themselves in illegal migration flows over the territory of the Croatian Republics. These protocols provide these people rights which protect their human rights and offer them security and protection.

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QUALITY MANAGEMENT - KNOWLEDGE MANAGEMENT

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ABSTRACT

Nowadays every day brings new and rapidly changing environment. Knowledge of contemporary trends and managerial tools and their application in the economy is the key to development, to gain competitive advantage and to the survival and advancement of businesses in the markets. Of all the resources that are available to them, the most precious in the modern business world today is knowledge, intellectual capital. Organizational knowledge and resources form the basis of the intellectual capital of the company. Radical changes in the business environment seeking new concept of management in relation to the previous practice. Thus, the need to control the use of such tools and technologies that enable a comprehensive, fast and efficient utilization of all available data and information, both inside and outside the operating system are important for the successful management of the company. This paper seeks to emphasize the importance of a culture of learning, investing in knowledge, intellectual entrepreneurship through the creation of a learning organization. The aim is to provide a new approach to the problem of knowledge management and utilization of knowledge in particular based on the data using business intelligence tools. In order to promptly respond to the challenges of the market the company must improve the quality of their products, processes and work on educating employees. You will see the importance of business intelligence for business enterprises, with a particular emphasis on the importance that has the concept of business intelligence in a learning organization.

KEY WORDS

Quality management, knowledge management, business intelligence, learning organization

1. INTRODUCTION

Of all the resources that are available to them, the most precious in the modern business world today is knowledge that is intellectual capital. Only the area of knowledge management in its short history, it's been a couple of generations, or phases, starting with a focus on intellectual capital and information technology, to focus on the human and cultural dimension to this form which is integrated more important aspects of the process of knowledge management.

Organizational knowledge and resources form the basis of the intellectual capital of the company. Application of the concept of business intelligence, like any other newspaper, is a challenge, but the uncertainty and risk, and sometimes resistance to certain interest groups, whether in businesses, especially in certain traditional structures of state institutions. Radical changes in the business environment seeking new concept of management in relation to current practice. The intense competition of the globalized market "forces" of the rejection of well-established stereotypes and traditional ways of doing business and to create a new positive atmosphere and create a creative work environment that encourages employees to share ideas and knowledge and creating an organizational culture that is based on learning.

Modern organizations are transformed into knowledge factories, their employees into knowledge workers and knowledge management becomes a core organizational framework of modern business. Today, more than fifteen years after first thinking about the systematic management of knowledge, it is clear that it has become an indispensable part of every modern and successful company.

2. THE LEARNING ORGANIZATION

The learning organization is a universal change in the traditional culture of management. The learning organization is an organization where people are continually expanding their creative capacities to achieve the results they want, where they supported a new way of thinking, which is free to set common goals and where people are continually learning how to work together. Such an organization is not primarily characterized by changes in organizational structure or redesign the job of transforming the organization's relationship to the individual, but the individual and the organization.
The term "learning organization" was introduced by Karl Erik Sveiby, according to which they are firms that are tailored to the customers, are characterized by creativity, knowledge intensive, highly educated people, the willingness and ability of management and employees to constantly learn. The father of the concept of the learning organization, Peter Senge (1990th, 17), by the term implies organization "where people continually develop their capabilities in order to obtain the results that they really want, where you nurture and open new modes of thinking, where collective aspiration free and where people are continually learning how to learn together."[1]

Organizations need to create a stimulating environment where individuals and enterprise continually increase your creativity, innovation and knowledge. Advances in information technology, expert systems and the Internet directly enable better management and quicker distribution of knowledge. On the basis of a different understanding of the concept of the learning organization can be concluded that this is an organization that seeks to create its own future, and the learning process is understood as a continuous and creative activity that will accomplish that goal. [2]

If people in interaction with the environment learned something, but the organization has not changed and is not used that knowledge to a new situation, then the organization has not learned. There is a closed relationship between the individual and the learning organization: individuals with learning impact on changes in an organization that creates new norms, values and strategic priorities and thus affects individuals to learn. An organization that learns and encourages learning among its people, promotes the exchange of information among employees thus creating an educated workforce. This produces a very flexible organization where people will accept and adapt to new ideas and changes through a shared vision. This is necessary as means to quickly learn quickly to adapt to their environment.
As fundamental characteristics of a learning organization can be distinguished:

1. An organization that is constantly learning and raises miscellaneous individual, overall organizational knowledge;
2. Constantly learning and development becomes a liability and an integral part of the work of all members of the organization;
3. Transfer of learning and "produced" knowledge becomes a duty, in a learning organization, everyone is both a teacher and a student;
4. Loyalty learning, influencing and knowledge transfer becomes an important factor evolving individual performance;

[1] Rupčić, N., "Kritički osvrt na konceptnorganizacije koja uči", Društveno istraživanje, Zagreb, 2007., str. 1239-1261

[2] Rupčić, N., "Kritički osvrt na koncept organizacije koja uči", Društveno istraživanje, Zagreb, 2007., str. 1239-1261

5. Learning is not seen as a separate activity, it is an essential part of the organizational culture, behavior and the existence of the organization;
6. The point of continuous learning is creating new ways of thinking, behavior change and application of learned into practice, or when creating and modifying products and services;
7. Knowledge becomes the share capital and the largest competitive power of a learning organization;
8. A learning organization is not determined by any of its technology or structure, or any other "hard" element, but its culture oriented knowledge and continuous learning, which encourages and rewards knowledge and innovation. It is a culture of continuous learning, change and innovation. Learning from their experience and best practices of others;
9. Competitive ability to evaluate the amount of knowledge, skills and abilities in relation to the competition. Taking into account these intangible elements of the so-called. "Soft" elements, necessarily requires the introduction of the concept of intellectual capital as their economic equivalent;
10. Active and attitude towards learning in such an organization is determined by the knowledge that its competitive position is determined by its knowledge.

Benefits provided by the learning organization are:[3]

• ensure the long term success of the organization;
• continuous improvement becomes a reality;
• success and best practices are transferred to and emulate;
• increased creativity, innovation and adaptability;
• attracting people who want to succeed and learn, and keep them in the organization;
• ensure that people are equipped to meet current and future needs organization.

[3] Avelini Holjevac, I., "Europa znanja: Organizacija koja uči I sustav upravljanja kvalitetom", str. 153

3. BUSINESS INTELLIGENCE IN THE LEARNING ORGANIZATION

Knowledge and learning today are increasingly part of the organizational culture and organizational processes. The greatest competitive advantage and the biggest entry barrier in addition to standard factors such as capital, access to distribution channels, product differentiation, economies of scale, today represents the shared knowledge and skills of employees in the company. Knowledge today as the strongest weapon in creating competitive advantage should be given greater attention.

As the problem is the question of creating the preconditions and infrastructure needed to manage their business knowledge and the creation of a learning organization. The development of information and communication technologies to successfully resolve these issues. Companies in which its business activities apply the concept of business intelligence, establish better control over information in relation to those who do not use its advantages, and make better decisions, create competitive advantage and new forms of revenue.

3.1. The impact of the application of the concept of business intelligence in an organization that teaches

Quickly learn exactly means to adapt to the environment. An organization's ability to learn has to be bigger and faster than the changes that are happening in her environment, and that it just allows the application of the concept of business intelligence. Right information today is a major prerequisite for survival in turbulent conditions. It helps companies to take appropriate action, and to do that there, business intelligence systems must engage with internal and external data. By adopting the concept of business intelligence and business information management company may use the remaining data collected from numerous sources, transforming them using BI systems in quality information.

The need for the introduction and use of business intelligence systems in advanced companies, the organizations that teach there is a business need, all because of stronger competition, developed

distribution channels and supply of goods and services that significantly exceeds demand.
Why learning organization is becoming increasingly important, here are some answers:[4]

- Information has become the most important organizational resource.;
- To keep pace with the rate of change of information is the biggest organizational challenge;
- Request that the more people who are able to quickly learn;
- Companies that can keep their most talented people who teach and develop the capacity for organizational learning will have a competitive advantage;
- Business opportunities are rapidly emerging, but also disappear;
- In order to survive, organizations must constantly change, and manage these changes is difficult. It often happens that while the organization is changing the preferred structure, when reached, this structure is no longer desirable.

Business intelligence precisely places emphasis on timely information, the information they need at a given time to make business decisions, and provides a learning organization achieve its goals and ideas on which it is based. Business intelligence aims to provide decision-makers with the knowledge that will be the basis for decision-making and management company plays a key role in the planning of these activities.

4. QUALITY MANAGEMENT- KNOWLEDGE MANAGEMENT

Knowledge comes from the mind. It is the totality of all that was understood, discovered or derived by reasoning. Knowledge is essential for good decision-making, recognition and understanding of cause / effect relationships that affect an organization's operations, and thus the ability to predict its future.
H. Davenport, L. Prusak: Working Knowledge: Knowledge is a fluid mix of shaped by experiences, values, related information and expert opinions, which provides a framework for evaluation and inclusion of new experiences and information. It originates and is applied in the minds of experts. In organizations, knowledge is often stored not only in documents or repositories (knowledge bases), but also in organizational routines, processes, practices and norms. The process of creating, coordinating and storing, transferring and applying (re-use) of knowledge in order to increase the efficiency of the organization. Refers to the people, culture, values, technologies and practices.
Highlighting the role of knowledge in recent years is the result of significant structural change in developing economies. It was late in the last century, completely changed in its essence and transition from the industrial to the modern information economy today, the main resources are no longer material goods, but also a new factor of economic activity and productivity becomes a knowledge economy. Businesses need to change the established ways of doing business and conduct. Turbulent market and market competition forces them to better use the basic resource, and these are primarily information and knowledge of their employees. Knowledge exists in people and teams and make the total organizational knowledge and potential that can be measured that is what makes the intellectual capital of the company and is part of the overall value of the company.
In a modern economy, the most valuable resource of the business is considered to be human knowledge, because knowledge management is an inevitable component of modern management. The goal of knowledge management process is continuous innovation and modification of existing knowledge that the organization was able to keep pace with the dynamic market environment.
According to a study conducted by O'Dell and Grayson (1998b.), as commonly recognized consequences of systematic knowledge management companies are: the improvement of practices and business processes, increase business volume, increase customer satisfaction, improve employee skills and organizational learning and increase innovation.
The process of knowledge management consists of several phases that are taking certain elements as

[4]http://www.student.foi.hr/~dkonjevo/FOI_related/Organizacija_koja_uci.htm (16.01.2014.)

follows:[5] obtain / knowledge creation, knowledge storage, knowledge distribution and end use of knowledge. The organization, which seeks to continuous renewal of knowledge, so-called "learning organization" that is, an organization that teaches the process traceability is continuous and cyclical.

Knowledge of employees, their business experience, ideas, innovation, motivation, readiness for teamwork enriches organizational culture and improving the processes within the company and to create more new knowledge in relation to the cost of doing business.

There are three practices that contributed the most knowledge management. These are: information management, quality management and human capital management and resources. Quality management is focused on clients, common processes and common goals within the organization and management of knowledge is borrowed these three goals.

Quality management is applied in the production process, and knowledge management has a broader view and access. Looking towards the future of knowledge management it can be taken two directions. One is, as in quality management, to become transparent so that its key ideas and goals rates in the organization and become more or less transparent to the organization that is to become a completely natural way in the organization of work. Another, less appealing way is to go through re-engineering that has become synonymous in some cases for the cutting of the organization and who in some cases would do more harm than good. Quality and knowledge are often cited as sources of competitive advantage and therefore serve the same purpose, and also be simultaneously applied in organizations.

When you consider the fact that the quality management systems are based on a systematic approach and a series of tools that solve problems and cause continuous improvement and continuous learning, relationship between quality and knowledge becomes more obvious. The main objectives of the quality management system and knowledge are the same: to create more organizational knowledge that enables continuous improvement.

The ultimate goal of knowledge management is among other organizations to improve the position of the market and the implementation of standards and regulations HCAAP and ISO 9000 indirectly leads the organization just to reach this goal. Adhering to these standards and regulations, companies will always have control of their products and their quality and purity. How these standards are essential to the organization so important and customers who will decide before the certified products in their manufacturing process go through the various controls, and thus benefiting the organization gets better and more valuable position in the market.

5. CONCLUSIONS

Today's business world is already widespread awareness that the total knowledge in the organization is much larger than that used in the processes of the organization. As the modern knowledge economy as the most important resource of today's business, knowledge management is an indispensable component of modern management. The organization, which seeks to continuous renewal of knowledge, so-called. "an organization that is constantly learning," Traceability this process is ongoing and cyclical. Knowledge of employees, their ideas, business experience, motivation and teamwork make the most valuable part of the capital of modern companies.

Companies are well aware that the monitoring of the development and installation of the latest achievements of information technology directly affects the possibility of utilization of the enormous amount of information which the daily barrage. Organizations that "learn" put knowledge and mutual learning in the foreground as the foundation of their future. It is important to note that companies in their business activities, apply the concept of business intelligence establish better control over information in relation to those who do not use its advantages, make better decisions, thus creating a competitive advantage and new forms of revenue.

[5] Ljubetić, V., "Upravljanje znanjem primjenom alata poslovne inteligencije", magistarski rad, 2005., str.16

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SUSTAINABLE SHIP SPEED CRITERIA FOR DIFFERENT SEA STATES WITH EXAMPLE ON CONTAINER SHIP

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ABSTRACT

The aim of this paper is to show application of operational criteria that are used to select sustainable speed for different sea states. Also is given overview how seamen feel operational criteria and which is sustainable speed for some sea states in real life.
Selected criteria are bow accelerations, slamming and green water occurrence.
Large container ship is used as example to show application of operational criteria on North Atlantic sea environment. Operability polar plots are calculated and selected for interesting sea states. Method used for this calculation is 3D panel method.
In conclusion are given advantages and disadvantages of existing criteria and guidelines for future research.

KEY WORDS

operational criteria, seakeeping, sustainable speed, North Atlantic sea states, container ship

1. INTRODUCTION

Maritime transport has a great role in global transport of goods and products so ship operations have to be safe and optimized. Safety and optimization lead to promptness and accuracy. Ship maneuvering is very important, especially on rough sea. Maneuvering on calm sea is, largely, a routine. Problems occur when environment conditions are extreme. Loads on ship structure are on high level in extreme environment conditions. Safe operability of ship, in extreme sea conditions, is questionable. In those cases ship maneuvering has to be done such as speed reduction and/or changing of wave heading direction. Knowledge of wave loads and sustainable speeds simplifies decisions to seafarers.
Question is what that knowledge should include and how seafarers have to react in rough weather. First of all, knowledge of operability criteria is necessary. Criteria considered in this paper are slamming, deck wetness and vertical acceleration on bow. Limiting values of operability criteria, for each type of ships, show if operability margin was overshot.
Influence of criteria limiting values are shown on example of 9200 TEU container ship by polar plots and operability diagram. Those diagrams and plots are useful to seafarers for safe and optimum ship maneuver in rough sea.

2. CRITERIA FOR SHIP OPERABILITY IN ROUGH SEA

Seakeeping studies are used to find out ship response on different sea states. The resulting response is validated by operability criteria limiting values. Operability limiting values are border between acceptable and unacceptable phenomena. Phenomena considered in this paper are slamming, deck wetness and vertical acceleration on bow.

2.1 Slamming

Slamming phenomena occurs if bow of the ship emerges out of the sea at certain speeds and certain sea states.
Re-entry leads to impact between flat bottom in the forward part of the ship and the sea surface. Result of impact is the suddenly developed force that produces transient vibrations of the hull, known as whipping. Seafarers can clearly feel slamming because vibrations of the hull complicate normal activity on board such as steerage, navigation, cargo control, etc. Slamming also complicates repose of the crew which is very important for ship safety. Emerging of the bow is result of relative motions between sea surface elevation and ship motion components such as heave and pitch. Slamming will occur if relative motion is larger than draft of the ship and if relative velocity is larger than critical velocity (Ochi & Motter 1974).
Ochi defined a critical relative velocity of the bow as:

$$v_{cr} = 0.093\sqrt{g \cdot L} \tag{1}$$

where g is acceleration of gravity and L is length of the ship.
Limiting value of slamming is usually given in term of probability. Probability of slamming is given as:

$$P_{slammning} = e^{-\left(\frac{D^2}{2m_{0r}}+\frac{v_{cr}^2}{2m_{0v}}\right)} \tag{2}$$

where D is draft of the ship, m_{0r} is zero-th spectral moment (variance) of relative motion,

m_{0v} is zero-th spectral moment or variance of relative velocity.

2.2 Deck wetness

Appearance of deck wetness can happen at any place on the ship where freeboard is not high enough. It usually occurs on fore part of the ship when relative motion of the bow exceeds height of the freeboard on bow. Deck wetness can cause equipment damage and loss of the cargo, especially on container ships.
This type of seakeeping criteria is the most recognizable amongst seafarers because it is visually attractive. Probability of deck wetness is given as:

$$P_{deck\,wetness} = e^{-\left(\frac{f_x^2}{2m_{0r}}\right)} \tag{3}$$

where f_x is freeboard on section x of the ship,

m_{0r} is zero-th spectral moment for relative motion.

2.3 Vertical acceleration at forward perpendicular

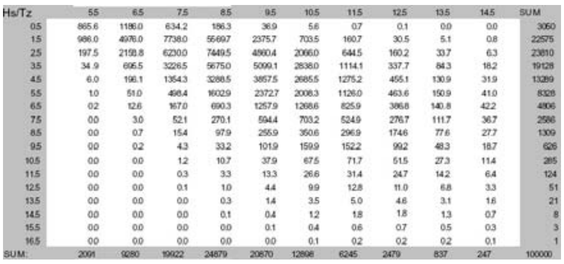
Absolute vertical acceleration on bow can cause damage of the structure or equipment. Furthermore, excessive accelerations could disturb seafarers in their normal activity on ship. Inexperienced or not adapted seafarers feel seasickness that leads to impossibility of normal work and deficit of safety on ship. Vertical accelerations on the bridge are also very important for seafarers but are not taken under considerations when calculating operability.

3. APPLICATION OF OPERABILITY CRITERIA ON 9200 TEU CONTAINER SHIP

Characteristics of 9200 TEU container ship:

Lpp	335m
B	42.8m
T	13.17m
V	25kn
Capacity	9200 TEU

Safety of the seafarers is the most important thing. Second point is safety of the cargo. To satisfy safety criteria seakeeping features of the ship have to be on satisfactory level. Seakeeping features can be described in many ways. The easiest way for seafarers and companies is by sustainable speed on rough sea states. Sea states are described by wave heights and periods. Sea states describing rough weather are given for North Atlantic sea environment according to the IACS recommendation Note No.34 (Figure 1.).



Hs/Tz	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	SUM
0.5	865.6	1186.0	634.2	186.3	36.9	5.6	0.7	0.1	0.0	0.0	3050
1.5	986.0	4976.0	7738.0	5569.7	2375.7	703.5	160.7	30.5	5.1	0.8	22575
2.5	197.5	2158.8	6230.0	7449.5	4860.4	2066.0	644.5	160.2	33.7	6.3	23810
3.5	34.9	695.5	3226.5	5675.0	5099.1	2838.0	1114.1	337.7	84.3	18.2	19128
4.5	6.0	196.1	1354.3	3288.5	3857.5	2685.5	1275.2	455.1	130.9	31.9	13289
5.5	1.0	51.0	498.4	1602.9	2372.7	2008.3	1126.0	463.6	150.9	41.0	8328
6.5	0.2	12.6	167.0	690.3	1257.9	1268.6	825.9	386.8	140.8	42.2	4806
7.5	0.0	3.0	52.1	270.1	594.4	703.2	524.9	276.7	111.7	36.7	2586
8.5	0.0	0.7	15.4	97.9	255.9	350.6	296.9	174.6	77.6	27.7	1309
9.5	0.0	0.2	4.3	33.2	101.9	159.9	152.2	99.2	48.3	18.7	626
10.5	0.0	0.0	1.2	10.7	37.9	67.5	71.7	51.5	27.3	11.4	285
11.5	0.0	0.0	0.3	3.3	13.3	26.6	31.4	24.7	14.2	6.4	124
12.5	0.0	0.0	0.1	1.0	4.4	9.9	12.8	11.0	6.8	3.3	51
13.5	0.0	0.0	0.0	0.3	1.4	3.5	5.0	4.6	3.1	1.6	21
14.5	0.0	0.0	0.0	0.1	0.4	1.2	1.8	1.8	1.3	0.7	8
15.5	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.7	0.5	0.3	3
16.5	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	1
SUM:	2091	9280	19922	24879	20870	12898	6245	2479	837	247	100000

Figure 1. IACS recommendation Note No.34

3.1 Methodology of calculation

Seakeeping features are calculated for different ship responses in short-term sea states based on the response amplitude operators (RAO). 3D panel method is employed for computation of RAOs, while 2-P Pierson–Moskowitz wave spectrum is used for short term spectral analysis.

RAOs are calculated using state-of-the-art seakeeping software Hydrostar (Bureau Veritas 2010) while results are post processed using program Starspec (Bureau Veritas 2010). Calculations are based on 3D panel method and linear potential theory.

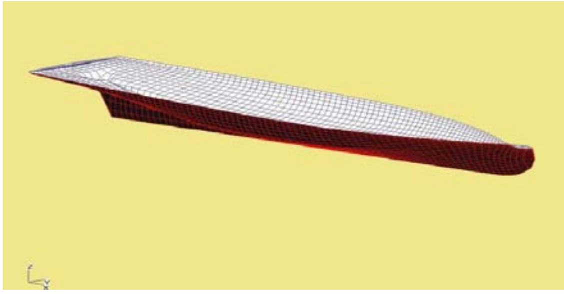


Figure 2. 9200 TEU hydrodynamic model in Hydrostar

Response amplitude operators are calculated at forward part of the ships for:

- relative vertical motion,
- relative vertical velocity,
- absolute acceleration.

All three RAOs are calculated for four speeds:

$$\tfrac{1}{4}v = 3.125m/s$$

$$\tfrac{1}{2}v = 6.430m/s$$

$$\tfrac{3}{4}v = 9.645m/s$$

$$v = 12.460m/s$$

For assessment of ship operability in rough sea states, ship response is calculated by Starspec software for spectral analysis. In this calculation only short term ship response is investigated because of assumption that rough sea state represents storm that lasts a few hours (short term). 2-P Pierson–Moskowitz wave spectrum formulation is used for short term spectral analysis. One of the results of spectral analysis is zero spectral moment m_0, from which significant response may be determined as:

$$R_S = 4 \cdot \sqrt{m_0} \qquad (4)$$

where R_S is significant response (double amplitude). Significant response is calculated for each combination of RAO and speed of the ship.

3.2 Limiting values of operability criteria

Limiting values are margin between acceptable and unacceptable significant responses.

Table 1. Limiting values used in operability calculation

Limiting probability of slamming	0.0112
Limiting probability of deck wetness	0.05
Limiting RMS of vertical bow accelerations	0.108g

3.3 Results

Practical results, useful to seafarers, are generated in program Starspec. Calculations carried out in Starspec connect significant response and limiting values of operability criteria. Results are shown in two ways:

- operability polar plots,
- operability diagram.

Computing is provided for bow heading sea.
Operability polar plots (Figures 3.-6.) show which navigating azimuth and which speed is sustainable for each sea state. Sea states are given in scatter diagrams. For calculation presented in this paper North Atlantic scatter diagram from IACS recommendation Note No.34 is used. Each sea state has its own operability polar plot.

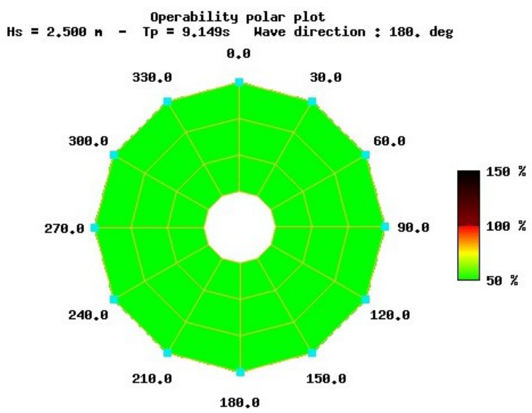


Figure 3. Polar diagram for four sppeds, H_s=2.5m, T_p=9.149s, heading=180°

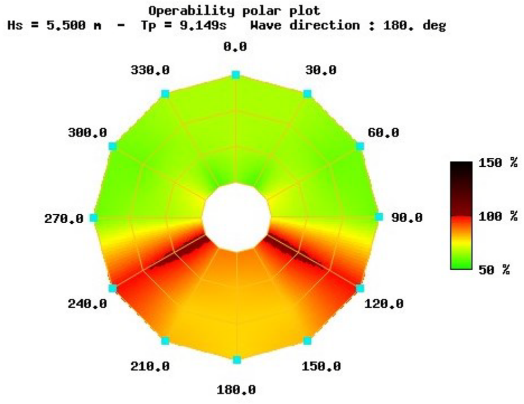


Figure 4. Polar diagram for four sppeds, H_s=5.5m, T_p=9.149s, heading=180°

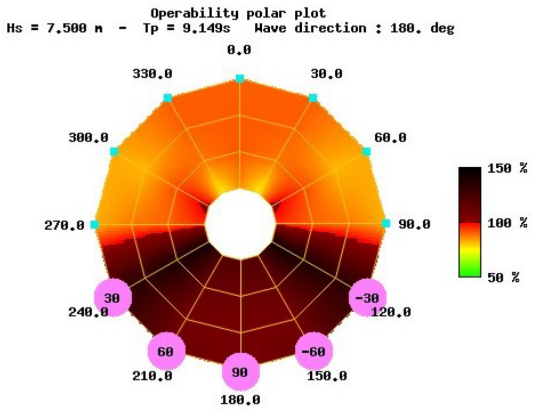


Figure 5. Polar diagram for four sppeds, H_s=7.5m, T_p=9.149s, heading=180°

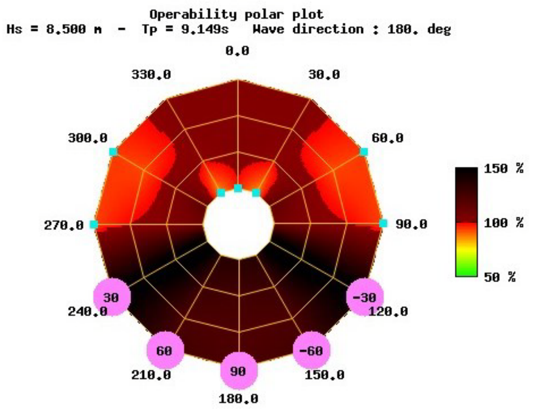


Figure 6. Polar diagram for four sppeds, H_s=8.5m, T_p=9.149s, heading=180°

Figures 3, 4, 5, 6 show operability polar plots for same wave period (T_p=9.149s), but for four different wave heights (H_s=2.5m, H_s=5.5m, H_s=7.5m, H_s=8.5m).
180° means that ship is heading waves with bow.
It is obvious that for seas state on Figure 3 no maneuvering has to be one.
For sea states shown on Figures 4, 5 and 6 maneuvering has to be done. Maneuvering activities are speed reduction (or acceleration) and/or azimuth change. Shown plots are taken from list of plots derived for a bunch of sea states because all plots can not be shown in paper. Reason for showing this sea states are great probabilities of their appearance in North Atlantic.

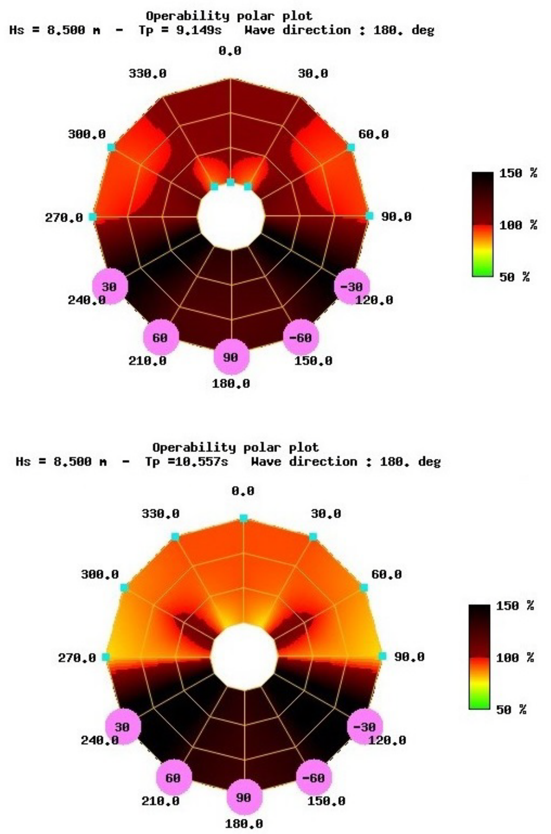


Figure 7. Comparison of two polar plots, same wave height, different periods

Figure 7 shows comparison of two operability polar plots, wave height is same but wave period is different.

Because of correlation between wave period and length of the ship, second polar plot shows better conditions of operability.
Conclusion for seafarers who navigate on considered 9200 TEU container ship is that wave period of 9.149s is more critical than wave period of 10.557s. In IACS recommendation Note No.34 is shown that sea state of H_s=8.5m and T_p=10.557s has higher probability of appearance.

Operability polar plots are not user friendly for seafarers. More useful could have operability diagram and speed diagram.
Operability diagram (Figure 8) shows appropriate maneuvers for navigation on different sea states.

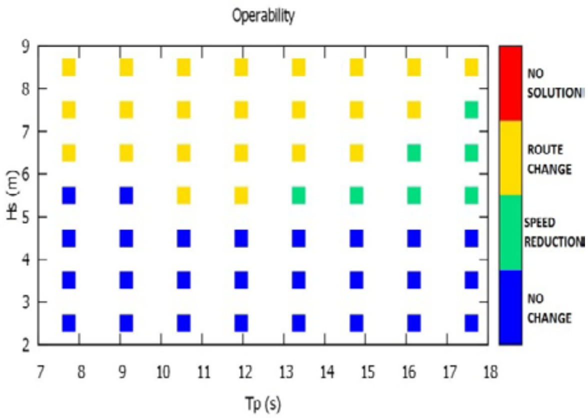


Figure 8. Operability diagram for 9200 TEU container ship

Interesting maneuvers are speed reduction ane route change. Operability diagram groups all polar plots for all default sea states in one place.

4. CONCLUSIONS

Results presented in this paper could be useful to seafarers, companies and ship owners.
Benefit for seafarers is that with operability diagram decisions, for speed reduction or for azimuth change, are easier to make. Those decisions have influence on:

- quality of life on the ship,
- less fear and stress of the crew,
- increased confidence of the crew,
- better performance of everyday service.

Benefit for companies that are responsible for cargo:

- cargo is much more safe.

Benefit for ship owner:

- ship construction is not exposed to maximum loads,
- ship equipment is more safe.

Benefit for all three groups is that safety is on higher level which is the most important thing.
Results, also, have some uncertainties.
Understanding and reading of presented diagrams depend on the experience of seafarers because recognition of sea states is subjective.
Calculation has uncertainties because depends on methods and theories that does not include all conditions. Also were provided only for bow heading seas. Other directions would be interesting for seafarers, like including side heading waves. Comparison of calculated results and experience from real service would be priceless for this field.
Recommendation of authors is training on simulators for seafarers. In that way they will get use to maneuvering on rough sea and practice will make their decisions safer and faster. Common contact between experienced seafarers and naval architects would, also, be priceless.
The mentioned field is of interest for both naval architecture and maritime research disciplines which will lead to better incorporation of reaction of seafarers on rough sea maneuvering in ship structural design.

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DECISION MAKING IN THE PROCESS OF COLLISION AVOIDANCE AT SEA – THE COGNITIVE ASPECT

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ABSTRACT

While conducting a vessel, the watch-keeping officer constantly makes decisions. His cognitive process is laden with developments in the area, with the movement of the own vessel and navigational devices that provide information about the movement of the own and observed vessels (by sight and sound). He/she uses all of the knowledge required in the given situation. Decision making is fast and dynamic and there is no room for wrong decisions. But people do make mistakes. The vast majority of maritime accidents are due to human error, so it is necessary to investigate the nature and cause of these errors. This article focuses primarily on the cognitive abilities of the individual in the decision making process: how we collect and process complex information and how bridge automation works for us.

KEY WORDS

Maritime Accidents, Decision Making, Human Error, Human Factor Analysis

1. INTRODUCTION

An example of a human error provided in the MAIB of 2011 deals with a collision stemming from a wrong decision that derived from the wrong assessment of the situation. In the early evening of 11th February 2011, container vessel Boxford collided with fishing boat Admiral Blake in the English Channel. There was a material damage to the fishing boat, but no human casualties. The analysis of the accident showed that the master of the container vessel did not assess the navigational situation well as he was tired at the time of the accident; moreover, neither him nor the cadet who was at that time with him on the bridge, had detected a fishing vessel until it was in close proximity. Another lack of situational awareness due to alcohol abuse on one hand and poor organization of bridge team management on the other led to the collision of the vessels Stena Feronia and Union Moon in the Gulf of Belfast on 7th March 2012 (MAIB, 2012).

Based on analyses of accidents at sea the reasons for collisions are mostly due to human error: bad lookout both by sight and by radar; insufficient adjustment of the radar for weather conditions, inappropriate speed of the vessel according to the navigational situation, lack of bridge team and bridge resource management, superficial communication between the crew on the bridge and/or with the pilot, excessive reliance on navigational devices, watch-keeping with an insufficient number of people on the bridge, misinterpretation of the traffic situation, misinterpretation of information obtained from navigational aids, ignorance and disregard of the COLREG rules, etc. In addition to these reasons, there are also accidents due to stress, fatigue and impaired judgment of navigators (Dekker, 2002;

Zhengjiang, 2003; Diestel, 2005, Gale, 2007; Tzannatos, 2010).

Maritime accidents are rarely the result of one human error, rather a sequence of human errors by those conducting the vessels. They are a result of activities on the bridge, where one wrong decision leads to another, etc. (Rudan, 2012). These so-called active errors or errors of operators were already defined by Reason in his model of a human error, which he called the "Swiss Cheese" model. According to this model the accident is a sum of errors – a system error. He divided errors into active and latent errors, where the latent were considered as human errors indirectly linked to the accident – errors by system designers, organizational managers, agents, etc. (Reason, 1990). Wiegmann & Shappell (2003) divided the aspect of human error in aviation into six main areas: cognitive, ergonomic, behavioral, health, psycho-social and organizational. The cognitive aspect observes the mental functioning of the operator, focusing on his perception/processing of information, and, consequently, decision making. The ergonomic aspect deals with man-machine interaction; the behavioral aspect in particular highlights the problem of the behavior of operators (safety culture). The health aspect considers human error as a consequence of psychological or physiological symptoms (illness or fatigue). The psychosocial aspect considers mutual relations between people on vessel - with other departments, etc. The organizational aspect of human error looks at the impact of the organization (eg., the shipping company) on human errors that lead to maritime accidents. Similarly, Chauvin (2011) presented the role of the human factor in maritime accidents, dividing it into three levels: the cognitive factor, the social-interpersonal factor and the latent (organizational/system) factor. Of course we can not forget to mention that the International Maritime Organization (IMO) in cooperation with the International Labour Organization (ILO) deals with the problem of human factors/human error in maritime by implementing laws and regulations for working conditions, the working environment, as well as the living environment for seafarers, as this is crucial when discussing safety on vessels. The most important implemented instruments are; the International Safety Management (ISM) Code, Seafarers Training, the Certification and Watchkeeping (STCW) Code, Formal Safety Assessment (FSA), Human Reliability Analysis (HRA) and other important resolutions like A.850(20) on the human element vision, principles and goals for the organization, as well A.890(21) on principles of safe manning (along with the International Convention for the Safety of Life at Sea - SOLAS chapter V. Reg.14).

2. DECISION MAKING IN NAVIGATION

While conducting a vessel, decision making requires from the watchkeeping officer both full attention and the capability to respond quickly. However, due to the decreasing number of crew on the bridge, the amount of information for one officer to process has increased, adding to the burden of the decision-making. In addition to crew reduction, the problem is exacerbated by increasing density of traffic in many of the world's waterways, reducing the room for maneuver (consider Belfast Bay). Decision-making is also affected by weather conditions, and, ultimately, the experience of the navigator. Avoiding vessels has further specificity, since the officer on the watch has a lot of knowledge about his own vessel, but limited knowledge of the other vessel, meaning that he makes decisions under conditions of some uncertainty (Nielsen, 2001).

According to research, people are able to handle a relatively small amount of information (by which we make decisions) at the same time: on average, not more than seven specific items (Bohanec, 2006). Marois (2005) argues that the capacity of visual perception of an individual is limited to no more than four objects, and is also limited by the complexity of the objects themselves. Gasar (2001) has mentioned that the human information processor can retain an average of only 5 to 9 units of information and only for 40 seconds, or a little bit more by constant repetition. People do of course differ in regard to the amount and time of maintaining information in their working memory and processing speed, but not to a significant degree.

Of course, a more experienced officer can monitor more data from the equipment and the environment at the same time, while a less experienced officer processes informations more slowly, making decisions somewhat more difficult. Decision-making exercises on navigational simulators improve navigators' ability to analyze complex situations (Pekcan, 2005); training in a real environment (working on a vessel) teaches the navigator to recognize complex patterns (pattern matching) and to find appropriate options to solve various problems more easily (Chauvin, 2009). Singh (2003) noted that the quality of decision-making is influenced not only by experience, age or education, but also by specialized training. This basically means developing the quality of anticipation: learning to observe the traffic situation and react swiftly, even if one is not directly involved in a problematic circumstance (the ability to forecast and analyze situations). However, it is important to consider that quite often people are looking for shortcuts in decision-making when dealing with large amounts of information (Olsson, 2006). Especially in stressful situations we are looking for information that would confirm our assumptions. There is a tendency to choose the first acceptable solution rather than assessing the best of a number of solutions.

Proper decision-making is a product of so-called situational awareness, which is the mental ability to be aware of what is happening and what will happen (Hetherington, 2006). For proper awareness of the situation in the first place the correct perception is needed: what is happening in the vicinity of the vessel - the correct interpretation and data processing; and reaching the correct conclusion. When these conditions are met, the navigator takes a decision (with the help of his knowledge), which will be rational and appropriate to the situation. How the officer decides in a situation requiring avoiding other vessels depends on the navigational area, interaction of vessels, types of vessels and visibility conditions. The rules that precisely govern the mutual avoiding obligations are united in the COLREG convention, but avoidance is further governed by mutual understandings of vessels or unwritten practices in various areas (Lin, 2006; Chauvin, 2008).

2.1 The impact of bridge automation on decision making

Automation of working processes facilitates the work of marine navigators. The Global Navigation Satellite System (GNSS) has reduced the amount of time for determining the true position of vessels; communication systems has simplified the work of traffic control, search and rescue procedures, and in particular, facilitated the mutual identification of vessels. Navigational radar, the electronic chart and display information system (ECDIS), the automatic identification system (AIS) have made especially significant contributions to the safety of navigation. And although automation has reduced the need for the manual conduct of vessels, the amount of information provided to the navigator remains the same, or perhaps has even increased.

Many researchers have warned about the problem of automation in the maritime field. Lützhöft (2002, 2004) pointed out that automation in particular changes the nature of human error. She highlighted the importance of training for seafarers to work on integrated navigational bridges and the problem of relying on the automatization (Lützhöft 2002, Schager 2008). Schager, inter alia, proposed the maintenance of an attitude of skepticism towards technology; in particular stressing that human error in maritime accidents is also attributable to manufacturers of navigation equipment and aids, which, for instance often neglect ergonomic aspects (how the device provides information, how the user sees the information, what the user has to do to obtain the relevant information, etc.). Diestel (2005) additionally pointed out the problem that technological developments in maritime creates new training requirements, a new aspect of risk.

In the case of collision accidents, over-reliance on devices has been most problematic concerning ARPA radar. ARPA radar is a collision avoidance aid and data such as CPA (Closest Point of Approach) and TCPA (Time to Closest Point of Approach) provides navigators essential information for the assessment of navigational situations, or, rather, indicates the risk of approaching vessels or objects in the vicinity of the vessel. The disadvantage of the CPA data is that it does not take into account the dimensions of own and observed vessels or objects, which means that the distance that data represents is not precise enough to complete the evaluation of the situation. One such accident in which the information provided by ARPA radar distracted the watchkeeping officer was a collision between the container vessel P & O Nedlloyd Vespucci and the motor yacht Wahkuna, which occurred in the English Channel at the end of May 2003. Due to the reliance on the CPA information, the officer on the container vessel assessed the navigational situation incorrectly and consequently made a faulty decision, which among other things, affected the turn of events (MAIB , 2003).

Another problem in regard to technological development has arisen with the introduction of AIS. Instead of a system which allows the exchange of static and dynamic information between vessels reducing radio communication between vessels, it has actually increased since vessels now easily identify the other and find it easier to negotiate avoidance maneuvers. Consequently, this represents more abuse of avoidance rules, reducing the possibility that the officer on watch will complete the prescribed maneuver on time (Harati-Mokhtari, 2007).

A particular problem in automation is its cognitive aspect. The speed of technological development represents a major challenge to humanity, as means of conceiving the immediate environment are rapidly altered in non-human ways. For instance, on the bridge communication between several observing and working navigators is replaced by communication between man and machine. Proper training is needed to learn how to use navigational devices/aids and also to accustom the human to this quite new (especially historically speaking) phenomenon. Especially from the cognitive point of view, man-machine interaction is important (May, 1999 Gauss, 2007; Brüggemann, 2009): How does the human brain process particular information? What are the effects on cognition of the lack of immediate human support? How much information can a person accept at the same time? How must information be given so that a person can accept it in the correct format? Design related problems have been highlighted by May (1999), who mainly focused on cases in which a device provides too much information that is not needed on certain types of vessels; devices that perform tasks ineffectively; devices that are inappropriate in applicability – e.g., when integrated bridge devices are not all integrated with each other; contradictory systems - two devices that offer the same information, but one in analog and the other in digital format; inconsistency of installing devices - some devices, which should for reasons of safety be placed next to each other, are not, etc. May pointed out that the perception of different information is a very important factor in the successful implementation of bridge team/resource management.

The problem of information processing was also mentioned by Gauss (2007), who proposed a support system for the analysis phase of the cognitive processing of information. Simply put, all information provided on the bridge during watchkeeping were united in support of a decision-making system which would advise the navigator at the time of assessment of navigational situations. The system itself was tested with experimental sailors (students and active officers /masters) on a navigational simulator, where they examined the decisions made by seafarers and decisions provided by the system. The system draws information from various sources such as radar, ECDIS, an integrated navigation system and by using fuzzy computing converts them into levels of risk, which are displayed to the user, for different areas. Which tasks navigator's cognitive system faces interested Brüggemann (2009), who demonstrated with a model of a virtual navigation officer his psychological processes and defined the external influences that guide the thinking of an officer. The model that uses PSI theory is part of a project with which they wanted to understand and explain the behavior of the navigational officer. The goal of the project is finding solutions for the development of navigational devices that would better integrate the work of a man and a machine.

2.2 Psychological factors that affect decision making

As already mentioned, the mental state of the navigator also influences the decision making process. By reducing the number of the crew, the scope of work for seafarer has increased. And although the length of working time is specified by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), actual work on a vessel, in reality, often exceeds the denoted time frame. In

addition to the regular watchkeeping during the voyage, at anchor or in port, each officer has additional work that can be performed only outside the watchkeeping time. Sleep affects all three areas of psychological operation: activity, cognition and emotion. Amount of sleep not only affects perception, but also the management and evaluation of one's own actions in new and complex situations (AIBF, 2008). Impairment of cognitive functions leads to wrong actions, incidents or accidents. Lack of sleep also affects memory and rationality, may induce melancholy and sometimes even leads to a state of euphoria.
Stress in the workplace has a negative impact on the ability of the individual's decision-making. Stress is the human body's reaction to the stressor (simulant which causes stress, which may be real or imaginary). Signs of stress can be of an emotional, physical, behavioral and cognitive nature. Prolonged exposure to stress can trigger different states of anxiety that affect the complex of decision making processes that lead to accidents at sea.

3. HUMAN FACTOR ANALYSIS AND CLASSIFICATIONS SYSTEM

As with aviation, the maritime industry perpetually seeks to improve safety. One particular tool now available is the Human Factor Analysis and Classifications System (HFACS), which was initially used to investigate the impact of human factors in aviation accidents and recently has been applied to the investigation of maritime accidents (Xi, 2010). This system was created on the basis of Reason's model of human error. The model encourages accident investigators to seek latent (hidden) errors as well as more obvious ones. The model is divided into four main parts:

- Unsafe acts;
- Preconditions for unsafe acts;
- Unsafe supervision;
- Organizational influences.

If we would place the problem of decision making of the navigator in this system, we would find that it is affected by all parts of the HFACS system.

3.1. Unsafe acts

Unsafe acts are divided into errors and violations. The problems of decision making are divided into: decision errors, skill-based errors and perceptual errors. These are the actual errors of navigators. There are not many accidents that are simply caused by unsafe acts, but due to hidden errors, which imperceptibly influence the development of events, a chain reaction that eventually lead to an accident is discovered.

3.2. Preconditions for unsafe acts

Focusing on the dangerous acts of navigational officers, without knowing the reasons for them, is not the correct approach. Watchkeeping officers can make wrong decisions due to substandard experiences or bad working conditions. Primarily this reflects: poor human resource management or poor physical/mental readiness for work (fatigue, exhaustion); harmful mental states (poor motivation, mental fatigue, reduced awareness of situations, etc.); adverse physical conditions (disease/illness, physical fatigue, impairment, etc.); and physical/mental limitations (poor ability to make quick decisions in crisis situations).

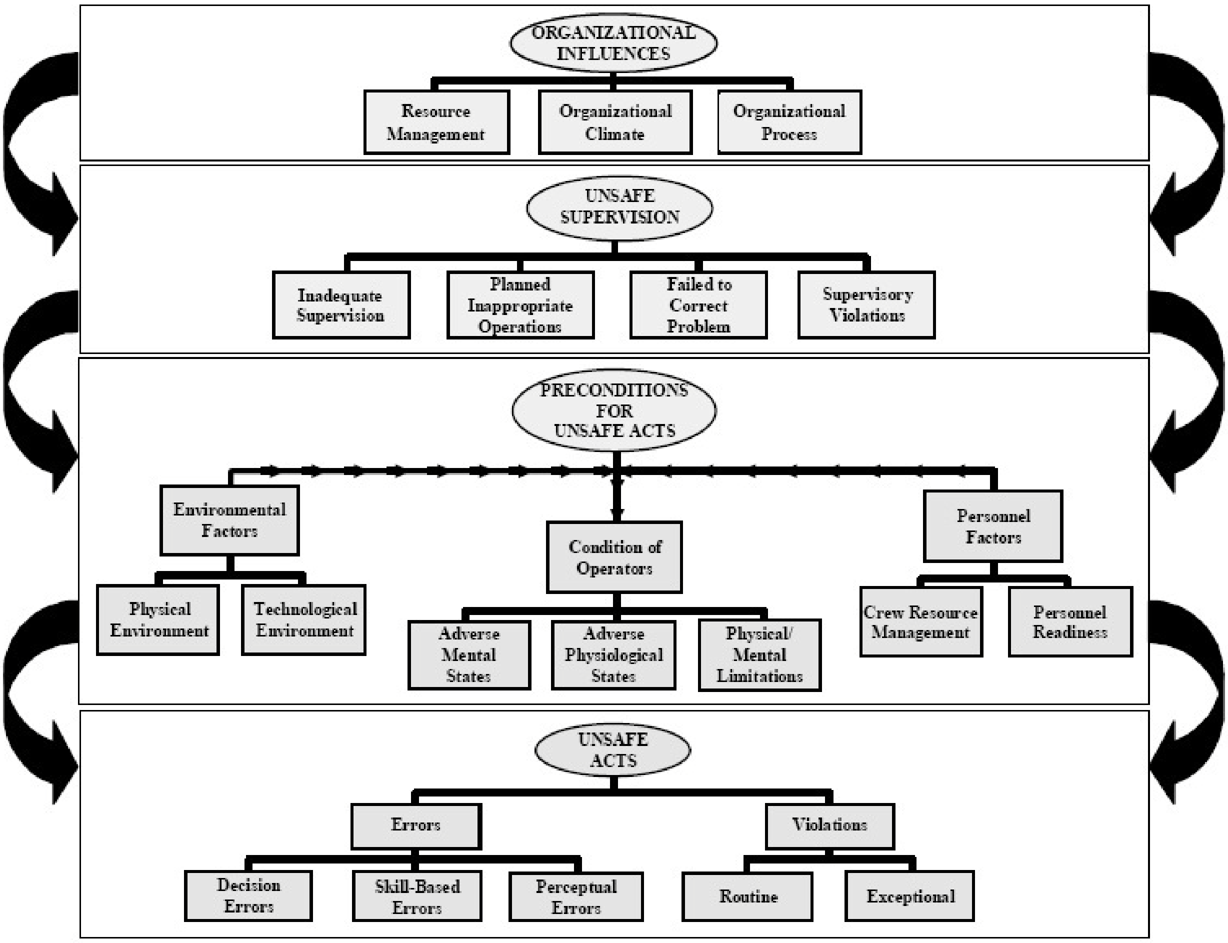

Figure 1. HFACS system (Wiegmann & Shappell, 2003)

3.3 Unsafe supervision

If the shipping company does not care for the additional training of seafarers, does not control the interpersonal relationships on the vessel and the quality of the working environment, the navigator's work is more likely to be subpar.

3.4 Organizational influences

Misguided management decisions (e.g., by the shipping company) directly affect supervisors, as well the state and actions of "firstline" operators. Company policies may force seafarers to work more and faster, reduce the number of employees to an unsafe minimum, purchase navigational equipment of inferior quality, and/or lead to a poor working atmosphere (mobbing, lack of communication, etc.). Analysis of accidents has shown that fatigue and stress are largely due to pressure exerted by the shipowners on seafarers.

4. CONCLUSIONS

Conducting a vessel is a life/dynamic process, which may change steadily or instantaneously (tremendous complexity can 'appear' in a moment). The IMO and other bodies are continuously developing and proposing various instruments (Conventions, Codes, Regulations...) to overcome and minimize human errors aboard the ship. Neither implemented legal instruments nor utilized technological achievements have tremendously reduced human errors. For example, the general view concerning the implementation of the ISM Code is negative because seafarers believe extra paper work adds time consuming tasks that must be completed at times at the expense of marine safety.

With the latest Amendments to the STCW safety culture is further advanced and it is believed that along with the additional training regarding leadership and maritime resources management maritime safety can be improved. Further achievement or knowledge can be obtained by studying the nature of human error case by case. At the same time, more recognition of the complexity of accidents has led to such tools as the HFACS system, which, importantly, helps to relocate the concept 'human error' into a context that includes a greater number of humans, in particular those who have the most control over the entire system of maritime operations.

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WHAT BRINGS THE NEW COMMUNICATION ON THE EUROPEAN PORT POLICY?

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ABSTRACT

In its Communication on the European Port Policy in 2007 the European Commission identified the main challenges faced by the port sector. These challenges are related to port performance and hinterland connections, the need to modernize ports while respecting the environment, the lack of transparency in the use of public funding, restricted market access to port services and issues related with organization of labour in ports. The approach taken in 2007 was to regulate those issues by means of horizontal legal instruments and soft law measures. Since then, some progress have been made and number of developments have taken place. But some issues related to the functioning of the port sector identified in 2007 are still relevant today. After a long and detailed consultation process the Commission has come to the conclusion that the review of the port policy should address issues such as connection ports to the trans-European network, modernization of port services, attraction of investments to ports, promotion of social dialogue, raising the environmental profile of ports, encouragement of innovation in ports. Those issues are being analyzed in this paper.

KEY WORDS

port policy, modernization of port services, attraction of investments, promotion of social dialogue, environmental protection, encouragement of innovation

1. INTRODUCTION

Creation of the European port policy began in 1974 with the establishment of Port Working Group composed of representatives of port authorities and chaired by the European Commission. That was possible only after the judgment by the European Court in the French Seamen's case,[1] which confirmed that the general freedom and competition principles laid down in the Treaty of Rome were applicable to the transport sector as a whole, and thus also to the port sector. In 1977 the Port Working Group delivered a report describing the legal and financial status of European ports. In 1980 the Commission still considered that special measures for the port sector were unnecessary and that the common transport policy was sufficient. In 1990s the legal status of ports draw attention again following a number of decisions by the European Court and Commission concerning restrictions of the freedom to provide services and

[1] Case 167/73 *Commission v France* [1974] ECR 359.

freedom of competition in Italian ports.[2] Meanwhile a comprehensive European regulatory framework was developed for the liberalization of various transport sectors (road, rail, air, inland and maritime shipping). [3]

The European Commission announced liberalisation of the port services market in 1997., in its *Green Paper on Sea ports and Maritime Infrastructure*. In February 2001., the European Commission adopted a Communication to the European Parliament and Council entitled *Reinforcing Quality Service in Sea Ports: A key for European Transport*. Added to this Communication, was a proposal for a *Directive on market access to port services*. This proposal was the first attempt at designing a specific European legal regime for port sector. The proposal for the enactment of a specific European Directive on port operations was, in itself, a positive move because it wasn't always clear how provisions and principles of primary European Community law should be applied to the port sector. The available case law on port services offered partial solutions. The Directive could codify available case law and rules from managerial practice in Member States and ports that operate transparently and in conformity with market conditions. In that way the Directive would contribute towards more uniform enforcement of European law, and it would be useful instrument in creating legal certainty for the benefit of port authorities, operators and users. It could help to create preconditions for open competition within and between ports without compromising operational autonomy of the ports and safety in the ports. But, from the beginning, the Directive met with resistance in certain port circles. Broad public opposition to the Directive began after trade unions of dock workers in some Member States had realised that existing national legislation on dock work would be compromised. This was the main reason why the first proposal for the Directive was rejected by the European Parliament.

In October 2004 the European Commission presented the second proposal for an EU *Directive on access to the market for port service*. In the second proposal some significant shortcomings of the first proposal were still apparent. The second proposal was also more complex and contained many ambiguous and illogical provisions that could compromise legal certainty. It was rejected by the European Parliament in January 2006.[4]

The next step towards Common European port policy was made in 2007 with the *Communication on a European Ports Policy* from the European Commission which provides guidance on the interpretation of Treaty rules to the port sector and announces a number of forthcoming measures and soft law instruments. Six fields of action were introduced, these include port performance and hinterland connections, expanding port capacity while respecting the environment, modernisation, level playing field with the clarity for investors, operators and users, structured dialogue between ports and cities and work in ports. The positive difference comparing to the previous attempts to formulate a common European ports policy was that many issues which were never addressed on EU level in the past were analysed in that Communication.[5] The approach taken in 2007 was, because of the great diversity of the European ports, to regulate those issues by means of horizontal legal instruments and soft law measures. Since then, some progress have been made and number of developments have taken place. But some issues related to the functioning of the port sector identified in 2007 are still relevant today. After a long and detailed consultation process the Commission has come to the conclusion that the review of the port policy should be made and *Communication from the Commission-Ports: an engine for growth*[6] is the result of that process.

[2] These are, for example, decisions in the following cases: Case C-179/90, *Merci Convenzionali Porto di Genova v Siderurgica Gabrielli,* [1991] ECR I-5889, case C-343/95, *Diego Cali & Figli v Servizi Ecologici Porto di Genova,* [1997] ECR I-1574, case C-266/96, *Corsica Ferries France SA v Gruppo Antichi Ormeggiatori del Porto di Genova & Others,* [1998] ECR I-3949, case C-18/93, *Corsica Ferries Italia Srl v Corpo dei Piloti del Porto di Genova*[2] [1997] ECR I-1574.

[3] See, Bulum, B.: *Pravo tržišnog natjecanja Europske zajednice i morske luke,* Zbornik pravnog fakulteta u Zagrebu, br. 1-2, 2008., pp. 617-661.

[4] See, Van Hooydonk, E.: *The Europen Port Services Directive: the Good or the Last Try?*, Il diritto maritimo, Genova, Vol. 1 2006., pp. 66.

[5] See, Radionov, Nikoleta *et al*, *Europsko prometno pravo*, Pravni fakultet Sveučilišta u Zagrebu, 2011., str. 266-269.

[6] COM (2013)0295 final.

2. COMMUNICATION ON PORT POLICY FROM 2013

In its Communication from 2013 European Commission reviews the European Port Policy from 2007. It identifies eight set of EU actions needed to further unlock the potential of ports. Ports can contribute significantly to the economic growth and competitiveness of European industries because 74% of goods imported and exported and 37% of exchanges within the Union transit through seaports. The availability of adequate port infrastructure, good performance of port services and a level playing field are vital if the Union wants to remain competitive in the global markets and improve its growth potential.
Significant investments are needed to adapt port infrastructure and facilities to suit growing transport and logistics requirements for the next decade during a time of scarce public funding. It is a big opportunity for the EU to increase options available to transport operators and shippers and create growth and jobs in coastal areas and across the Union as a whole.

The approach taken in Communication on the European Port Policy in 2007 was to address port issues by means of horizontal instruments and soft measures on the access to the market of port services and financial transparency. Since then, a number of changes have taken place. In that sense very important is Commission proposal for a Directive on Concessions in 2011.[7] This proposal applies to concession contracts granted in ports, although some form of awarding contracts such as land leases are not covered. Furthermore Commission proposed new guidelines for the development of the trans-European network (TEN-T)[2] and the Connecting Europe Facility (CEF) which provide a common planning tool for more targeted investments. Also the economic crisis has led some Member States to introduce reforms of their port sector by the need for fiscal consolidation.

The biggest problem at this moment are the soft measures proposed in 2007 on a fair market access and on transparency have had little or no impact on ports. There is no single level playing field for the sector and the interventions at national level threaten to fragment the internal market of the EU even more. Consequentially, most of the issues identified in 2007 are still relevant today.

Besides, infrastructure investments in European ports are required. Ports need new facilities such as cranes, new passenger terminals, new operational procedures and good coordination of the different services provided by the port actors inside the port and outside the port in the context of door-to-door logistics.

Additional challenge for EU ports, and especially the ports of the trans-European network, is service of hinterland and a catchments area which go beyond their local and national borders. Diversity of governance models and ownership structures is an important feature of the European port system, with no two ports operating in exactly the same way. In this document European Commission stresses that it will respect that diversity and does not seek to impose a uniform model for ports.

3. THE NEW STRATEGY FOR PORTS

In 2011 EU ports handled 3.7 billion tonnes of cargo. According to the latest projections in a low growth scenario, it is estimated that volume will increase by 50% by 2030. All ports across the trans-European network will be needed to help accommodate this growth. While some European ports are among the most performing ports in the world, other ports continually underperform. Today, 20% of the goods coming to Europe by sea pass through just three ports. High performing ports cannot optimally develop their maritime connections with other EU ports, increasing the risk of congestion in their hinterland, in particular road congestion.

Ports need to adapt to new challenges which include:

- Increased size and complexity of the fleet, in particular ultra-large container ships, new types of Ro-Ro ferries and gas-carriers; [8]

[7] COM(2011)897 final.

[8] For example, a leading European shipping line has ordered 20 ships for 2015 with a capacity of 18,000 Twenty Foot Equivalent Units (TEU). This is the equivalent of a continuous lane of heavy goods vehicles from Rotterdam to Paris.

- Stricter requirements on environmental performance and alternative fuels (e.g. cold ironing and LNG;

- Growing cruise industry and logistics and distribution systems have led to an increased need for value added services within the area of the port; and

- Shift from oil and refined products towards gas created a need for significant gasification facilities in ports.

The EU strategy is founded in the principle of avoiding unnecessary interferences with ports that perform well, helping ports which underperform to implement good practices, while fully respecting diversity of ports.
After a consultation with all interested parties, the Commission has come to the conclusion that the review of port policy should pursue the following actions to address the issues raised above.

3. 1 Connect ports to the trans-European network

The important aim is to connect ports to the trans-European network. Efficient EU funding will be possible in 2014-2020 under the new TEN-T guidelines, the Connecting Europe Facility and the new approach of the Structural Financial Instruments. The new TEN-T guidelines have identified the multimodal core network on the basis of an objective methodology. Ports play an important role in this methodology, as they define nodes which are connected by multimodal core links.

The TEN-T proposal includes 319 ports, 83 in the core network and 236 in the comprehensive network. The new core network corridors are the tools which will help develop the core network by 2030 and they start or end in core ports[.[9] Maritime transport infrastructures of the TEN-T have certain requirements, in particular: Connection of TEN-T ports with railway lines, roads and, where possible, inland waterways; availability of at least one terminal in the port open to all operators in a non-discriminatory way and applying transparent charges; and adequacy of sea canals, port fairways and estuaries for connecting adjacent seas or providing access from the sea to maritime ports.
In this context as Commission action number one Particular consideration will be given to projects corresponding to investments identified in the future corridor development plans to be defined by the Coordinators within corridor structures in 2014 as foreseen in the guidelines for the development of the TEN-T. In the governance of corridors which will be set-up in the framework of guidelines for the development of the TEN-T, ports will be encouraged to act as enablers of inter-modality, for instance by taking the necessary arrangements in order to provide information on traffic flows allowing the better organisation of intermodal logistics.
Ports will also apply for financing through EU funding. Until now, due to a lack of prioritisation and clear criteria EU funding for ports has lacked focus and insufficient attention has been given to the coordination with hinterland access infrastructure.[10]

In order to be eligible for funding for the period 2014-202,[11] the regulation establishing the Connecting Europe Facility (CEF) requires ports to belong to the core network or to a Motorway of the Sea linking a port to the core network. It also places importance on the complicated cost/benefit analysis of projects.

In this context as Commission action number two attention will be given to projects which contribute to the coordinated development and management of ports, rail and inland waterways infrastructures and those which enhance port and shipping environmental performances.

In partnership with the Member States, the Commission will strengthen the alignment of transport projects funded under the Structural and Cohesion Funds with the TEN-T, promoting

[9] Corridors are proposed in the Connecting Europe Facility (COM(2011)650).

[10] From 2007 to 2012 from the TEN-T budget €244.6 million was granted to ports, approximately 4% of the total TEN-T budget available. Of this, 58% was devoted to develop port capacity, 27 % to develop access to the hinterland and 15% to green technology. As regards cohesion funding, the Court of Auditors has been particularly critical of the lack of coordination with hinterland access.

[11] Commission has presented its proposals for the 2014-2020 Financial Framework in June 2011 (COM(2011)500).

priority to projects concerning port access and hinterland connections.

3.2 Modernise port services

The quality and efficiency of port services are essential for the performance of the port. Usually, total port costs can account for a significant proportion of the total costs associated with the logistics chain. For some trades in traditional ports, costs of ports and ports terminal operation may exceed 30% of the total door-to-door logistic costs. In terms of internal reparation of costs, port infrastructure charges represent between 5-10%, technical-nautical services between 10-15%, cargo-handling between 45-60% and other charges and ancillary services between 10-30%.[12]

In the past, port services have operated within frameworks characterised by exclusive rights or de facto monopolies of a public or private nature. Restrictions to the freedom to provide service are acceptable only when justified by objective reasons, such as the lack of space in ports or reasons of public service, and as long as they do not lead to abuses However, in such cases the providers of port services should be designated according to a procedure which ensures transparency, equal access and an efficient use of public resources.

To guaranty a fair market access the Regulation proposed in parallel to this Communication, establishes the freedom to provide services in ports, except for cargo handling and passenger services on which Directive on Concessions will be applied.[13] In cases of a limitation in the number of providers of port services, the provider shall be designated after an open, transparent and non-discriminatory procedure.

In this context as Commission action number three for cargo-handling and passenger terminal concessions, the Commission will ensure that the horizontal Directives on Concessions (expect to be adopted) and Public Contracts[14] are fully applied.

Port activities that constitute economic activities are subject to competition rules. Agreements that restrict competition and abuses of dominant position, as defined in Articles 101 and 102 TFEU respectively are prohibited. The Commission and national competition authorities may therefore assess the conduct of providers of port services operators.

The Regulation proposed in parallel to this Communication introduces common rules to ensure supervision by an independent authority of the port service charges levied by operators which have exclusive rights and which have not been designated through a procedure which is transparent and non-discriminatory.

In recent years, a number of EU initiatives to reduce formalities in ports have been put in motion. Those initiatives should be pushed forward in order to achieve better port services.

In this context as Commission action number four the Commission will further develop its initiatives on:

-"Blue Belt" which aims at reducing the administrative burden for EU goods carried by vessels sailing between EU ports;

- "e-maritime" initiative to promote the use of electronic information for the reduction of administrative burden; and

-“e-Freight” initiative which aims to facilitate the exchange of information along multimodal logistics chains and which will contribute to improve port efficiency as ports are important multimodal platforms.

3.3 Attract investment to ports

Transparent funding in ports is one of goals of this Communication. The lack of transparency

[12] See, *Communication from the Commission-Ports: an engine for growth, pp.7.*

[13] Bulum, Božena, Oršulić, Ivana, Skorupan-Wolff, Vesna: Award of the concession contracts in the law of the European Union (Review), *International Maritime Science Conference, Split 2013.*, pp. 133-139.,

[14] Proposal for a Directive on the award of concession contracts (COM 2011) 897 final and Directive 2004/17/EC coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sector and Directive 2004/18/EC on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts.

of public funding in ports creates uncertainties for investors. Attracting both public and private funding requires a simple and clearly defined framework. Regulation proposed in parallel to this Communication will introduce rules ensuring the transparency of financial relations between the public authorities and the port authorities. Also Member State very often decide to give public funds to ports: for regional development purposes or for addressing market failures in cases where important port services present little interest for operators.

In that sense as Commission action number five is predicted the modernisation of its State aid rules for all economic sectors, including ports.

Efficient pricing is a prerequisite to efficient port infrastructure investments. As a step towards more efficient pricing, the Regulation proposed in parallel to this Communication introduces a degree of autonomy enabling Port Authorities to establish the structure and level of port dues according to their own commercial and investment strategy. It is very important that prices are transparent and applied without discrimination to all operators.

3.4 Promote the Social Dialogue

European Ports employ, directly and indirectly, more than 3 million people. Ports must offer good working conditions and improve the quality of the working environment to attract skilled personnel. Industrial disputes that affect relations may damage the image and competiveness of ports.

Depending on the type of terminal, port labour can represent a significant share of the operational costs for terminal operators. It could be 15%–20% at dry bulk terminals; 40%–75% at general cargo terminals. After a long negotiation process, the social partners of the port sector have asked for the creation of a port sector Social Dialogue Committee in line with the competences recognised in the Union by Article 152 of the Treaty on the Functioning of the European Union (TFEU). This is the first time that such a dialogue has been requested in the sector and will allow for key issues, including those that may lead to contractual relations to be addressed. If the social partners so desire, they may then request jointly that agreements concluded by them at Union level be implemented by a Council decision on a proposal from the Commission in accordance with Article 155(2).

In this context as Commission action number six, in line with Articles 151 and 154 of the TFEU, the Commission is willing to facilitate the Social Dialogue at Union level by providing technical and administrative support.

Port work is an occupation with a high risk of accidents and health implications for workers, because of that every port needs to develop working practices that safeguard the safety and health of port workers. Technological changes and new transport and logistics needs will require innovative port operations and the need for employees with the high skills, training and qualifications to exploit all the advantages provided by the new technologies.

In this context as action number seven the Commission will launch a project to examine health and safety, training and qualification challenges in EU ports. Social partners will be full involved in this action.

3.5 Raise the environmental profile of ports

Port operations have significant impacts on environment in terms of emissions. Ports located close to cities may often have to balance the development and management of port activities with the preservation of natural habitats and the quality of urban life. [15]

The Commission published guidelines in 2011 on implementing the Birds and Habitats Directives in estuaries and coastal zones.[16] Some ports reward operators who anticipate or exceed the application of mandatory environmental

[15] See, Van Hoydonk, E.: Soft Values of Seaports, A Strategy for the Restoration of public Support for Seaports, Garant, Antwerp-Apeldoorn, 2007., pp.157.

[16]http://ec.europa.eu/transport/modes/maritime/doc/guidance_doc.pdf

standards and promote the use of door-to-door low-carbon and energy efficient logistics chains, e.g. short sea shipping. A more consistent application of such rewards in a way of infrastructure charges at a European or regional level would help to increase their effectiveness.

In that sense as Commission action number eight, to encourage a more consistent application of environmentally differentiated port infrastructure charges, the Commission will propose principles for environmental charging and promote the exchange of good practices by 2015.
The Commission is planning a review of the Directive on port reception facilities in 2013/2014 with the view to further improving the effectiveness and efficiency of the system.

3.6 Encourage innovation

The global port industry has changed significantly. Ports are becoming more and more dependent on technological innovations across the entire logistics chain.

The competitiveness of European ports will depend on their ability to innovate in terms of technology, organisation and management. Research can also be used as a way of addressing social concerns. These can range from health and safety risks for port workers to the need to manage and reduce the impacts of port activities on the environment and the urban areas.

In the context of the implementation of the Horizon 2020 programme to support research, development and innovation from 2014 to 2020 is very important.

4. CONCLUSIONS

The scope of the proposed measures and actions predicted in the *Communication from the Commission Ports: an engine for growth* will cover more than 330 seaports (all TEN-T maritime ports) differing substantially in many aspects such as size, governance and organizational structures, markets which are serving, geographical location, competitive position and market power, way of financing port investments and operations and port tasks. [17]All this differences make it very difficult to develop a legislative set of rules for port sector. This is very clear from the prior experience in creating European port policy.

On the other hand, while some European ports perform well, structural problems regarding the insufficient connectivity to the hinterland, the lack of transparency in the use of public funds, market entry barriers, outdated governance models and excessive bureaucracy affect the performance of many other ports. In this Communication and its accompanying documents European Commission addressed those problems and prescribed actions for dealing with them.

Furthermore, ports are faced with challenges of tomorrow; growing volumes in ports are predicted to rise by 50% by 2030, ever-increasing ship size and costs of the subsequent adaptation of port and hinterland infrastructure, an increasing societal (city development needs) and environmental pressure, further globalisation, transition to alternative fuels and others.[18] Because of that a regulatory frame for ports sector, which fully considers the specificity of each port, is necessary.

In this Communication on port policy Commission predicted eight actions for archiving goals set in it. It is obvious that this goals are very similar to those put in Communication on port policy from 2007. Actions predicted include bringing just one legislative instrument what confirms the fact that port sector, because of its diversity is not so easy to regulate.

In order to monitor the progress of the implementation of this reviewed European Port Policy, the Commission has initiated a project that will develop and collect a set of generic European indicators on the performance of ports.

Legislation proposed in parallel to the European Parliament and Council is designed to tackle the key issues related to the market access to port

[17] See, Van Hoydonk, E.: Soft Values of Seaports, A Strategy for the Restoration of public Support for Seaports, Garant, Antwerp-Apeldoorn, 2007., pp.15.

[18] See, *Communication from the Commission-Ports: an engine for growth, pp.4.*

services and the financial transparency and autonomy of ports.

The Commission will address the remaining issues mentioned in the Communication and check their progress. Those issues include: fully use the new TEN-T guidelines and EU financial instruments to improve the connections of ports to their hinterland and promote the European Port Policy, monitor that existing EU law applicable to concession and ports is correctly applied, provide the necessary administrative and technical support to the Social Dialogue at Union level, present new initiatives to further simplify the administrative procedures in ports, notably customs procedures and promote environmental technologies and short sea shipping through common principles on the variation of port infrastructure charges.[19]

Our opinion is that this Communication is a step forward to more transparent and more efficient but also environment friendly functioning of ports and that it could encourage innovation and social dialog in ports, but time will show how this measures will be implemented.

[19] See, *Communication from the Commission-Ports: an engine for growth, pp.13.*

MARITIME MEDICINE AND MEDICINE FOR SEAFARERS

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ABSTRACT

Maritime medicine and medicine for seafarers are not the same. Maritime medicine is specialization for medical doctors. Medicine for seafarers is some part of medicine which some crew members (master, chief mate) need to know. Seafaring has always been considered a dangerous occupation with a higher morbidity and mortality than in most occupations ashore. Crews of merchant ships are exposed to extremes of weather, hazards connected with the operation of mechanical equipment, toxic cargoes and toxic substances used aboard. Their health is affected by noise, vibration, smoke inhalation, fatigue, overwork, and other exposures. Travel to the tropics results in exposure to exotic diseases as malaria, and other infections. Due to the nature of their work, seafarers spend long periods of time away from their families and, therefore, represent a group at risk for sexually transmitted diseases, including HIV infection. Seamen are swept overboard by heavy seas; they can die as a result of vessel casualties (foundering, capsizing, explosions, fires).

The continuing medical challenges of injury and illness on board remained the same as before, but better communications have enabled tele-medical advice to be readily obtained in all parts of the world's oceans. The introduction of antibiotics and better antimalarial drugs has further reduced the threat from infectious disease. Physical, chemical and biological health hazards as well as the ergonomic ones related to physical job demands, and psycho-social ones from isolation, organization pressures and complex work demands remain or have increased because of reduced crews and tighter schedules.

In case of sudden illness or an accident and injury during the ship's voyage, the chances of receiving proper and effective treatment are not as good for seafarers as for a worker on shore because of lack of direct and prompt access to qualified medical assistance. Due to the above mentioned, seafarer's health education and training of seafarers to provide basic medical services on board are mandatory.

Maritime medicine has important areas of shared interest and competence with occupational medicine, primary health care, emergency medicine, public health, tropical medicine, and travel medicine.

KEY WORDS

Maritime medicine, medicine for seafarers, health risks

1. MARITIME MEDICNE

The definition of "maritime medicine" covers a large number of issues, such as: the environment of seafaring (effects of microclimate and macroclimate, noise and vibration aboard ship on seafarers, other work related exposures); conditions of work and life on merchant, passenger or fishing ships or on oil rigs; sanitary problems on ships; nutrition and food hygiene aboard ship; pathology of workers employed on ships (diseases, accidents and injuries); toxicology of seafaring; exotic diseases; health problems of navy personnel; personal hygiene of seafarers; vaccinations of ship's crew members and other preventive interventions as their health education; training of seafarers in providing basic medical services on board ship
during voyages; health standards for work at sea and medical examinations of seafarers and radio medical advice for ships.
In the past, seafarers have been the source of transmission of infectious diseases from country to country. Nowadays, there is a similar problem with HIV/AIDS infection. The research published show that seafarers, more often than the rest of the population, contract HIV/AIDS infections and introduce it to the population of the country which they inhabit.

2. WORKING AND LIVING ENVIRONMENT OF SEAFARERS AND FATIGUE

Living abroad can also pose strains from unfamiliar diets and climates, from limitations in accommodation and from crewmembers not understanding and being empathetic to one another. Distance from familiar places and loved ones is also often an important contributor to feel bad.
On-board periods are often long and leisure time choice of activities is usually limited. Much of leisure time is thus spent on meals, snacking, resting and corresponding with family or friends, whereas only a minority of seafarers engage in physical fitness activities. Limited space on board makes running or walking impossible. Many jobs on modern vessels have become sedentary or require only moderate levels of energy expenditure, the extent of physical inactivity is alarmingly high.
It is the fact that nutrition quality is often limited and ships often lack professional cooks. The results are overweight seafarers.
On the other hand, the development of technical standards of building and fitting of vessels, as well as the competitiveness of the shipping market have caused saving on labour, i.e. cost reduction on account of reduced number of crew. The decrease of such costs has also included the hiring of a cheaper labour force from the Far East and countries of Eastern Europe.
Another trend accompanying the world shipping industry is the reduction in the number of crew in accordance with the "safety minimum", which means minimum manning document, determined by the law of the country of vessel's registry.
Reduction in the number of crew greatly affects the crew efforts because the number of crew is often disproportionate to the number of functions that are in the unit of time. Fatigue is also contributed by poor work organisation, inadequate work position, long-lasting and intensive work and insufficient training. Poor nourishment, insufficient motivation, various illnesses, discontent with private life and poor interpersonal relations, and contract duration are factors which also contribute to fatigue.
Fatigue was consistently associated with poor-quality sleep, negative environmental factors, high job demands and high stress. Other
important factors included frequent port turn-rounds, physical work hazards, working more than 12 hours a day, low job support and finding the switch to port-work fatiguing.
Evidence suggests that large numbers of seafarers work hours in excess of those allowed by current legislation, and that under-recording of working hours is associated with higher levels of fatigue.
Some researchers have also shown that the consequences of fatigue are not only
felt in terms of impaired performance and reduced safety but decreased well-
being and increased risk of mental health problems, also known to be risk factors for future chronic disease.
Acquaintance with all of the above mentioned is necessary to be able to understand the processes and pathophysiology of different diseases accompanying seafaring professions, and this is the subject of research of maritime medicine.

3. INFECTIOUS RISKS WITH SEAFARERS

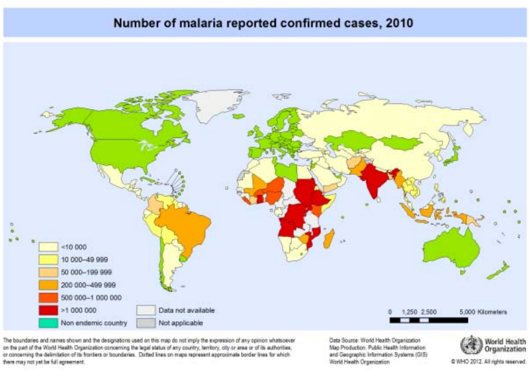
Seafarers are a unique occupational group in that their travels to different parts of the world expose them to different types of infections, an exposure comparable only to airline staff. Quite different to the situation in the past, seafarers rarely get an opportunity to visit places far away from the ports of call, due to the rapid turn -round time at ports. However, they are still exposed to infections at ports of call. Respiratory illness is the most common cause of presumably communicable diseases aboard cargo ships and may cause outbreaks of considerable morbidity.

Recent studies conducted mostly in Europe, have shown concerns on malaria, hepatitis A, hepatitis B, hepatitis C, HIV and gastro-intestinal infections.

Because of the nature of their work seafarers spend long periods of time away from their families and, therefore, represent a group at risk for sexually transmitted diseases, including HIV infection.

Malaria is endemic in 92 countries with small pockets of transmission occurring in further six countries (WHO 2012). Transmission of malaria depends on environmental factors: temperature, humidity and rainfall. If they are favourable for breeding of the anopheles mosquito vector, transmission occurs. It may be seasonal (in temperate zones) or perennial, in hot and humid climates.

Seasonality of transmission should be taken into consideration when advice is given to seafarers. However, it is not an important factor for assessing the risk of infection of seafarers in hyper-endemic coastal areas in Africa and Asia, where transmission continues throughout the year.



Source:http://reliefweb.int/sites/reliefweb.int/files/resources/map_2264.pdf

4. LABOUR STANDARDS

The Maritime Labour Convention, 2006 (MLC, 2006) establishes minimum working and living standards for all seafarers working on ships flying the flags of ratifying countries.

Convention No. 180, which was adopted by the 84th (Maritime) session of the International Labour Conference (Geneva, 1996), introduced

for the first time comprehensive international provisions to establish limits on seafarers' maximum working hours or minimum rest periods so as to maintain safe ship operations and minimize fatigue.

Regulation on *Watchkeeping Arrangements and Performance of Other Duties on Board Ships for Assurance of Safety of Navigation and Marine Pollution Protection*, prescribe that the maximum hours of work of master, officers and other members of crew shall not exceed 14 hours daily, and that the master, officers and other members of crew shall have minimum hours of rest, not less than10 hours in any 24-hour-period, and 77 hours in any 7-day-period (168 hours).

The same Regulation prescribes that the hours of rest may be divided into no more than two periods, one of which shall be at least 6 hours, and the interval between consecutive periods of rest shall not exceed 14 hours.

5. MEDICAL CARE / MEDICINE FOR SEAFARERS

An ill seafarer or one who is injured at sea does not have ready access to professional health care. Ships which do not carry a medical doctor shall be required to have either at least one seafarer on board who is in charge of medical care and administering medicine as part of their regular duties. Persons in charge of medical care on board who are not medical doctors shall have satisfactorily completed training in medical care. Hence, there must be medical equipment available, a person trained to use it and ready access to information on the prevention, diagnosis and treatment of a disease. Normally this is in the form of a manual and this is supported by international arrangements for access to radio medical advice all over the world.

The Maritime Labour Convention requires all ships to carry a medical chest and medical equipment, while the IMO STCW Convention addresses medical competences required for seafarers on board. The aim is to ensure that, in emergencies, ship based medical care is similar to that found ashore.

The STCW Convention from 1978 is a very important convention from the maritime health professional's point of view.

It is the convention regulating the pre-sea medical and periodic examinations of seafarers, despite being very general in its approach. It also set up the standards for emergency medical training requirements for different groups of personnel on board.

Training in medical emergency procedures and medical care is another very important issue for the STCW Convention. The training requirements differ according to position on board.

On the lowest level is that of "personal survival techniques". This is obligatory for where anyone signing on to a ship, as is the next step "elementary first aid".

The next level is that of "medical first aid", which is obligatory for persons with a safety function in certain positions on board, usually working in the master and deck and engine departments.

The highest level is "medical care". This course aims at training dedicated personnel to carry out medical care on board, and is obligatory for nautical personnel. While the responsibility for medical care always lies with the ship's master, it is usually given to the 1st officer to handle all practical cases.

The knowledge and skills of seafarers on board a ship regarding medical competence are covered by the STCW Convention requirements for training level of nautical personnel as necessary for their certificates.

6. MEDICAL ADVICE AT SEA

The fact that on board merchant ships there are no medical doctors illustrates unfavourable conditions in which ill seafarers are found, helpless in the open seas, hundreds of miles distant from the closest doctor. The information that future seafarers in their regular education master the basics of first aid and medical care only partially mitigates the problem because the knowledge acquired is rarely refreshed, while the extent of medical aid which should be administered by ship's officers often extends beyond their professional abilities.

Due to the situation described the need has long been realized for seafarers to establish a fast contact with a doctor to consult hi/her about the diagnosis, treatment and care of the diseased. Conditions for such contacts have been established only after the introduction of radio on board ships and increase in the range of marine radio stations.

Medical Advice at Sea Recommendation from International Labour Organization (ILO) was the first ILO document discussing radio medical advice for seafarers. It is a rather short document, but very important. At this time several shipping nations had already realized the need and established radio medical services based on risk assessment and professional evaluation, with the CIRM in Rome as the oldest and best known of them all.

7. THE SHIP'S MEDICAL CHEST

ILO Maritime Labour Convention 2006 stipulates that all ships shall carry a medical chest, medical equipment and a medical guide.

The ship's medical chest is mentioned in several ways. To sum up, we can say that ships must have adequate medical supplies that are periodically inspected, kept in good condition, and are ready for use whenever required. Quantities will depend on duration and destination of the voyage, the number of crew members, and the nature of the cargo.

World Health Organization (WHO) has developed a recommended list of medicines, based on professional assessment and best practice, linked to the International Medical Guide for Ships (IMGS) and published as an appendix to the IMGS.

8. INTERNATIONAL MEDICAL GUIDE FOR SHIPS

The International Medical Guide for Ships shows designated first-aid providers how to diagnose, treat, and prevent the health problems of seafarers on board ship. This Guide is a standard reference for training courses of medical first aid and medical care, and is designed for use by all crew members charged with providing medical care on board.

Since its first publication in 1967, the International Medical Guide for Ships has been a standard reference for medical care on board ships. The second edition, written in 1988, has been translated into more than 30 languages, and has been used in tens of thousands of ships. The third edition, written in 2007, contains fully updated recommendations aimed to promote and protect the health of seafarers, and is consistent with the latest revisions of both the WHO Model List of Essential Medicines and the International Health Regulations (2005).

9. CONCLUSIONS

Medicine for seafarers is a certain amount of knowledge and facts accumulated by seafarers in the course of their education and training, required for administering aid to the diseased and injured seafarers in situations in which professional assistance is out of reach and available only via radio-medical advice or other means of telecommunication including, in the best of cases, telemedicine.

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FINANCING THE SMALL AND MIDDLE-SIZED MARITIME SHIPPING COMPANIES IN THE REPUBLIC OF CROATIA

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ABSTRACT

By applying the theories, concepts and techniques of the financial management, the financial managers attempt to secure indispensible financial resources required to pay off mature debt, as well as finance the company's capital investments. Due to the recession limitations and insufficiently developed financial markets, in an effort to invest and maintain competitiveness of the fleet, the financial managers of maritime companies are often forced to make decisions that give rise to increasing financing costs, thus unfavourably influencing the company's capital structure. This paper, using the multiple case studies method, based on the sample of six (6) small and middle-sized maritime shipping companies in the Republic of Croatia, researches the abilities of the companies with regard to investing and financing the capital investments. Also, it aims at determining whether the basic characteristics, such as the company's size, structure, ownership dispersal, capital structure, market and the like, impact the sources of financing capital investments.

KEY WORDS

financial management, capital investment, financing sources, maritime shipping companies

1. INTRODUCTION

After the extensive pre-recession investments into the restoration and fleet development, which resulted in increased demand and increased prices of new and used cargo ships, the shipping companies are facing the diminished demand for freight transport, the lowering of incomes and cash inflow, all due obligations toward investors and the growth of current expenditure costs. Numerous factors have influenced the growth of current expenditure costs for shipping companies, particularly the following: (1) the increasing price of energy resources, as a direct consequence of energy resources market instability; (2) the increase of security costs, influenced by the frequent pirate attacks inside the less secure areas of operations, as well as the (3) illegal competition from the companies that, while employing lower security and ecological standards also decrease the shipping fees, thus forcing out competitors from the market (Sulimovici, 2010).

In these novel conditions, the financial managers of the shipping companies hold a quite demanding role, for they are required to find out quality financial solutions, thus ensuring the adequate decision making regarding the capital investment, maintaining liquidity, and finding investment projects or financial instrument investments. The research regarding the financial decisions and capital investment choices inside the small and middle-sized companies is realised using the multiple case studies method, on the sample of small and middle-sized shipping companies in the Republic of Croatia.

2. THEORETICAL OVERVIEW

By applying the theories, concepts and techniques of the financial management, the financial managers attempting to secure indispensible financial resources required to pay off mature debt, as well as finance the company's capital investments represent a significant factor of success for the company's business success. The financial manager should secure assets on the global markets, ensure the establishment of financial plans, the financial control and performance measurement, ensure an optimum managing of the cash flow and the current assets, as well as ensure good relations with the creditors and the investment public (Vidučić, 2011).

Although the finance represents the lifeblood of business entities, the financial management holds as a central element for the functioning of a company (Vidučić, 2011), for all the decisions made by the financial manager have to be consistent with the general business and financial strategy and in accordance with the strategic business and financial goals, which are laid out by the adopted business plans. Some of the basic business goals for the company include the maximization of profit, the increase of the company's value (through maximizing the shareholders wealth or maximizing the stock price), and long-term survival of the company and the maximising of the employee's wages (Mramor and Valentincic, 1999). The financial planning represents a sound foundation for establishing adequate short-term and long-term financial decisions.

According to the neoclassical theory, the shareholder interests remain as the most important factor when establishing financial decisions (Mramor and Valentincic, 1999). The company that has a goal of maximising wealth carefully monitors the fluctuations of the stock price. During that entire period, the stock price is determined on the basis of appraised value, fluctuations and the risk of cash flow expected during the prolonged time frame (Vidučić, 2011). The owners of capital, as key companies managerial subjects are directly invested in the maximization of shareholder wealth and are able to, by observing the fluctuations of stock price, straightforwardly assess the degree of business goal fruition. However, owners and management of corporations holding stocks that are freely sold on the financial markets, under the pressure of other stakeholders (such as employees, suppliers, buyers, the general public, etc.) are forced to somewhat modify the goal of maximising the shareholders wealth, thus paying respect to some other business goals.

According to the post-Keynesian theory, the managers governing the company are primarily pursuing their own agenda, their very own business goals (Mramor and Valentincic, 1999). According to the aforementioned theory, out of fear of liquidation, bankruptcy or the endangerment of personal interests, the managers strive to systematically avoid poor business decisions, thus focusing on the goal of maximising the probability of long-term company's survival. The following business goal – maximising the wages, is characteristically a trait of the systems that put real managerial powers in the hands of their employees, in the form of the so-called "workers shareholding".

The financing decisions that influence the liabilities portion of the balance sheet also influence the competitiveness and the business outcome for the company, especially in the case of long-term financial decisions that can endanger the market and financial standing of the company. The financial decisions include the following (Vidučić, 2011): (1) decisions on how much assets need to be procured from external sources, (2) whether the company will reinvest net yield or pay dividends, and in the latter case, what would the amount of dividend paid be, (3) should the assets be secured on the stock exchange or the bank market, national market, foreign market or Euromarket, in the domestic or foreign currency, (4) should the assets be procured for the short or long-term operations, (5) should the equity financial instrument or the debt instrument be issued and (6) what form of securities will be issued and when.

The companies may sate its financing needs by whether using internal sources (cash flow generated trough business dealings) or through the use of external sources, regardless of the form, be it a credit from a bank or the flotation of financial instruments with the net present value that is acceptable to both the company, as well as the investors involved. The research indicates that internal finances represent the most important financing means in the developed countries, especially for the market oriented systems characterised by the dispersal of ownership. However, the internal sources of finance are gaining in importance for the bank-oriented systems (Schmidt and Tyrell, 1997). Although internal sources of financing have their advantages when compared to the external sources of financing, such as the simplicity of capital procurement and maintaining control over business, the management has to recognise that internal capital has the exact same cost as the external (Vidučić, 2011; Higgins, 2009; Dotur, 2011). It is paramount for the financial management to find out the combination of long-term and short-term assets, debt or capital which will meet the investment demands of the company and the planned project, all the while adhering to several key elements, the risk, ownership, maturity and the possibility of getting into debt (Pike and Neale, 1999).

When deciding on the long-term source of financing, the company first has to decide between financing trough equity capital or using debt. However, for most companies, especially the ones belonging to the SME sector, the ones whose stocks are not quoted on the stock exchange and have not established the adequate image on the market, the decision about which form of long-term financing to utilise often translates into the choice between various distinct forms of debt financing (Higins, 2009).

Management decides on the financial decisions that influence the financial leverage and the capital structure on the basis of the perceptions different sources of financing have on the company's value and the realistic possibilities of capital procurement in the specific financial environment. Capital structure implies the specific combination of diverse financial instruments used by the company to procure capital used to finance investment activities. The financial leverage implies the ratio between debt and equity (Vidučić, 2011). Different capital structure theories deal with the optimal capital structure and the adequate financial leverage. The traditional outlooks on the capital structure hold that the optimal capital structure is the one with the minimal cost of financing equal to the pondered average cost of capital (Vidučić, 2011). The decision theory thus takes into consideration both the cost resulting from financial troubles, as well as that arising in the form of agency problem costs.

According to the Higgins model of adopting financial decisions (Higgins, 2009), the financial managers, when facing the dilemma of choosing between debt financing or recapitalization, take into consideration how 5 factor influence financial decisions: (1) tax advantages, (2) market signalizing, (3) flexibility, (4) the costs of financial difficulties and (5) managerial bolstering.

The companies that finance its capital needs through the use of debt have tax protection. The cost of accrued financial debt decreases the tax basis and trough the diminished due to the national budget, thus influences the increase of wealth for the owners of the company. When choosing the adequate amount of debt, the financial managers decide between the tax protection and the cost of financial difficulties for the company in question. At the specific level of debt, the cost of financial difficulties exceeds the possible tax benefits for the company in debt (Higgins, 2009). By using the optimal financial leverage (capital structure), the companies maintain flexibility so that their current financial position does not limit the future investment decisions. Less profitable companies that are not able to generate adequate cash flow or recapitalize with adequate amount of capital are unable to get into debt indefinitely. Therefore, they cease to be flexible and at certain point lose their market competitiveness, due to the inability to invest.

According to the signal theory, the financial decisions made by the management, while choosing between debt financing and equity financing, serves as an indicator of profitability and the feasibility of investment done by the company. As the management gathers capital by floating debt financial instruments, this serves as a signalling feat, that the latest investment is viewed by management as a feasible one. Therefore, by maintaining the high EPS (earnings per share) indicator, the entrance to new shareholders is thus denied.

In situations of dispersed corporate ownership and the real managerial power transferred from the owner to the management, the latter is often restive, individualising benefits whilst not heeding the interests of the owner. When refusing to pay dividends the preferential for growth favours over profitability and the satisfactory business becomes a goal, instead of utmost business excellence, (Higgins, 2009). This, coupled with the low level of company indebtedness, makes the management adopt financial decisions without regard for the long-term impact on the company's competitiveness.

Although the financial theory and practice indicates that numerous sources of financing exist, the financial managers of small and middle-sized companies are often limited by numerous factors, such as the level of indebtedness, the unfavourable capital structure, the unfavourable cash flow, insufficiently developed financial markets and the like, so are forced to choose between a quite limited array of financial instruments. Therefore, instead of choosing between internal and external financing sources, debt or equity financing or the long-term financial credit instruments, the company is limited in its choice of financing.

3. METODOLOGY AND RESULTS OF THE RESEARCH

The multiple case studies method used to collect available business data, coupled with the interviews with the CEO's, forms a basis for the research of small and middle-sized businesses that deal with maritime shipping in the Republic of Croatia.

The research sample consists of 6 small and middle-sized businesses that deal with maritime shipping in the Republic of Croatia. The company size is assessed on the basis of criteria for determining whether the company is small, middle-sized or large, as defined by the accounting regulations and laws (NN 109/07, NN 54/13). The sample equally features the small and middle-sized companies. The majority of small and middle-sized shipping companies in the Republic of Croatia sampled are privately held (2/3 of the companies) and the lesser number is owned by the state or features a mixed type of ownership (1/3 of the companies). Small and middle-sized companies featured in the sample are mostly companies with a concentrated ownership (2/3 of the companies). The rest corresponds to the dispersed ownership model. The sample further features companies doing business on the maritime shipping market of the Republic of Croatia, the companies that are fully export-oriented, as well as the companies that established competitiveness on numerous specific international market niches. The 1/3 of the companies sampled are quoted on the Zagreb Stock Exchange. The professional managers manage 2/3 and the owners manage 1/3 of the sampled small and middle-sized companies.

The following chapter briefly presents the research results, along with the fundamental business and financial goals and the capital structure data, the degree of indebtedness, investment decisions, financing the capital investments of small and middle-sized shipping companies. The results are shown in the tables 1, 2 and 3.

Table 1. The basic characteristics of small and middle-sized sampled companies

Company name / characteristics	Alpha	Beta	Gamma	Delta	Epsilon	Zeta
Company size (small, medium)	small	medium	medium	medium	small	small
Ownership structure (privately held, mixed, state-owned)	mixed	state	private	private	private	private
Ownership dispersion (concentrated, dispersed)	concentrated	concentrated	concentrated	dispersed	dispersed	concentrated
Quoted on the exchange market (Yes, No)	no	yes	yes	no	no	no
Market (RoC, international market, RoC + international market)	mixed	international	mixed	international	RoC	mixed
Management (professional management, manager-owner)	profess. manager	profess. manager	manager-owner	manager-owner	profess. manager	profess. manager

Table 2. Business and financial goals, capital structure, level of indebtedness

Company name / characteristic	Alpha	Beta	Gamma	Delta	Epsilon	Zeta
Business goals (company value growth, long-term market survival)	long-term market survival	long-term market survival	company value growth	long-term market survival	long-term market survival	long-term market survival
Financial goals (liquidity, profitability)	liquidity	liquidity	profitability	liquidity	liquidity	liquidity
Capital structure / financial leverage (debt-equity ratio) <1, 1-2, >2	>2	<1	1:1	>2	1-2	1-2
Debtedness coefficient (total debt / total equity) <0.3, 0.3-0.6, >0.6	>0.6	0.3-0.6	0.3-0.6	>0.6	0.3-0.6	>0.6

Business and financial goals, capital structure and the degree of indebtedness

The business and financial goals of small and middle-sized shipping companies change with regard to the economy cycle phase and the conditions governing the global markets. During the periods of global commerce expansion, characterised by the soaring levels of demand for the shipment of cargo, it had the outcome of increasing company value, all the while heeding the interests of all the stakeholders (employees, suppliers, customers, general public, etc.), during the periods of recession the majority of small and middle-sized companies (5/6 of the companies sampled) is focused on the long-term market survival. Only the occasional, rare companies, which are profitable, are focused on maximising the value of the company. In the same period, the small and middle-sized shipping companies that earn high amounts of profit during expansion try to maintain liquidity by optimally using the cash flow, using a revolving credit.

Small and middle-sized shipping companies seldom have a favourable capital structure, the ratio between debt and equity (1:1). Just a single sampled company has a favourable ratio between debt and equity (1:1), while all the others show a lower or greater value of financial leverage when compared to the optimal. When discussing the companies' that do not have an optimal capital structure, most are the companies whose debt is significantly greater that equity (2/3 of the sampled companies). At the same time, the after mentioned companies are often too much in debt and it is significantly greater than their equity (indebtedness coefficient is greater than 0.6). The small and middle-sized shipping companies that prefer debt over equity capital do not acquire tax advantages, for they belong to the group which, instead of the VAT pays the tonnage tax. The shipping companies only seldom have a level of equity which is greater than debt, with the debt very small when compared to the total equity (the indebtedness coefficient is 0.3).

Furthermore, there is a consensus among the sampled that the correlation between the financial leverage and the risk is not only the result of the magnitude of financial leverage, but also the value of the equity, especially if the value of the said equity fluctuates, as is the case with the shipping trade. The shipping companies that have the same level of financial leverage, but of a differently valued equity will face various financial difficulties in the conditions of unfavourable markets. During the times of unfavourable market fluctuations, which result in endangerment of both companies and the interests of business banks which finance capital investment of the shipping industry, the latter often reprogram the debt of companies (which they can amend at any time) so not all is lost.

Lastly, it can be concluded that 2/3 of small and middle-sized sampled companies have an optimal or acceptable capital structure. The remaining 1/3 of the sampled companies are completely dependent on the creditors, primarily banks and suppliers (and have a ratio of debt and equity that is greater than 2). On the other hand, one half of the small and middle-sized sampled companies have too great of a debt (indebtedness coefficient greater than 0.6). The other half is able to take out additional loans.

The investment activity and the source of financing capital investment

It is indisputable that at present times, characterised by low demand, a barely noticeable market recovery and the low ship price, the companies that aim to maintain or improve competitiveness should invest in the fleet growth. Half of the sampled small and middle-sized shipping companies invest insufficiently, 1/3 of them are somewhat more active in their investing endeavours and just a single one heavily invests in the expansion of its fleet. It should be noted that small and middle-sized companies that have a more optimal financial leverage (capital structure) and are less in debt when compared to other companies invest more in the fleet growth and development.

The research done on the sample of small and middle-sized maritime shipping companies in the Republic of Croatia shows that capital investment financing by long-term bank loans is the most significant source of financing capital investment. It is worthy to note that small and middle-sized companies that do business on the international markets usually have a more favourable capital structure and lower debt (companies Beta and Gamma). Also, they also take out debt on the international market, which means the criteria is more demanding, but the interest rates are thus also lower. Small and middle-sized companies that do business on the national market take out loans from primarily banks that operate in the Republic of Croatia.

Table 3. The investment activity and capital financing sources

The investment activity and capital financing sources						
Company name	Alpha	Beta	Gamma	Delta	Epsilon	Zeta
Investment activity during the 2012.-2013 period. (low, intermediate, high)	low	high	intermediate	low	intermediate	low
I. Financing the capital investments using available net cash flow						
Financing the capital investments using net cash flow	*	**	**	*	**	*
Financing the capital investments by other means of cash flow (financial revenue, assets revenue)	*	*	**	*	*	*
II. Financing the capital investment by floating equity and debt financial instruments on the capital market						
Financing the capital investments by floating the equity financial instruments on the capital market	-	-	-	-	-	-
Financing the capital investments by floating the debt financial instruments on the capital market	-	-	-	-	-	-
III. Financing the capital investments using the long-term bank debts / Other forms of financing						
Financing the capital investments using the long-term bank debts. (RoC, international market, mixed)	***	***	***	***	***	***
Financing the capital investments by associating with clients and business partners (brokers, insurance companies, cargo owners)	**	*	*	*	-	-

*** The most important sources of capital investment financing
** The intermediately important sources of capital investment financing
* The least important sources of capital investment financing
- The sources of capital investment financing that were not used

According to the theoretical framework, the internal sources of financing, such as the available net cash flow, holds a significant role when financing capital investment. The research results confirm that the small and middle-sized shipping companies, which are characterised by an intermediate or high degree of investment activity, see the net cash flow, as well as the other forms of net cash flow (financial revenue and the equity sale revenue) as the sources of financing capital investment of intermediate significance. Additionally, the research results show that the companies that have a favourable net cash flow are more willing to invest in the fleet growth and development.

Small and middle-sized shipping companies, especially the ones that exhibit an unfavourable capital structure and an uneven ratio between debt and equity, coupled with the unavailability of long-term debt and insufficient amount of net cash flow are at times using the financial resources of clients and business partners – brokers, insurance companies and cargo owners to finance capital investment.

Although the floating of equity or debt financial instruments on the developed financial markets is one of widely accepted sources of financing capital investments worldwide, small and middle-sized companies that are globally obscure and quite hazardous from the viewpoint of potential investors very rarely use them. SME are often forced to use debt financing when financing capital investment. SME dealing with maritime shipping in the Republic of Croatia are limited to debt financing and specific sources of debt capital, such as the long-term loans lent by national or international banks, as well as the financial engagements with clients and business partners.

However, some of the small and middle-sized shipping companies in the Republic of Croatia attempt at creating preconditions for improving the companies' image and gathering cheaper capital by floating debt financial instruments or recapitalization, by (1) changing the accounting regulations, (2) enhancing the relationships with potential investors (banks and institutional investors), (3) increasing the transparency of business practice and (4) improving the company's image.

4. CONCLUSIONS

During the times of recession and low demand for shipping services, the management of small and middle-sized maritime shipping companies, faced with the increasing costs, unfavourable capital structure and increased debt, coupled with the need for investing in fleet development and restoration holds a demanding role for finding out adequate financial solutions for financing the capital investments, maintaining the company's liquidity and the like. When adopting the decisions concerning the sources of financing, which subsequently influence the level of indebtedness and the company's capital structure, the financial managers of small and middle-sized shipping companies, instead of choosing among a wide array of theoretical sources of long-term financing, decide on a single source of capital investment financing: (1) long-term loans, (2) net cash flows and the (3) loans from business partners (clients, insurance companies, brokers). The long-term loans represent the most important source of financing capital investments, while sources of intermediate significance differ and depend on the specific company.

Research results of this paper confirm that small and middle-sized companies having a desirable capital structure and a lower degree of debt, the ones with the significant net cash flow at their disposal take up significant investment activities when compared to other companies. On the other hand, small and middle-sized companies that have a less desirable capital structure, high degree of debt (greater than 0.6), and are not quoted on the stock exchange are also less likely to invest.

The companies doing business on the international markets and have significant net cash flow at their disposal are also more likely to obtain cheaper long-term loans issued by international banks. The companies that are not as export-oriented and do not have significant net cash flow at their disposal are forced to finance loans issued by national or international banks by selling equity or entering into various business arrangements with clients and partners.

The research results also confirm that small and middle-sized shipping companies did not use the flotation of equity or debt financial instruments as a method of financing capital investment, regardless of their size, capital structure, or other characteristics. The limitations imposed on the decision making process of financing capital investment for the shipping companies resulted in further deterioration of the capital structure, unfavourable debt level and the continued decrease of the competitiveness for the Croatian companies.

Finally, it is worthy to note a few significant limitations to this research: (1) a small sample which makes it impossible to maintain unequivocal conclusions that would apply for the entire industry, (2) the objectiveness of the interviewed individuals and (3) the research methodology which actually guarantees the guidelines for future research. In the future research attempts, it is recommended that it be carried out on the entire population of the Republic of Croatia, as well as the neighbouring countries of SE Europe, with the use of quantitative research methodology and establishing the connection between indicators of business efficiency and the structure of sources of capital investment.

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THE ROLE OF SUPERVISORY BOARDS OVERLOOKING SMALL AND MIDDLE-SIZED MARITIME COMPANIES IN THE REPUBLIC OF CROATIA

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ABSTRACT

Characterised by the dual board structure of corporate governance, the supervisory board of small and middle-sized maritime companies assumes an ever more significant role, thus representing a quite significant economic segment for the export-orientated shipping countries. Due to the recession limitations and strong competitive rivalry, also coupled with the intensive focus of shipping companies hold on the challenge of maintaining liquidity and long-term market survival, whilst maintaining their traditional role of management monitoring, supervisory board members also participate in other business areas. This paper, using the multiple case studies method, based on the sample of six (6) small and middle-sized shipping companies in the Republic of Croatia, researches the impact supervisory boards have on business activities. More specifically, it aims to determine in what scope is their influence most prominent and whether the recession periods impact the sway the supervisory board holds, especially when compared to the periods of favourable economic conditions.

KEY WORDS

supervisory board, supervisory board impact, small and middle-sized shipping companies

1. INTRODUCTION

Small and middle-sized companies are often regarded as the source of entrepreneurship and their development is motivated by individual creativeness and innovativeness (Vighneswara, 2011), giving rise to the direct contribution of BDP, employment growth and is quite often, through the supply of diverse products and services directly linked with the industrial productiveness of large corporations. Small and middle-sized shipping companies are of a particular importance especially for the economies of maritime nations for, along with the contribution by way of BDP growth, employment and taxation, they also represent the core export capabilities of a particular country. Empowering the small and middle-sized companies in a particular economy, coupled with the understanding that the SME sector is fraught with diverse, at times conflict interests of numerous stakeholders, have increased the interest of both the expert and the scientific community with regard to the issues regarding the functioning of supervisory boards overlooking small and middle-sized shipping companies in the Republic of Croatia.

The owners of small and middle-sized companies that operate in the Republic of Croatia can choose among the two fundamental models of corporate governance: the monistic or the dualistic one. Most of companies employ the dualistic model consisting of the supervisory board and the management board, which constitute key instances of corporate governance. The exception consists of only small and middle-sized companies that are legally organised as Limited Liability Companies. These, according to the existing legislative regulations of the Republic of Croatia may, but are not required to institute a supervisory board, so the role of proprietor and manager is usually assumed by a single person. Exploring the role of supervisory boards in the small and middle-sized companies is achieved by using the multiple case studies method, on the sample of small and middle-sized shipping companies that do business in the Republic of Croatia.

2. THEORETICAL OVERVIEW

A supervisory board is an organisational instrument, which shareholders use to influence managerial behaviour, in order to ensure that the latter govern in the interests of owners (Tipuric et al., 2008). As a mechanism of corporate governance, according to the monotheistic model of corporate governance, the company's board can be organised as a unitary board of directors, or through establishing two distinct bodies, the supervisory board and the board of directors, according to the dual model. The monotheistic model of corporate governance is characteristic for the open systems of corporate governance, when the dispersion of ownership with the control over the corporation is naturally transferred from the shareholder to management (Tipuric et al., 2008). On the other hand, the dual model of corporate governance is characteristic for the closed systems of corporate governance, which is characterized by a small number of owners who are trying to maintain the control over management and its business conduct.

According to the agency dilemma, which represents the dominant theory for explaining the role of the boards, they are supposed to act as watchdogs and guardians, ensuring the reconcilement of managerial and stakeholder interests (Neville, 2011). However, considering that small and middle-sized companies are quite specific (available resources and the structure of ownership) and diverse from large corporations, the agency theory is insufficient when explaining the board role in small and middle-sized companies. Some other theories, such as resource theories, emphasize the board role as the source of human capital (Neville, 2011), whilst according to the theory boards service the main task for the boards if to "serve and advise" (Neville, 2011), supporting the managerial decision process through diverse competencies and experience. Boards are also crucial in connecting the companies to the relevant factors in the environment. Generally, board role may be divided into two basic categories: the control or service role (Huse, 2000). According to the research of board roles in the small and middle sized companies done by Mette Neville (2011), board role can be analysed through: (1) managerial and business activities, (2) participating in the business strategy formation, (3) contributing to the business competencies unrealised by other means, (4) promoting good relationship with relevant environmental subjects (legislative branch, business partners, suppliers, distributors), (5) attracting resources, (6) protecting of financial and other interests of all the owners and (7) compliance of the business with the existing laws and regulations.

3. METODOLOGY AND RESULTS OF THE RESEARCH

Researching the role of supervisory boards in small and medium sized companies is realised using the sample of small and middle sized naval shipping companies in the Republic of Croatia, using the multiple case studies method which consisted of collecting the available business data and interviewing CEO. Researching the role of boards was realised using the theoretical framework used by Mette Neville in his own research of small and middle sized companies (Neville, 2011).

The research sample consists of 6 small and middle sized naval shipping companies in the Republic of Croatia. The company's size was estimated on the basis of criteria determining the categorisation of businesses on small, middle and large size, as defined by the accounting regulations and laws (NN 109/07, NN 54/13). Small, as well as middle sized businesses are equally represented. Most sampled small and middle sized naval shipping companies in the Republic of Croatia are owned by trade associations or natural persons and a single one is under the majority ownership of the State.

Table 1. Research results

Company name	Alpha	Beta	Gamma	Delta	Epsilon	Zeta
Company size (small, medium)	small	medium	medium	medium	small	small
Ownership structure (privately held, mixed, state-owned)	mixed	state	private	private	private	private
Ownership dispersion (concentrated, dispersed)	concentrated	concentrated	concentrated	dispersed	dispersed	concentrated
Market (RoC, international market, RoC + international market)	mixed	international	mixed	international	RoC	mixed
Management (professional management, manager-owner)	profess. manager	profess. manager	manager-owner	manager-owner	profess. manager	profess. manager
Monitoring of management and business practices, their accordance with the regulatory provisions	***	***	**	**	***	***
Participation when determining the business strategy	**	**	*	*	***	***
Contributing to the business competencies	**	*	*	*	**	**
Promoting favourable relationships with relevant subjects in the environment (legislature, business partners, suppliers, distributers)	*	*	*	*	*	*
Attracting resources	**	*	*	*	**	**
Protecting the interests of all of the stakeholder groups	**	***	*	*	**	**

*** The supervisory boards is completely involved in the company's business practices
** The supervisory board is somewhat involved in the company's business practices
* The supervisory board is only nominally involved in the company's business practices

The sample also equally features the companies characterised by the concentrated and the dispersed ownership model. The companies characterised by concentrated ownership model, along a smaller number of shareholders that dominate the ownership structure, there exist numerous small shareholders with miniscule ownership shares.

In this sample of small and middle-sized naval shipping companies, there are companies doing business in the market of Republic of Croatia (RoC), companies that are wholly export-oriented, as well as the ones that do business on the RoC market, as well as the less demanding international markets, on the specific market niches. Out of the sampled SME, the portion of companies that are managed

by professional management is more significant than those that have the board comprised of owners. The members on the supervisory boards of small and middle-sized naval shipping companies in the Republic of Croatia are mostly shareholders with majority ownership rights or the individuals representing the owner's interests, primarily the dominant shareholders.
The research results of the role supervisory boards have on business functioning of the small and middle-sized naval shipping companies is as follows. The results are given in the Table 1.

a) *Monitoring of management and business practices, their accordance with the regulatory provisions*

The supervisory boards, trough the monitoring of management, as well as the business activities also supervise the management behaviour, business activities and the company's business performance. They are also responsible for the lawful business conduct of, according to the statute of trade associations and the regulatory rules valid in the Republic of Croatia. When monitoring the management and business practices, as well as their accordance with the regulatory provisions, most sampled supervisory boards (66%) are completely involved in the company's business practices. Only 33% are just somewhat involved in the company's business practices.
Supervisory boards, when monitoring the management and business practices are more active in their duties during the times of recession. In those times, the frequent supervisory board meetings and the resulting interaction with the management is aimed at supporting managerial activities and to ultimately protecting the interests of dominant owners.

b) *Participation when determining the business strategy*

Although CEO, as defined by the statute of trade associations, are not allowed to make strategic decisions without the approval of the supervisory board, the supervisory boards role differs from company to company. The formation and proposition of strategic decisions falls under the jurisdiction of the supervisory board or the company's management, and this holds true for all the sampled companies. As a rule, the supervisory boards have a regulatory function when making strategic decisions, which means they are free to accept or dismiss the strategic decisions put forth by managers. The CEO's, who do not participate in the ownership of the company, hold that it is imperative to speed up the process of accepting or dismissing the proposed strategic decisions, by enhancing the operational level of the supervisory board.
In the situations of a privately held company managed by professional management, the supervisory board is completely included in the process of making strategic decision, especially during the times of recession and unfavourable business results.

c) *Contributing to the business competencies*

Although the roles of the supervisory board and the board of directors remain distinct and separate when dealing with big, well organised companies managed by professional management, this does not hold true for the small and middle-sized companies that have limited resources. Here, they are allowed to influence the business decision process, although it would generally be perceived as a sign of mistrust toward the board of directors.

d) *Promoting favourable relationships with relevant subjects in the environment (legislature, business partners, suppliers, distributers)*

Although the CEO's of small and middle-sized naval shipping companies agree that the supervisory boards could have a more significant role of promoting favourable relationships with the relevant subjects in the environment, they are usually just nominally included in the business practices. Raising the level of the supervisory board participation when promoting favourable relationships with subjects in the environment is a prerequisite for creating more favourable business conditions, ones which could result in managerial actions that give rise to the increased competitiveness of the company.

e) *Attracting resources*

Large companies, that have a professional and well organised management, the board of directors is responsible for attracting resources, regardless of their type (new customers, potential lenders,

educated employees, or the like). However, when considering a large number of small and middle-sized companies that have limited resources, the supervisory board members are also very active in resource attracting (Neville, 2011), acting in tandem with the board of directors.
Supervisory boards of the small and middle-sized naval shipping companies extremely rarely participate in the activities that aim to attract resources. The exceptions are privately held companies or the ones that correspond to the mixed model of ownership that have a functioning professional management, where supervisory board members support management in attracting resources trough establishing contact with prospective lenders (banks, insurance companies, or other business partners).

f) *Protecting the interests of stakeholders*
The fundamental role of the supervisory boards is to monitor managerial and business activities, ensure the protection of the companies owners interests and adequately redistribute financial output among the small and big shareholders. The small stakeholder interests are often threatened, especially if the company is not profitable, so no basis for the paying of dividend is met or the share capitalization is not feasible. On the other hand, the board of directors is responsible for the protection of all of the stakeholder's rights, including the employees, business partners and the wide community.
Supervisory boards for most of the small and middle-sized naval shipping companies are completely involved in the protection of owners and stakeholders interests (66%). A somewhat lower involvement of the supervisory boards is characteristic of privately held companies managed by owners. Of course in the afore-mentioned companies, the interests of dominant, majority owners are most protected. Although the companies managed by professional management, which are under state, mixed or private ownership, have the formal protection of interests of all the stakeholders, in practice the small shareholder's interests are protected just in the cases of profitable business practices, when the dividends are paid. The profitable companies thus protect the owners in the short term. In the long run, paying the dividends and not reinvesting can, especially in times of recession and low shipping demand cause the diminished competitiveness and endanger the market survival of the company.

4. CONCLUSIONS

The supervisory boards operating in small and middle-sized naval shipping companies are spreading their business activities on the protection of stakeholder interest and attracting valuable resources, thus adding it to usual roles of controlling the accordance with the regulatory bodies and the oversight of management.
Dominant shareholders, regardless of the existing legislature, which guarantees the protection of all the owners' interests, aim at protecting their special interests, all the while assuring complete control over management. In the times of unfavourable market conditions and unsatisfactory business performance the supervisory boards aim at increasing the influence over the decision making in the company.
When considering the companies characteristics and the roles of supervisory boards, the small and middle-sized naval shipping companies can be categorised into three basic groups: (1) companies that are state or mixed owned, managed by professional management, the role of supervisory boards during times of recession grows, the board of director and the supervisory boards aim at protecting the interests of all of the stakeholders; (2) the company is privately held and managed by the owner, the supervisory board role is formal and reduced, the board of directors and the supervisory board aim at protecting the interests of major stakeholders and (3) a privately held company managed by professional management, the role of supervisory board during times of recession grows, the board of directors aims at protecting the interests of all of the stakeholders, while the supervisory board tries to protect the interests of only the dominant stakeholders.
Finally, it is worthy to note a few significant limitations to this research: (1) a small sample which makes it impossible to maintain unequivocal conclusions that would apply for the entire industry, (2) the objectiveness of the interviewed individuals and (3) the research methodology which actually guarantees the guidelines for future research. In the future research attempts, it is

recommended that it be carried out on the entire population of the Republic of Croatia, as well as the neighbouring countries of SE Europe, with the use of quantitative research methodology and establishing the connection between indicators of business efficiency and the influence of small and middle-sized company's boards on the business activities.

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COMPOSITE MATERIAL APPLICATION AND POTENTIAL IN SHIPBUILDING

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ABSTRACT

There is a notable increase of applications of fibre reinforced polymer composite materials in the past few decades in the marine industry. A variety of applications ranges from specialized equipment components to large structural parts. The paper presents basic mechanical properties of composites in comparison to usual shipbuilding materials like steel and aluminium. An overview of major advantages and disadvantages of using composites in shipbuilding is given in terms of production, design and exploitation. Governing regulation, identified as a key problem for wider composite use in shipbuilding, is mentioned.

KEY WORDS

Composite materials; Shipbuilding, SOLAS

1. INTRODUCTION

Composite materials found a variety of applications in the marine industry. These materials are commonly used in the boatbuilding industry and have also found numerous applications on naval ships. Merchant shipbuilding and shipping industry are still conservative regarding composite material applications although there are some examples, e.g. lifeboats, ballast water piping, bathroom modules etc.

As often happens, a range of innovations arrives from military research and applications, thus naval industry could be considered a good starting point for a review on the state of the art of composite use on ships. Recent military applications, current and potential, include composite superstructures, decks, propulsions, advanced mast systems, machinery components etc. Composites have become a standard choice of material for the complete construction of patrol boats and mine-countermeasure vessels and corvettes. Lengths of all-composite ships have been steadily increasing over the years and currently there are all-composite naval ships up to 80-90 meters in length. Trends of composites applications are backed with examples in the offshore and energy sector and can be expected to influence the merchant shipping fleet.

It is considered that, at the moment, one of the key inhibitors of more composite applications on ships is the regulatory framework of the International Maritime organization, specifically certain chapters of the SOLAS convention, which are primarily written and developed for steel constructions. Other, related and before mentioned, marine sectors do not abide the same regulatory framework and thus adopted these new materials more freely. Other than regulation, another key issue is cost compared to steel, as a standard engineering construction material, where composites parts are several times more expensive than steel in capital expenses (CAPEX) and should

be estimated through savings in operating expenses (OPEX) which decrease. It has been shown that ship-owners are mainly focused in CAPEX and less with OPEX.
The paper aims to give basic parameters and considerations for further implementation advances of composites structural components on ships.

2. BASIC PROPERTIES

Composite materials, keeping to textbook definitions, are materials made up from different materials that together provide properties as neither of the constitution materials by themselves. In the marine industry composites usually refer to fibre-reinforced plastics (FRP). They are constituted as layers of fibre reinforcement embedded in a polymer resin. The fibre reinforcement gives strength and stiffness to the composite while the resin serves as a matrix to bond all the different fibbers and layers and make them work together. Grading from more economic and low-tech to more expensive and high-tech, usually applied resins are: polyester, vinylester and epoxy; and most common applied fibre reinforcement are: glass (E-type), carbon and aramid (better known under the commercial trade name Kevlar). More usual are combinations of lower or higher end resin and fibre choices between themselves depending on desired mechanical properties , but all combinations of resin and fibre-reinforcement are possible as well as hybrids where several type of reinforcement types is used together. Hybrid composites offer more possibilities to control material stiffness, strength and cost. When designing a composite layout an engineer tailors the material to the desired properties both globally and locally.
Other than the choice of constituting materials, FRP parts can also be divided by production technology and construction configuration. Typical prediction methods are: hand lay-up, vacuum bagging, vacuum infusion and Pre-preg, listed ascending based on complexity, cost and expected obtained properties. Production technology dictates the fibre-to-resin ratio which greatly influences the final properties of the composite. It is also very important, when choosing and applying a certain production method to maintain the quality level to reduce the number of imperfections to a minimum. Structural configuration of the part being manufactured in composite material can be single skin configuration (monolith or framed with stiffeners) and sandwich (having a core material between two outer skins). Structural configuration, as well as material choice and production method, is chosen based on the type of the loading, design requirements, available budget of the client and knowledge of the manufacturer. Having a vast number of possible composite configurations and the final properties of the FRP being sensitive to case-by-case parameters, it is current practice in all professional composite manufacturing processes to perform experimental testing on samples to confirm if the desired mechanical properties have been obtained. As a general guide and a valid starting point for design, mechanical properties can be found in literature and calculated using established composite theory.

Material	Modulus (GPa)	Strength (MPa)	Density Kg/m^3)
Steel	~200	400-1300	7800
Aluminium	~70	100-600	2700
Glass Composite	25-40	500-1000	1800
Carbon composite	100-180	1500	1600

Figure 1. Mechanical properties comparison. Source: Howarth D., Composites in Ships, 2012, Southampton

		Fibres				Resins	
		E Glass	Aramid	HS Carbon	HM Carbon	Polyester	Epoxy
Specific gravity (g/cm³)		2,54	1,45	1,80	1,90	1,20	1,20
Young's modulus (N/mm²)	parallel to fibres	73000	130000	230000	370000	3000	2600
	perpendicular to fibres	73000	5400	15000	6000	–	–
Coulomb's modulus (N/mm²)		30000	12000	50000	20000	–	–
Poisson's ratio		0,25	0,35	0,35	0,35	0,316	0,40

Figure 2. Mechanical properties of fibre reinforced plastic. Source: GL, HSC code 2002

3. ADVANTAGES AND DISADVANTAGES OF COMPOSITES

Two major advantages of composites over steel are the beneficial effects on light weight and the lower level of maintenance needed. Other benefits are usually derived from these two key properties. If topside weight is reduced, stability is improved. Generally, weight saving reduces draught and thus resistance and fuel consumption or alternatively offers allowance for increased payload, which both translate into a wider profit margin for the ship owner. Otherwise, if we account for weight, i.e. displacement reduction, in the design process we can select a more slender hull and aim for increased speed for the same fuel consumption. As for maintenance reduction, the key benefit of composite materials is that they are not subject to corrosion which is a major issue in a marine environment.

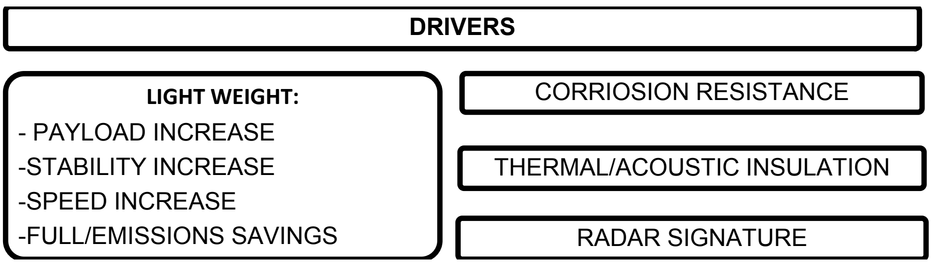

Figure 3. Drivers for composite applications. Source: Job S., Composites in ships, Knowledge transfer network

Moreover composite materials, as an effect of their manufacturing technology, are suitable for complex 3D shapes whereas steel is more difficult to form. This makes composites suitable for production of streamlined shapes in attempt to reduce hydrodynamic and aerodynamic drag.
The main challenges for the wider use of composite on ships are manufacturing costs and fire resistance requirements. Manufacturing costs issues can be tackled in series production, for parts of complex curvature or integrated functionality. Fire resistance remains one of the largest challenges for composite applications.
In any case, only if a successful business model is found, which can make composite parts comparable in price to its steel counterparts either calculated directly or through the life of the ship, composites application will find a wider market in the industry.

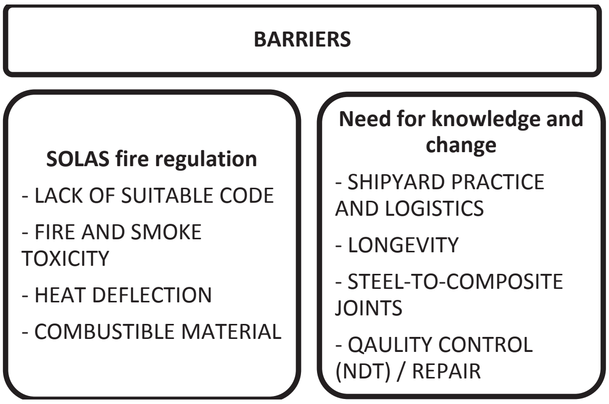

Figure 4. Barriers for composite applications. Source: Job S., Composites in ships, Knowledge transfer network

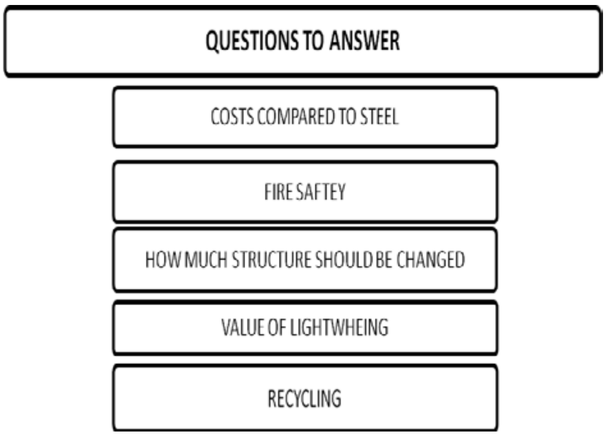

Figure 5. Questions to answer for composite applications. Source: Job S., Composites in ships, Knowledge transfer network

4. RELEVANT REGULATION

Appropriate regulation, within classification societies' scope of work, generally exist to an extent for the design and exploitation of composites within smaller vessels, medium length range within the yacht construction industry and is especially well addressed within the High Speed Craft Code referred to by several classification societies. The existing regulation on the statutory level exists that acts prohibitively on the application of composite solutions on large ships. International Maritime Organization (IMO) through the SOLAS convention prohibits use of combustible materials for structural components on ships.

Chapter II-2 of SOLAS requires hull, superstructures and structural bulkheads, decks and deckhouses to be built form steel or equivalent materials.

Opponents to the policy point that although composites are combustible by nature that due to their superior insulation properties and the mode and course of failure (if designed properly) within a fire can provide a higher level of safety in case of fire than metallic construction material.

July 2002 Chapter II Rule 17 allows alternative construction materials to be used where it can be proven they offer the same level of safety as if the prescriptive rules requiring non-combustible materials had been followed.

This is the only path for approval of composite parts on large ships within the existing framework. This approach is on a case to case basis is timely and expensive

Several research projects funded by the EU commission (IMPROVE, CO-PATCH, MOSIAC, ADAM4EVE) address the issues of composite materials use for ship construction and repair. All projects are followed by interested classification society representatives and several guideline documents have been produced to cope with composite material evaluation and manufacturing procedures.

5. CONCLUSIONS

Shipbuilding is and old and conservative sector where research is focused on optimizing processes and raising efficiencies. Application of novel materials is one of the ways to improve certain aspects of ship behaviour, increase profitability. The paper identifies the key properties of composite material compared to traditional shipbuilding materials as well as the main advantages and disadvantages of potential wider implementation of composites on ships. Governing maritime regulation currently acts a main inhibitor for this. The range and state of composite applications in related sectors suggest a transfer of innovation in the future and a wider use of composites on merchant ships if the relevant regulation is revised to allow so. The paper specified the main driver barriers and unanswered questions for this process.

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SIMULATION OF THE MARINE ENGINE PERFORMANCE WITH THE PURPOSE OF PREDICTING PARAMETERS

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ABSTRACT

The paper elaborates a computer-aided model for simulating the performance of a marine slow-speed diesel engine. The simulation model provides an analysis of the specific fuel consumption, temperature within cylinders and the effective engine power while changing the compression pressure in the cylinders. The results of the model's examination have revealed a close correspondence with the ones obtained at the testbed, which proves the validity of the model. It is possible to apply the model to the electronically controlled engines and, in addition, in the foreseeable future, the model may foster the implementation of new technologies, such as neuron networks, into the control systems of marine two-stroke slow-speed diesel engines. The results presented in the paper have been obtained in the scientific research project No. 250-2502209-2364 and the international research Project "The possibilities of reducing pollutant emissions from ships in the Montenegrin and Croatian Adriatic implementing Annex VI of MARPOL Convention" supported by the Ministry of Science, Education and Sport of the Republic of Croatia.

KEY WORDS

Diesel engine, Simulation, Compression ratio, SFOC

1. INTRODUCTION

Marine slow-speed diesel engines feature a number of advantages. One of the most important is their high efficiency. Moreover, diesel engines are very reliable and allow the use of lower grade, i.e. cheaper fuels.

Due to low revolution speed, slow-speed marine diesel engines are directly coupled to the ship's propeller. Also, owing to the low revolution speed, engine elements wear at reduced rate while slower combustion processes increase the engine's efficiency. Direct propeller drive arrangement results in avoiding additional losses as well as additional mass and complexity that are associated with installing the gearbox. Furthermore, the maintenance system is designed in such a way that it can be handled by the very crew.

Due to numerous requirements that are imposed on engine manufacturers by IMO (*International Maritime Organization)*, the organisation regulating the pollution of the environment from ships, and due to the overall economic and political situation in the world, the development of marine diesel engines has been geared towards meeting demanding objectives such as increasing the specific power, increasing the efficiency and reducing harmful emissions while maintaining the engine's reliability.

The numerous requirements that have to be met result in various innovations that are implemented to improve the performance of marine engines, including the use of new materials, turbocharging systems, common rail injection, and electronic control of exhaust valves and fuel injectors.

The application of simulation models for propulsion systems may lead to achieving a number of goals, e.g. system optimisation by introducing changes in engine configurations or regulation settings.

2. SIMULATION MODEL OF MARINE SLOW-SPEED DIESEL PROPULSION ENGINE

The objective of this paper was to use computer simulation model for a marine turbocharged slow-speed diesel engine. The purpose of such a model is obtaining a better insight into the state of the system or, even better, the possibility of predicting a sequence of events during the ship's exploitation in the design stage.

The computer-aided simulation model has been designed using the computer application MATLAB 7.0 – SIMULINK. [1]

As the propulsion system consists of numerous components, the model itself contains all the elements that simulate the operation of the propulsion system individual components (Figure 1).

The computer-supported simulation model has been designed based on the mathematical zero-dimensional model for the individual elements of the marine propulsion system which are interconnected by heat and energy transfer flows. The model is described by a set of non-linear differential equations supplemented by empirical and correlative equations describing the system components, boundary conditions, and features of individual interrelations. The simulation time defines the crank angle change and real time, so that all calculated condition variations can be observed through the crank angle and time. The simulation of dynamic real-life processes is based on a complex mathematical model.

The overall mathematical model for the turbocharged diesel engine consists of separate mathematical models for the engine constituent elements.

The model used in this paper is an open non-stationary thermodynamic system with an assumed balance of the condition changes in control volumes, and with non-stationary gas dynamic effects being ignored, i.e. this is a so-called quasi-stationary model.

For the purposes of this research, the model has been tested and exemplified through the comparison of the simulation results with the performance of the slow-speed two-stroke turbocharged diesel engine manufactured by MAN B&W, type code 6S50MC that directly drives a large diameter fixed pitch propeller.

Table 1 shows the basic characteristics of the engine. The simulation performed in this study corresponds to the 100% of engine load.

Table 1. Characteristics of the diesel engine 6S50MC at the testbed upon delivery

Engine load (from MCR)	100 %
Indicated power (kW)	8656
Effective power (kW)	8182
Revolution speed (min^{-1})	121,4
Governor index	79,2
Compression pressure (bar)	123,7
Maximum combustion pressure (bar)	141,4
Mean indicated pressure (bar)	19,01
Fuel lever position (mm)	75
Pressure in scavenge air receiver (bar)	3,55
Temperature in scavenge air receiver (°C)	41
Pressure in exhaust gas receiver (bar)	3,26
Temperature before turbine (°C)	404
Revolution speed of turbocharger (min^{-1})	15895
Specific fuel oil consumption (SFOC) (g/(kW·h))	174,66

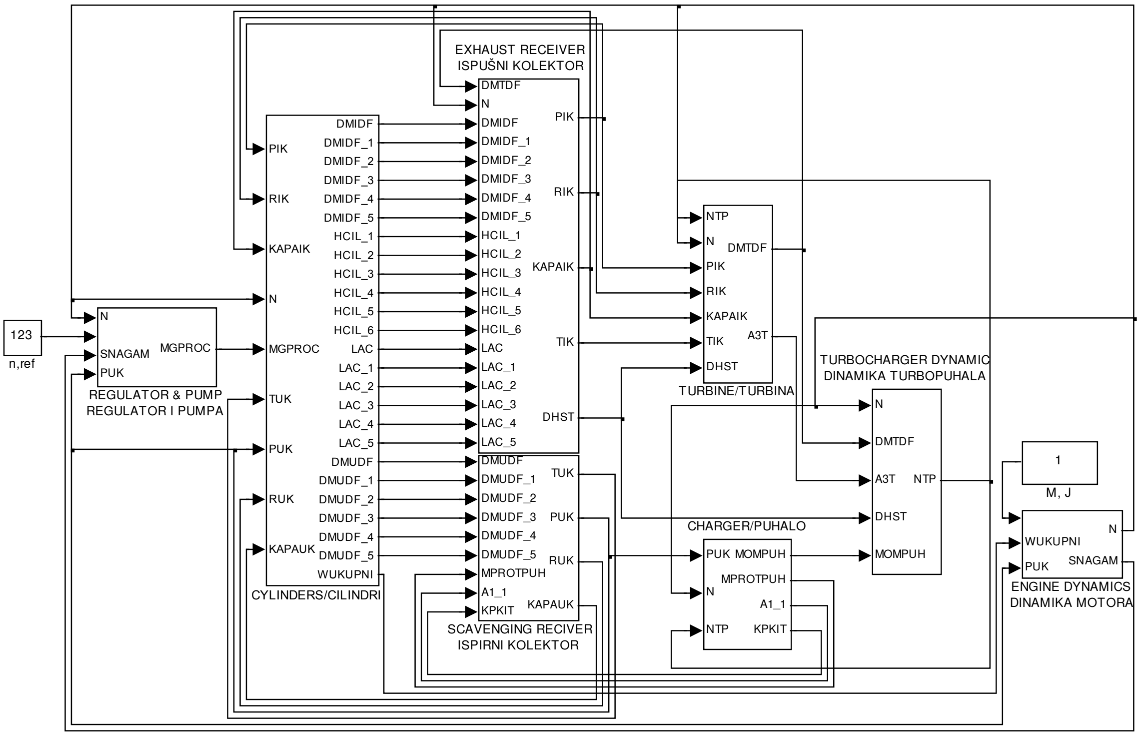

Figure 1. Simulation model for marine propulsion system in the Matlab-Simulink computer program [2]

3. APPLICATION OF THE SIMULATION MODEL

The already existing model in Simulink [1] has been used as a basis for developing the simulation model in this paper. The initial model has been upgraded by the possibility of changing of the cylinder volume. Along with presenting 2D results, the model has enabled the presentation of 3D results.

The aim of this paper is to analyse working parameters in the cylinder due to changing of the cylinder volume. The most interesting working parameters are pressure, realised heat in the cylinder, temperature, power and specific fuel consumption.

3.1 Mathematical model for the cylinder

The variation in thermal energy exchanged between the working fluid and the system boundaries has been defined by the fuel combustion heat and the heat that is transferred to the walls and environment:

$$\frac{dQ}{d\varphi}=\frac{dQ_g}{d\varphi}+\frac{dQ_{od}}{d\varphi}+h_u\frac{dm_u}{d\varphi}+h_i\frac{dm_i}{d\varphi}+h_p\frac{dm_p}{d\varphi}. \qquad (1)$$

The equation referring to the temperature change related to crank angle is:

$$\frac{dT_c}{d\varphi}=\frac{\dfrac{1}{m}\left[\begin{array}{l}-\dfrac{p\cdot dV}{d\varphi}-u\dfrac{dm}{d\varphi}-m\left(\dfrac{\partial u}{\partial\lambda}\right)\dfrac{d\lambda}{d\varphi}+\\ \displaystyle\sum_i\frac{dQ_i}{d\varphi}+\sum_j\left(h\frac{dm}{d\varphi}\right)_j-C\end{array}\right]}{\dfrac{\partial u}{\partial T}+\dfrac{A}{B}\dfrac{p}{T}\dfrac{\partial u}{\partial p}}. \qquad (2)$$

Where:

$$A=1+\frac{T}{R}\frac{\partial R}{\partial T},$$

$$B=1-\frac{p}{R}\frac{\partial R}{\partial p},$$

$$C=\frac{p}{B}\frac{\partial u}{\partial p}\left[\begin{array}{l}\dfrac{1}{m}\dfrac{dm}{d\varphi}-\dfrac{1}{V}\dfrac{dV}{d\varphi}+\\ \dfrac{1}{R}\left(\dfrac{\partial R}{\partial\lambda}\right)\dfrac{d\lambda}{d\varphi}\end{array}\right].$$

The work carried out in the cylinder is:

$$\frac{dW_c}{d\varphi} = p_c \frac{dV_c}{d\varphi}. \tag{3}$$

The pressure in the cylinder is derived from the gas state equation:

$$P_c = \frac{m_c \cdot T_c \cdot R_c}{V_c}, \quad R_c = f(p_c, T_c, \lambda_c). \tag{4}$$

The change of the cylinder volume is determined by the crank mechanism kinematics.

$$\frac{dV_c}{d\varphi} = \frac{V_s}{2}\left[\sin\varphi + \lambda_m \frac{\sin\varphi \cdot \cos\varphi}{\sqrt{1-\lambda_m^2 \cdot \sin^2\varphi}}\right] \tag{5}$$

3.2 Heat transfer from the cylinder walls

According to Hohenberg, [3] the coefficient of the heat transfer in the engine cylinder is determined using the equations:

$$\frac{dQ_{st}}{d\varphi} = \sum_{i=1}^{n} \alpha_c \cdot A_{st,i}(T_{st,i} - T_c)\frac{dt}{d\varphi} \tag{6}$$

$$\alpha_c = C_1 V_c^{-0,06} p_c^{0,8} T_c^{-0,4} (c_m + C_2)^{0,8}. \tag{7}$$

3.3 Model of the combustion

The heat release rate during fuel combustion is:

$$Q_g = f(\varphi) = x_g \cdot m_g \cdot H_d \cdot \eta_{Izg}. \tag{8}$$

This paper uses the analytic form of the combustion function according to Vibe, where the combustion process is divided into two parts:

$$x_g = x_{g1}(\varphi) + x_{g2}(\varphi), \tag{9}$$

$$x_{g1}(\varphi) = 1 - \exp\left(-C\left(\frac{\varphi - \varphi_{PI}}{\varphi_{TI}}\right)^{m_1+1}\right), \tag{10}$$

$$x_{g2}(\varphi) = 1 - \exp\left(-C\left(\frac{\varphi - \varphi_{PI}}{\varphi_{TI}}\right)^{m_2+1}\right). \tag{11}$$

Where: C=6,901 (for 99,9 % of fuel combustion efficiency).

According to Woschni and Anisits [4], Vibe's exponent depends on the ignition delay, mass of the working fluid, and the engine speed, as it is defined by the equation (12), whereas the variation in combustion period is set by the equation (13).

$$m = m_0 \left(\frac{\Delta\varphi_{ZP,0}}{\Delta\varphi_{ZP}}\right)^{0,5} \left(\frac{p_c \cdot T_{c,0}}{p_{c,0} \cdot T_c}\right) \left(\frac{n_{M,0}}{n_M}\right)^{0,3} \tag{12}$$

$$\Delta\varphi_{TI} = \Delta\varphi_{TI,0} \left(\frac{\lambda_0}{\lambda}\right)^{0,6} \left(\frac{n_M}{n_{M,0}}\right)^{0,5} \tag{13}$$

The equation according to Sitkei is used for calculation of the ignition delay [5]:

$$\Delta\varphi_{ZP} = 0,5 + \exp\left(\frac{3,92782}{T_{c,ZP}}\right) \cdot \left(0,1332 \cdot p_{c,ZP}^{-0,7} + 4,637 \cdot p_{c,ZP}^{-1,8}\right). \tag{14}$$

During the combustion there is no mass exchange between the cylinder and the environment, therefore:

$$\frac{dm_c}{d\varphi} = \frac{dm_{g,c}}{d\varphi} = \frac{dx_g}{d\varphi} m_{g,pr}, \tag{15}$$

$$\frac{d\lambda_c}{d\varphi} = -\frac{\lambda_c \cdot dm_{g,c}}{m_{g,c} \cdot d\varphi}, \tag{16}$$

3.4 Model for the mass exchange in the cylinder

When modelling the thermodynamic process during the gas exchange period within the engine, the gas flow through the scavenge ports and the exhaust valve should be determined. The quasi-stationary flow is assumed. There is no combustion during the working fluid exchange. The gas flow can be calculated with the aid of a continuity equation for the stationary flow:

$$\frac{dm}{d\varphi} = \alpha_v \cdot A_{v,geom} \cdot \psi \cdot p_1 \sqrt{\frac{2}{R_1 T_1} \frac{dt}{d\varphi}}, \qquad (17)$$

where:

$$\psi = \sqrt{\frac{\kappa}{\kappa-1}\left[\left(\frac{p_2}{p_1}\right)^{\frac{2}{\kappa}} - \left(\frac{p_2}{p_1}\right)^{\frac{\kappa+1}{\kappa}}\right]} \qquad for$$

$$1 \geq \frac{p_2}{p_1} \geq \left(\frac{2}{\kappa+1}\right)^{\frac{\kappa}{\kappa-1}},$$

$$\psi = \left(\frac{2}{\kappa+1}\right)^{\frac{1}{\kappa-1}} \sqrt{\frac{\kappa}{\kappa+1}} \qquad for$$

$$\frac{p_1}{p_2} \geq \left(\frac{\kappa+1}{2}\right)^{\frac{\kappa}{\kappa-1}}.$$

The variation in air excess ratio due to gases entering from a receiver marked with index *i* occurs only during gas inlet and it is:

$$\frac{d\lambda_c}{d\varphi} = \frac{\frac{dm_{c,i}}{d\varphi}\left(1 - \frac{m_c \cdot m_{g,c,i}}{m_{g,c} \cdot m_{c,i}}\right)}{L_{st} \cdot m_{g,c}} = \frac{\frac{dm_{c,i}}{d\varphi}\left(1 - \frac{\lambda_c \cdot L_{st} + 1}{\lambda_i \cdot L_{st} + 1}\right)}{L_{st} \cdot m_{g,c}}. \qquad (18)$$

The variation of combusted fuel mass in the cylinder during scavenging process is:

$$\frac{dm_{g,c}}{d\varphi} = \frac{dm_{c,i}}{d\varphi} \frac{1}{\lambda_i \cdot L_{st} + 1}. \qquad (19)$$

The working fluid exhaust from the two-stroke engine cylinder with uniflow scavenging starts with the opening of the exhaust valve. The scavenging process starts when the scavenge ports open. The variation in fuel mass during the scavenging process is defined, according to the equation (20), by the difference of the exhaust gases leaving through the exhaust valve and the air entering through the scavenge ports.

$$\left(\frac{dm_g}{d\varphi}\right)_{IRM} = k_u \frac{dm_u}{d\varphi} - k_i \frac{dm_i}{d\varphi}. \qquad (20)$$

The concentration of the combusted fuel in inlet and exhaust gases depends on the type of scavenging. In this paper, the scavenging model has been designed in compliance with the Benson-Brandham model [6], which describes scavenging as a combination of displacement and mixing, with the possibility of short circuiting of the fresh charge directly through the exhaust valve.

3.5 Results off the simulation

The simulation model has been used to simulate engine working parameters for three different cylinder volumes. In practise this can be obtained by inserting different shims under the piston rod. Referent cylinder volume is 0,375 m^3, and corresponding compression ratio is 17,2. The diagrams presenting the results also contain the results for bigger volume off 0,377 m^3 (-10) with corresponding compression ratio being 15,84 and for smaller volume of 0,373 m^3 (+10) with the corresponding compression ratio being 18,89.

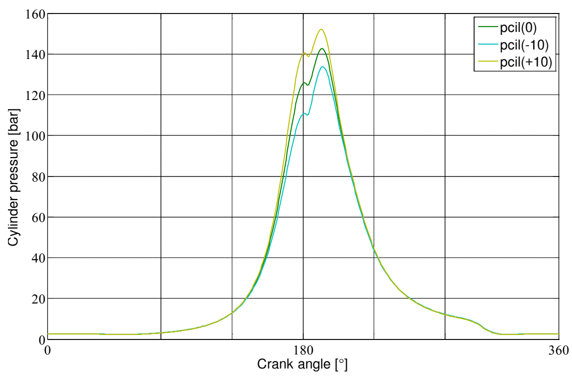

Figure 2. Pressure curve in the cylinder at varying compression ratio.

When analysing the results presented by the diagram in Figure 2 it can be noticed that in case of increased compression ratio the maximum pressure has not risen as much as in case of lower compression ratio. The increased compression pressure results in more work per cycle, therefore less fuel consumption at the same load (Figure 3).

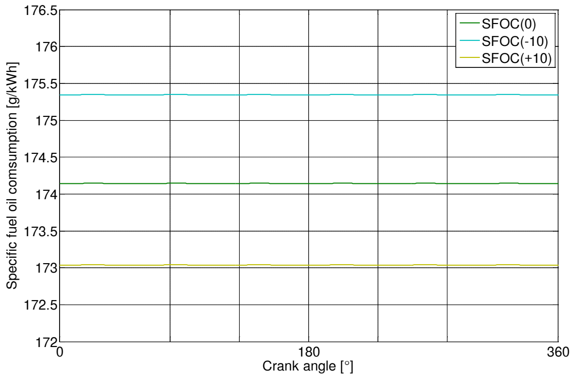

Figure 3. Specific fuel oil consumption at varying compression ratio.

Reduced compression pressure results in less work per cycle, therefore more fuel consumption. The model simulates a regulation system that maintains constant effective power according to Figure 4, hence the same revolution speed of the drive shaft, when the amount of fuel is changed.

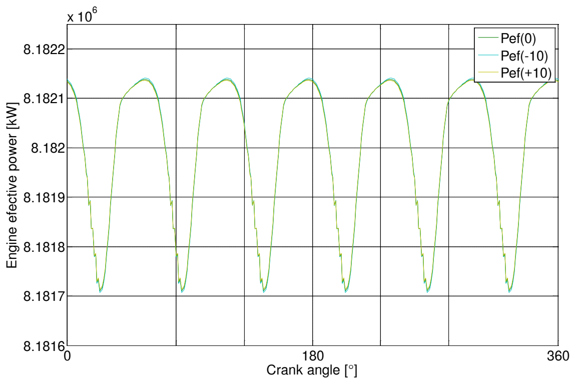

Figure 4. Engine effective power at varying compression ratio.

As compression ratio is increased, the temperature of gases in the engine cylinder is reduced due to combustion of less fuel at increased pressure (Figure 5).

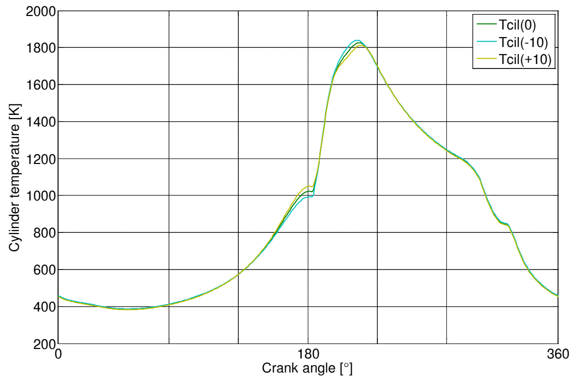

Figure 5. Temperature curve in the cylinder at varying compression ratio.

The results of simulation show the difference of 26° for the maximum temperature in cylinder due to the difference between the bigger and smaller volume of the cylinder. The difference is clearly observable in Figure 6.

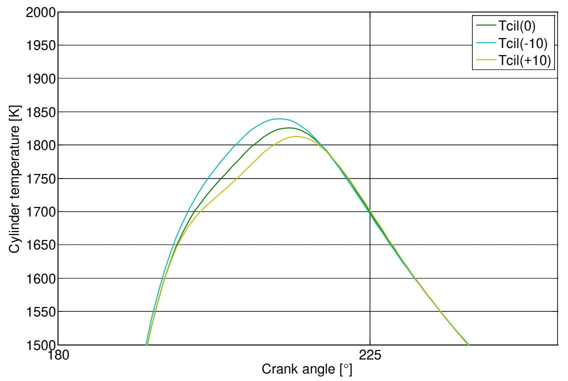

Figure 6. Enlarged view of the temperature curve in the cylinder at varying compression ratio.

On the contrary, reduction of compression pressure results in higher temperature of gases in the engine cylinder due to combustion of more fuel at reduced pressure. Boundary temperatures are very important because of NO_x emissions.

In line with the temperature distribution in the cylinder, the temperature of exhaust gases also rises. Figure 7 shows the temperature fluctuations in the exhaust gas receiver due to exhaust from each cylinder.

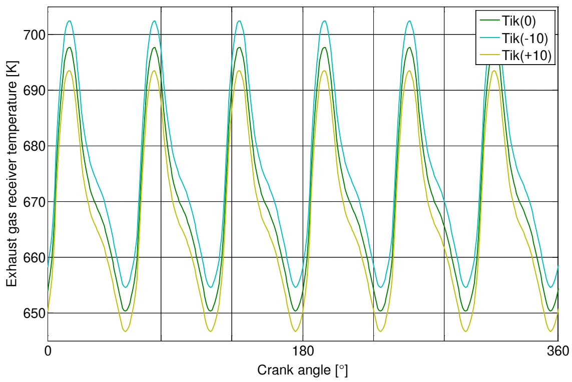

Figure 7. Exhaust gas receiver temperature.

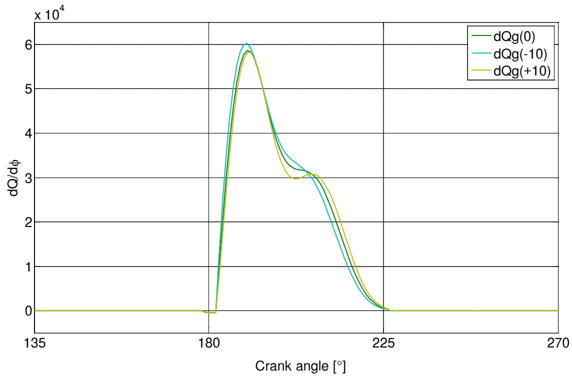

Figure 8. Heat release rate in cylinder.

The heat release rate during the combustion process in the cylinder has been presented in Figure 8.

4. CONCLUSIONS

This paper discusses the development of a computer-aided simulation model for a marine internal combustion slow-speed two-stroke turbocharged engine. The model has been designed using the computer application MATLAB 7.0 – SIMULINK.

The basic goals of the model include:

- easier monitoring and predicting the behaviour of certain parameters of the marine propulsion diesel engine
- monitoring of all parameters during simulation
- faster way of obtaining the desired values from the propulsion system.

The paper provides an analysis of a marine slow-speed two-stroke diesel engine subjected to changes in compression ratio of engine cylinders. According to the research findings, increased pressures in the cylinders result in a more efficient engine performance with lower fuel consumption. Lower temperatures of exhaust gases reduce the emissions of harmful gases such as NOx.

This paper may serve as a basis for further research focusing on the implementation of this type of model into electronically controlled diesel engines. The existing model can be upgraded in such a way that it promptly produces both graphic and datasheet layouts of the changes in engine performance and the interdependence of the desired values in order to address the problem of regaining the initial effective engine power after the pressures in the cylinders have changed.

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Symbols

A	-area, m^2
a	-heat transfer coefficient, $J/m^2 s \cdot K$
h	-specific enthalpy, J/kg
k_u	-concentration of the combusted fuel in inlet gas
k_i	-concentration of the combusted fuel in exhaust gas
L_{st}	-stoichiometric air mass, kg/kg
m	-mass, kg
m	-Vibe's exponent
n	-revolution speed, min^{-1}
p	-pressure, Pa (bar)
Q	-heat, J
R	-gas constant, J/(kg◌K)
T	-temperature, K
u	-specific internal energy, J/kg
V	-volume, m^3
W	-work, J
x	-relative part of the heat released during fuel combustion
κ	-adiabatic exponent
λ	-air excess ratio
λ_m	-ratio r/l of the cranking linkage
φ	-crank angle, °
ψ	-flow function

Subscripts

c	-cylinder
g	-fuel
geom	-geometrically
IRM	-working fluid exchange
i	-exhaust, index
j	-index
M	-engine
o	-nominal operating point
od	-released
p	-working fluid leaking
PI	-combustion start
pr	-process
s	-stroke
st	-wall
TI	-combustion period
u	-suction
v	-valve, channel
ZP	-ignition delay

EUROPEAN AIR TRAFFIC MANAGEMENT SYSTEM WITH REFERENCE TO BOSNIA AND HERZEGOVINA

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ABSTRACT

The continuous growth of air traffic and transport demand in Europe caused high rates of airspace congestion and delays in air traffic at the end of the last century. The impact of delays and congestion in air traffic is reflected on the economy in huge financial losses and unnecessary costs. The European Air Traffic Management System (ATMS), due to the large number of defects, greatly contributes to the creation of congestion and delays in air traffic, and it is, therefore, necessary to reorganize and optimize it.

Reorganization and optimization of the European ATM system began in early 2000 by introducing the Single European Sky project. This project identified the main problems of the European ATM system, such as fragmentation of airspace, technical obsolescence systems and infrastructure, differences in procedures used by the European air navigation service providers, lack of the plans and the development strategies at the European level, poor cooperation between the neighboring countries, poor information flow, mismatch of the route network, poor coordination between military and civilian authorities, and the lack of airspace capacity. This paper analyzes the current status of implementation of the European air traffic management system, and the projection of air traffic following the implementation of the Single European Sky legislation.

In this context, the paper specified the main determinants of strategic development of air traffic management system in Bosnia and Herzegovina, and its implementation and operationalization.

KEY WORDS

Air Traffic Management System, Single European Sky, SESAR project, Air Navigation Service Provider

1. INTRODUCTION

European airspace along with the associated airports is at risk of excessive congestion. Around 800 million passengers every year pass through more than 440 European airports. About 27 000 controlled flights are carried out in the European airspace on a daily basis which indicates to 9 million controlled flights annually. Approximately 80% of these flights take place within the European Union.

European air transport sector successfully copes with the current situation. It is expected that air traffic will grow by 3% per year, under normal economic conditions. Increase by 50% in the number of flights is also expected in the next 10 – 20 years.

In such circumstances it would be chaos, if anything was not done. Apart from large portion of potential demand decline, Europe would be exposed to delays and flight cancellations at an unprecedented scale so far. Due to congestion, costs would increase for about 50% till 2050.

The main problem of European air traffic management system is its fragmentation and inefficiency. European airspace is still divided into 27 national air traffic control systems which provide services from 60 centers, while the airspace itself is divided into more than 650 sectors. This means that the airspace is currently organized concerning national boundaries and therefore flying direct route is often not possible. Because of the airspace fragmentation, aircraft in Europe fly on average 42 kilometers longer than necessary causing thereby longer flight duration, delays, higher fuel consumption and carbon dioxide emissions.

Additional costs, which are passed on to businesses and passengers, in the amount of 50 billion euro annually occur as a consequence of inefficiency caused by the airspace fragmentation. Air traffic control services currently account 6 – 12 percent of the total airline ticket cost value. Faced with these challenges, the European Commission launched the Single European Sky initiative (SES) in 2004 which seeks to eliminate national boundaries and create a single European airspace in order to:

- increase safety tenfold,
- increase airspace capacity threefold,
- decrease costs for air navigation service provision for at least 50%,
- reduce environmental influence of air traffic by 10% [1].

Single European Sky initiative consists of two regulatory packages. The first regulatory package SES I (introduced in 2004) was capacity and safety oriented but no importance was given to the overall efficiency of air navigation service provision. Therefore, the second regulatory package SES II was implemented in 2009 in order to strengthen and accomplish given performance objectives of certain key areas which had not been fulfilled through first regulatory package. The Single European Sky II, except for the performance scheme implementation, gave regulatory framework for the functional airspace block, network manager and charging scheme.

2. EUROPEAN AIR TRAFFIC MANAGEMENT SYSTEM

Air traffic plays a significant role in the economy and society of the European Union. In that context, air traffic management system (ATMS) is crucial for air traffic operations whose challenges relate to competitiveness, safety and sustainability. Compared to other similar systems in the world, the European air traffic management system costs additional 2 – 3 billion euro annually due to its complex structure.

For example, the US[1] air traffic management system is twice as effective as the European ATMS because it manages the double number of flights with threefold less number of air traffic control centers at similar costs.

The main question is – how will the European airspace adapt to air traffic flow increase when at the same time costs are reducing and air traffic performance is enhancing?

The answer lies in the initiative of organizing airspace into functional airspace blocks according to traffic flows rather than national boundaries. Such initiative would not have been possible without common rules and procedures established at European level. Single European Sky initiative was launched precisely for this reason – to comply with the aforementioned needs.

2.1 The Single European Sky initiative

Since it is still based on national sovereign airspace, the European air traffic management system is still highly fragmented and dominated by national monopolies which provide air traffic control services. Given the substantial increase of air traffic due to unique aviation market development, the airspace fragmentation poses serious capacitive problems and major delays for passengers. While the air navigation service

[1] US – United States

provision costs in Europe amount 8 billion € annually, the total additional costs defrayed by airlines due to suboptimal efficiency and fragmentation are estimated at approximately 4 billion € a year [1].

There has been a rapid delay increase in air traffic with serious implications for users and significant financial burden on airlines. Delays in air traffic represent combination of following factors:

- insufficient air traffic control system's capacity,
- adverse weather conditions,
- airport problems, or
- problems within the airlines

Imposed costs for airlines amount between 1.3 and 1.9 billion € per year.

Air traffic definitely recovered after a temporary slowdown following decline of the world economy and after terrorist attack in September 2001. Estimates indicate that air traffic will grow 4% annually over the next 15 years leading almost to its doubling by 2020.

In addition, air traffic amplification requires constant emphasis on safety. Safety management and regulation framework must be strengthened in order to enable continuous traffic growth without passenger exposure to risk. The Single European Sky initiative is ambitious reform of European air traffic control system's structure and is mainly intended to organize airspace at European level (including ATC[2]) [2].

Decision for launching SES initiative was adopted in 1999 in Brussels with the announcement of European Commission. Reasons for initiating the Single European Sky result from continuous air traffic growth, congestion boost and thus delay increase, major losses with the impact on the economy. All of the conducted analyses were indicating the trend of further deterioration of the mentioned conditions and projection of additional losses with cost accumulation. Estimated indirect costs due to congestion and delays amounted 5.4 billion € per year.

Single European Sky initiative seeks to minimize the impact of fragmented European airspace by consolidating the European sky into unique system with abolition of national boundaries. This is the context in which decision to launch SES initiative (intended to establish a unified airspace) was adopted. An important factor in starting this initiative is the fact that EUROCONTROL[3] did not provide sufficiently reliable and adequate methods in its strategy and air traffic development projection which could satisfactory respond to continued traffic growth without increasing congestion and delays make possible.

The initiative includes national air navigation service providers and plans for graduate establishment of unified airspace over Europe. Countries included in the SES initiative are shown in Figure 1 (EU[4] Member States, ECAA[5] Member States, countries with signed cooperation agreement and countries which are still in negotiating process).

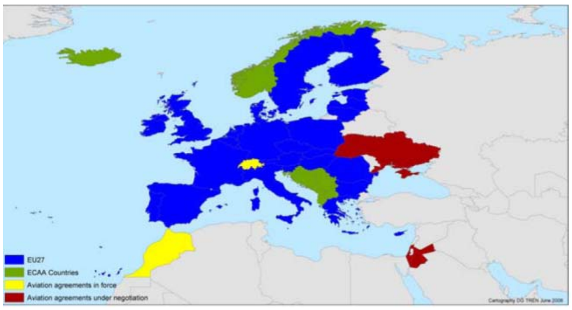

Figure 1. SES initiative in Paneuropean dimensions

Planning and establishment of initiative is conducted by EUROCONTROL which provides a reference framework for all participants in SES. To ensure compatibility of all participants and systems involved in unique framework, it is necessary to set up a whole range of measures. The EUROCONTROL's role implies setting up alternative routes and accompanying plans in cases of emergency.

It is required to accept SES initiative at national levels as well as to blend and harmonize national, regional and global plans. For this reason, initiative should be viewed through a political framework. So as to realize this comprehensive initiative, decision-making mechanisms are necessary for providing specific measures to fulfill this requirement. Separation between ANSP[6]s'

[2] ATC – Air Traffic Control

[3] EUROCONTROL - European Organization for the Safety of Air Navigation

[4] EU – European Union

[5] ECAA – European Common Aviation Area

[6] ANSP – Air Navigation Service Provider

functions and regulator must be carried out (i.e. creation of separate organizational units) in order to conduct all activities in efficient and safe way.
The main objective is compliance with future capacitive and safety needs through regulatory packages. As a response to dramatic increase in air traffic which we have witnessed in the last two decades, the European Commission adopted two regulatory packages aimed at creating a legislative framework of European aviation.

2.2 Single European Sky regulatory constitution

Draft of the first regulatory package (SES I) created in 2001 was accepted by the European Parliament and the European Council at the end of 2004 and entered into force one month later. Tasks of this regulatory package were referring to increase in safety and efficiency of European air traffic, delay reduction, service improvement, cost reduction by reducing the fragmentation of ATM systems and the integration of military into the European ATM[7] system [1].
The first regulatory package provides an approach to solving these problems, meets the required standards and enables successful overcome of anticipated traffic growth. It consists of four basic regulations that enhance safety, foster the reconstruction of European airspace and provides a framework for the creation of additional capacity, efficiency and interoperability improvement.
The four mentioned requirements refer to:

- a framework for creating the SES initiative,
- air navigation service provision within SES,
- organization and usage of airspace within SES,
- interoperability of the European air traffic management system.

Since the SES initiative did not bring expected results in key areas (such as integration of airspace into FAB[8]s) and there has been no improvement in European ATM networks' cost efficiency, there was a need for upgrading the first regulatory package.

Thus, the European Commission proposed the implementation of second regulatory package in July 2008 which was adopted by the European Council and European Parliament at the end of 2009. Purpose of the second regulatory package (SES II) has been acceleration of Single European Sky from 2012 and beyond. Package consists of five pillars: performance, safety, technology, airport capacity and human factor [3]. Single European Sky II received strong support not only from airlines and airports but also from air navigation service providers. Support of the entire ATM community was confirmed with guideline approval in Madrid in 2010 and at the meeting of ministers same year. This strong political support confirms the urgent need for reformation of ATM sector and particularly the high level priority that should be given to full and forehand implementation of SES initiative.
Annual carbon dioxide emissions will be reduced by 16 tons, 2 – 3 billion € will be saved and European ATM system will completely be reformed with its establishment.
These improvements should be achieved through four basic elements:

- framework establishment for improving the performance of European ATM system by setting quantified targets,
- creation of a common safety framework in order to facilitate coordinated development of safety regulations and their effective implementation,
- new technologies and operational templates with safety amplification,
- upgrading the airport capacity management.

2.3 Performance scheme implementation

Since the first regulatory package of Single European Sky initiative did not bring any expected results, the second regulatory package (SES II) has been implemented. It consists of five pillars, all oriented to increasing the overall efficiency of air navigation service provision: technology, legislative pillar, safety, airports, and human factor (Figure 2) [4].

[7] ATM – Air Traffic Management
[8] FAB – Functional Airspace Block

Figure 2. Overview of SES II pillars

As a part of legislative pillar, the performance scheme of air navigation service providers has occurred. Performance scheme was first mentioned in 2008 when the Performance Review Commission published a discussion paper in collaboration with the European Commission. The objective of this paper was to inform about general principles about the implementation of performance scheme in accordance with the Regulation 549/2004. Discussion paper eventually resulted with a detailed regulation draft in 2009 and then adoption of Regulation 691/2010 laying down a performance scheme for air navigation services and network functions in 2010.

The Performance scheme should provide indicators and binding targets of four key performance areas (KPA):

- safety,
- environment,
- capacity, and
- cost-efficiency.

Key performance indicators (KPI), used for setting up certain targets, are allocated to each KPA. Consequently, the key performance indicators are as follows:

- within the KPA Safety → Effectiveness of Safety Management (EoSM), RAT method application and Just Culture,
- within the KPA Environment → average horizontal en route flight efficiency,
- within the KPA Capacity → minutes of en route ATFM delay per flight,
- within the KPA Cost efficiency → determined Unit Cost for en route air navigation services [5].

Implementation of performance scheme is carried out during two reference periods. First reference period, considered to be a transitional period, includes the time between 2012 and 2014 while the second reference period includes the time between 2015 and 2019.

Targets for every reference period are set at EU level, as well as the national and functional airspace block level. According to its transitional feature, targets for first reference period are set in environment, capacity and cost efficiency key performance areas but not in safety KPA of which KPI are just being observed. Therefore, the targets for improving the overall efficiency of European air navigation service provision for first reference period are:

- SAFETY – States must monitor safety key performance indicators,
- ENVIRONMENT – reduce extension of en-route flights by 0.75%,
- CAPACITY – reduce annual average en-route delays to 0.5 min,
- COST EFFICIENCY – determine the unit rate at 53.92 € [6].

EUROCONTROL has been designated as the performance review body which in collaboration with the European Commission monitors, benchmarks and reviews performance of air navigation service providers at European level. National supervisory authorities are in charge of performance as far as the national or functional airspace block level.

Since proposal for EU wide targets is developed at least 15 months and then adopted 12 months before beginning of reference period, new targets are set for second reference period which are:

- SAFETY – all air navigation service providers have to achieve at least EoSM level 4 in all management objectives; by the end of RP2, all ANSPs should be reporting ATM Ground using the RAT methodology for severity classification for all reported occurrences (i.e. 100%),
- ENVIRONMENT - average horizontal en route flight efficiency will have to range between 4.1% - 4.4%,
- CAPACITY – annual average en-route delays will have to amount between 0.3 – 0.6 min,
- COST EFFICIENCY – still in determination process [7].

2.4 Technological support to Single European Sky initiative

If Europe wants to face the challenges of transport demand, it needs to accelerate development of air traffic control system. Equipment used in the European ATM system has not changed or evolved in last several decades and newly adopted initiative cannot be based on outdated technology. Single European Sky ATM Research (SESAR) program is imposed as a solution.

It is ATC infrastructural and technological modernization program which should develop a new generation of ATM system capable of providing high level of safety and traffic flow in the next 30 years [8]. SESAR deployment will solve the fragmentation and diversity problem as far as the equipment used by air navigation service providers as well as the users. It will also accelerate air traffic and aviation technological expansion by new system appliance.

With a view to SESAR realization, management instrument assurance is needed. Therefore, the European Commission adopted a regulation on the joint venture establishment for developing new generation of EATMS (SESAR JU).

SESAR JU is composed of two founders (EUROCONTROL and European Commission) and 15 members representing all ATM stakeholders: civil and military ANSPs, aircraft and equipment manufacturers. In addition, SESAR JU includes airspace users, scientific institutions with numerous associated partners, employees' associations that conduct numerous activities for program realization.

3. STATUS OF AIR TRAFFIC MANAGEMENT IN BOSNIA AND HERZEGOVINA

Since Bosnia and Herzegovina still does not have its own ATMS or human resources, the provision of air traffic control services in Bosnia and Herzegovina is segmented, complex, uneconomic and contains a number of agreements with the third parties.

Considering the current situation, the airspace of Bosnia and Herzegovina, in terms of sectorisation and organization of the air navigation service provision, and the vertical layers of airspace, is described as follows:

„According to the Temporary agreement on delegation of responsibility for the provision of air traffic services in upper airspace of Bosnia and Herzegovina, between BHDCA[9], CCL[10] and SMATSA[11], the provision of air traffic services in the portion of the airspace of Bosnia and Herzegovina (FIR[12] Sarajevo – upper airspace) from FL 290 to FL 660 is delegated to CCL westward and SMATSA eastward of straight lines" (Figure 3) [9].

Figure 3. Current responsibility of ATS of neighboring countries in upper airspace of Bosnia and Herzegovina

According to the recommendations of ICAO[13] and the need that the airspace of Bosnia and Herzegovina is reopened for the civilian air traffic, in 1999 the agreements on delegation of responsibility for the provision of air traffic control services in the airspace of Bosnia and Herzegovina were signed with the Croatian and Serbian ANSP.

For the time being, a provision of air traffic control service in the lower and upper airspace of Bosnia and Herzegovina is still performed by CCL and SMATSA, while the provision of air traffic control

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[9] BHDCA – Directorate of Civil Aviation of Bosnia and Herzegovina
[10] CCL - Croatia Control Limited
[11] SMATSA - Serbia and Montenegro Air Traffic Services Agency
[12] FIR – Flight Information Region
[13] ICAO – International Civil Aviation Organization

service in TMAs[14] is performed by BHANSA[15] from the beginning of 2014.
Currently, the Bosnia and Herzegovina airspace volume is part of sectorization of ACC[16] Zagreb and ACC Belgrade. It is vertically sub-divided into lower, upper and top upper airspace in accordance with the levels shown in Figure 4.

<table>
<tr><td colspan="12">Strictly prohibited without prior co-ordination</td></tr>
<tr><td colspan="12">FL460</td></tr>
<tr><td colspan="6">TU
ACC Zagreb</td><td colspan="6">WTU
ACC Beograd</td></tr>
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ACC Zagreb</td></tr>
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Figure 4. Current airspace sectorization of Bosnia and Herzegovina

In the lower en-route airspace three sectors are handled by ACC Zagreb. In the upper and top upper airspace ACC Zagreb handles four sectors. ACC Belgrade handles eight sectors. The division between lower and upper airspace control area is at FL 285. According to the agreement between Croatia and Bosnia and Herzegovina, ATS[17] delegation to CCL in Croatia is applied over the whole lower airspace of Bosnia and Herzegovina from FL 095 to FL 285 (Figure 5).

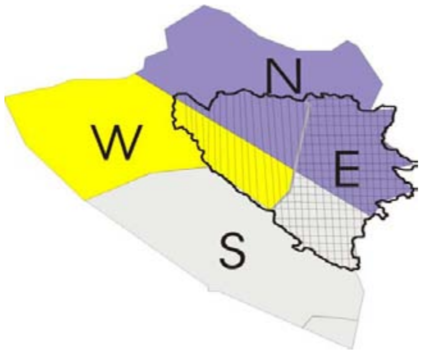

Figure 5. Croatian Lower sector division incorporating ATS delegation to CCL in B&H lower airspace

3.1 Regulatory framework

Pursuant to the Article 28 of Convention on International Civil Aviation, each member state is responsible for providing air navigation services over its territory. This international obligation of Bosnia and Herzegovina was established under the Article III, Paragraph 1, item (j) of the Constitution of Bosnia and Herzegovina, which was defined that the air traffic control is under the authority of the institutions of Bosnia and Herzegovina.
In the Article 5, Paragraph 3 of Aviation Law of Bosnia and Herzegovina, it was defined that the air navigation services in the airspace over the territory of Bosnia and Herzegovina shall be provided by ANSP.
In accordance with these provisions, the development processes have been initiated on the basis of which the conditions for the implementation of ATM system in Bosnia and Herzegovina were created.

3.2 Allocation of costs and revenues of en-route air navigation services

According to appendices of agreements, concluded between BHDCA, CCL and SMATSA on the provision of air traffic control services in the area of airspace of Bosnia and Herzegovina, the financial arrangements charges for rendered air traffic control services have been set out between these entities.

[14] TMA – Terminal Manoeuvring Area
[15] BHANSA – Bosnia and Herzegovina Air Navigation Services Agency
[16] ACC – Area Control Centre
[17] ATS – Air Traffic Services

In accordance with financial arrangements, the ratios were predefined, according to which the distribution of the collected funds was performed for the period 2005 - 2013 (Figure 6).

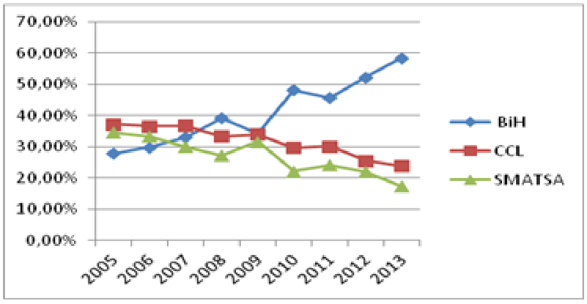

Figure 6. Comparison of the distribution of funds from overflights between the entities involved

Although the first two years of the study period had a gradual upward trend, it can be seen that the smallest percentage of the funds from overflights belonged to Bosnia and Herzegovina. After this period, the percentage begins to grow in favor of Bosnia and Herzegovina, since the cost base for providing of air navigation services was created according to the transition plan, which has been prolonged several times. According to that plan, Bosnia and Herzegovina should have put its own ATM system into operation a long time ago. A sudden increase in funds from overflights in favor of Bosnia and Herzegovina was observed during 2010, because BHANSA was established a year earlier, and therefore the cost base for providing of air navigation services includes the cost which will be generated by BHANSA.

On the basis of a multilateral agreement on route charges to which Bosnia and Herzegovina was integrated from the 1st January 2005, the financial costs of the air traffic control services shall be as follows:

- in the domain of area control - the revenue generated from the overflights;
- in the domain of approach and aerodrome control - the revenue generated from terminal charges.

Based on EUROCONTROL principles and to the designed cost base of air traffic control services in Bosnia and Herzegovina for 2009, the costs of en-route air navigation services over the territory of Bosnia and Herzegovina to the involved subjects are shown in Figure 7, [10]. It can be seen that CCL has the largest share of the costs of en-route services, which is understandable, since it provides air traffic control service in the most part of the airspace of Bosnia and Herzegovina.

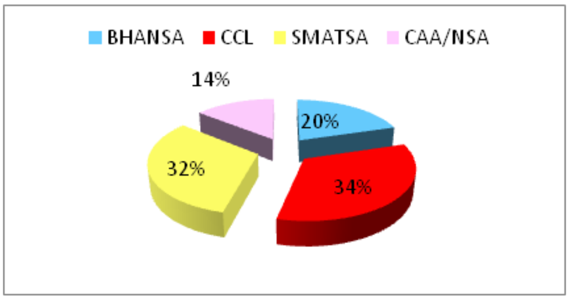

Figure 7. Entities in the costs of en-route air navigation services in Bosnia and Herzegovina in 2009

The costs of en-route air navigation services in Bosnia and Herzegovina in 2009, by type, are shown in Figure 8. It can be seen that the most of the costs refer to operating ones, which part are the costs of Eurocontrol's service, which constitute 6.26% of the total operating costs in 2009.

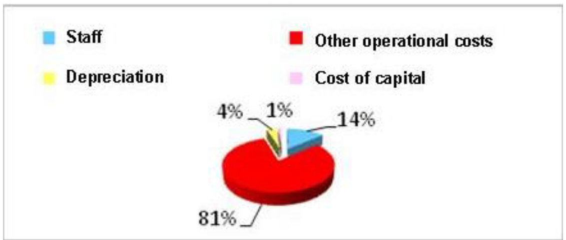

Figure 8. Share of costs types of en-route air navigation services in Bosnia and Herzegovina in 2009

With the establishment of BHATM[18] system it would cease the need to hire CCL and SMATSA for providing area control services in Bosnia and Herzegovina. In such a way, 70% of revenues from overflights over the territory of Bosnia and Herzegovina, which belonged to CCL and SMATSA in 2005, when BHATM strategy was adopted, would become the future revenues of BHANSA.

By creating the BHATM strategy, the activities have been undertaken to build and establish BHATM system, which will be:

[18] BHATM – Bosnia and Herzegovina Air Traffic Management

- sustainable and operational with its own resources;
- economically justified;
- in accordance with ICAO standards;
- in accordance with the standards of EUROCONTROL;
- in accordance with the standards of ECAC[19];
- in accordance with the FAB CE[20] project;
- in accordance with the Aviation Law of Bosnia and Herzegovina;
- with the possibility of involvement in regional and European ATM systems.

BHATM strategy established two strategic objectives:

- creation of BHATM system capable of taking over the function for providing air traffic control services over the territory of Bosnia and Herzegovina in accordance with the standards of Eurocontrol, and fulfilling the requirements arising from the FAB CE agreement;
- implementation of a functional transformation of the civil aviation institutions in Bosnia and Herzegovina, and harmonization with the European Commission in terms of the separation of regulatory and operational functions of air traffic control.

Based on the regulations of the European Commission, and in accordance with the procedures conducted in most European countries, Bosnia and Herzegovina has entered into a process of separation of regulatory and operational functions of air traffic control.

In this sense, the process of establishing BHANSA was launched and completed. It will consolidate the management and functioning of the new air traffic services in Bosnia and Herzegovina, as well as the existing operational approach and aerodrome control units.

4. CONCLUSIONS

Continuous air traffic and transport demand growth in Europe caused high rates of airspace congestion and delays at the end of the last century. Congestion and delay impact is reflected on the economy with huge financial losses and unnecessary costs. European air traffic management system greatly contributes to these problems due to large number of imperfections which imposes the need for its reorganization.

Single European Sky first regulatory package of the 2004th related to airspace restrucutring, safety and integration of military into the European ATM. Since it did not bring the expected results in important areas and there was no economic viability improvement of the EATMN – the need for SES upgrading arose.

Second regulatory package (SES II) has been adopted in order to improve the SES I and to make the European airspace safer and more sustainable. Afore-mentioned improvements should be achieved through performance scheme regulation, safety framework establishment and development of new technologies with SESAR program as well as airport capacity management. Performance scheme represents an essential part of SES II for achieving the ultimate efficiency of European air traffic through four key performance areas: safety, environment, capacity and cost efficiency. It should provide key performance indicators and binding targets (set at three different levels – EU, FAB and national) in mentioned areas in order to increase efficiency thorugh two reference periods.

Since Bosnia and Herzegovina still does not have its own air traffic management system or human resources, air navigation service provision is segmented, complex, uneconomical, and contains number of agreements with third parties. Air navigation service provision in the airspace of Bosnia and Herzegovina is currently engaged by ANSPs of neighboring countries. Therefore, Bosnia and Herzegovina launched an ATMS project which is presently in a transition phase and its full functioning is expected during the 2015. Necessity for engaging the ANSPs of neighboring countries would cease with BHATM systems' establishment. In that way, a large part of revenue arisen from flights over Bosnian and Herzegovinian territory would become the future revenues of the newly established Agency for air navigation service provision in Bosnia and Herzegovina.

[19] ECAC – European Civil Aviation Conference
[20] FAB CE – Functional Airspace Block Central Europe

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PROVIDING CONTEMPORARYNESS IN MARITIME EDUCATION: SOME EXPERIENCES FROM MONTENEGRO

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ABSTRACT

This paper considers efforts in implementing blended learning as a combination of tradional and e-learning into seafarers' education at the Faculty of Maritime Studies of Kotor (University of Montenegro). These attempts are the result of the enthusiasm of few professors, being partly supported by two small, initial projects of bilateral cooperation between Austria and Montenegro, as well as by one bigger Tempus project at which University of Montenegro has been a partner. The paper comprises the following segments: (i) The first one contains a brief description of the important moments of the maritime history (with a focus on education) in the areas of today's Montenegro littoral zone; (ii) The second one concerns contemporary issues in maritime education including possibilities of getting advantages through introducing e-learning within blended learning environment into this important field of education; (iii) Within the third part are described the projects which have supported implementation of blended learning at the Faculty; (iv) The fourth segment deals with measuring users', i.e. students' and teachers' level of satisfaction with newly implemented web based Moodle management learning system; (v) The fifth part considers some contemporary tools for creating e-instructional materials; (v) The last part recommends considerably greater promotion and valorization of cultural and historical heritage which has Montenegro in the field of maritime affairs, including maritime education as it inseparable part, as well as optimal combining maritime traditional and e-learning models.

KEY WORDS

maritime education, traditional learning, e-learning, blended learning

1. INTRODUCTION

Although education and training of (future) seafarers represent very responsible posts, it becomes evident that in the world, at the level of national legislation, there are large differences in the interpretation of the STCW (Standards of Training, Certification and Watchkeeping) Convention and its realization through teaching programs at maritime education and training institutions [1;5]. These results in issuing a large number of certificates, which do not correspond to objectively sufficient knowledge, skills and competencies of future seamen, that is, of those who may in the perspective educate the next generations of seafarers. This is, of course, a serious problem that could be overcome only by serious top-down approach, far greater investment in education and training (i.e. wages and mobility of teachers/trainers; simulators and other supporting equipment; literature; providing training onboard ships, etc). It is necessary to

engage and motivate competent teachers in the field of theoretical teaching (education) of seafarers (people with academic titles and adequate references), as well as experienced (active) captains and officers in the field of practical teaching (training); to establish active cooperation with referential maritime educational and training institutions in EU and worldwide, and also with successful shipping companies that should provide students with the appropriate training.
All mentioned above, is far beyond the scope of this paper in which the author is focused on highlighting, only, the needs:

(a) for better evaluation and presentation of traditional heritage in maritime education that exists in Montenegro, and

(b) for improving education of (future) seafarers based on the implementation of web based learning models in blended environmet.

2. SOME HISTORYCAL FACTS OF MARITIME AFFAIRS AND EDUCATION IN MONTENEGRO

The Faculty of Maritime Studies of Kotor (FMS), which is a constitutive part of the University of Montenegro, has long lasting tradition being founded even in the medieval times, when captain Marko Martinović has his own nautical school for Russian feudal lords (in 17th century) in Perast, a little seaside town near Kotor (today Republic of Montenegro). Later on, this nautical school continues to exist in Kotor, and it still works as FMS, educating students and seamen for variety of both ship and port vacations.
Maritime affairs, and education as its constituent, have long tradition along the coast which today belongs to Montenegro. Though, it is to be made a brief overview of key historical facts.
From the ancient times, the Montenegrin coast has represented the sea gate into the economically important area of the Adriatic Sea and its hinterland, primarily the Balkans.

Through the preserved archaeological findings and archival sources, it is possible, reaching into the distant past, to follow fragmentary rise of towns on the Montenegrin coast and their importance as maritime trade centers, which connected the Mediterranean and the Balkans. Here, maritime affairs have left noticeable trace in the commercial, cultural, and artistic infrastructure, not only in the towns on the Montenegrin coast, but also in those in hinterland. For that reason, all forms of preserved archeological findings, archival and library records, i.e. historical heritage, should unavoidably be the basis for research, studying or education in the field of maritime affairs.
The mentions of the littoral part of Montenegro, as an Illyrian settlement, are found in the works of Greek authors of the 5th and the 4th centuries B.C. Later on, there are the mentions of Roman writers, as well as cartographers and geographers (Ptolemy and others). These earliest mentions of the Montenegrin coastal towns and preserved archeological findings relate to the Greek colonization of Adriatic Sea, the aim of which had been placement of their goods using the sea route along the Adriatic coast and further on, within the Balkans territory towards the East and the West.
During Diocletian's reforms of the Roman Empire, when the territory of Montenegro was in the Province of Prevalis or Prevalitana, than later during the division of the Roman Empire into the Western and Eastern Roman Empire, i.e. Byzantine, and following the fall of the great Empire, the coastal towns on the Montenegrin coast survive as urban nucleus developing handicrafts, trade and cherishing cultural development.
From the middle ages date the facts about an association of navy (from 809), i.e. naval defense forces for Kotor municipality.
Preserved archival material is rich in data from the 12th century showing evidence about developed maritime commerce, than shipbuilding from 1336 (Fig. 1), shipwrecks, smuggling, piracy, sea battles and marine insurance.
Later on, a guild of seamen was founded, according to the testimony of the preserved Statute of the Fraternity from 1463 (Fig. 2). One should particularly emphasize its importance for education in the field of marine navigation at the time when there had been no maritime schools which would be founded not earlier than the mid 19th century. The modified form of this association exists today under the name the "Bokelian Navy".

There are also numerous preserved special privileges, while the oldest one dates from 1540, which the Venetian Doge or the Austrian cezar and other rulers used to award to the Montenegrin seamen for their achievements in battles or elsewhere.

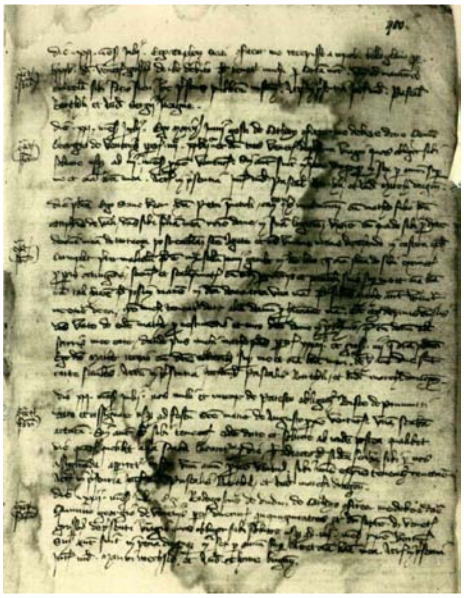

Figure 1. The ship building contract (1336).

The capital coming from the developed maritime trade flowed through centuries into the towns on the Montenegrin coast, what can be seen even today in architecture, art, different cultural monuments, folk tradition, etc. The best testimony of this is the Cathedral of Saint Tryphon built in 1166, which represents one of the oldest cathedrals in Europe [2;3;9;10;15].

Figure 2. The Statute of Fraternity of Seamen (1463).

The skill of Montenegrin seamen had been used in the past also for international training, as it is mentioned previously, in 1698 in Boka Kotorska Bay, captain Marko Martinovic (1663-1716) gave training to Russian boyars sent there by Peter the Great (Fig. 3). He had Venice Senate permission and training ship "Kotoranin" for sailing through Adriatic Sea teaching cadets in nautical science and other marine skills.

Also, there are some historical facts that the Russian emperor Peter the Great was impressed with knowledge of Matija Zmajevic (born in Perast in 1680) in nautical sciences, and consequently, he continued to quickly climb naval ranks in Russian Army. He was awarded with the title of Admiral in 1727.

Later, Montenegrin sailboats reached all parts of the world, e.g. captain Ivo Visin from Boka Kotorska Bay circumnavigated the world from 1852 to 1859 on sailing boat "Splendido".

Historical traces of rich maritime tradition on the Montenegrin coast reach until the present day and their professional application into research and educational processes can significantly contribute to the improvement of this branch of economy and to the study of maritime affairs.

Figure 3. Captain Marko Martinović teaching marine sciences in Perast (1698).

3. ABOUT CURRENT MOMENT IN MARITIME AFFAIRS AND EDUCATION IN MONTENEGRO

The actual moment of the Montenegrin economy is not flourishing one, and it is similar to the situation in the field of maritime education and training of (future) seafarers. In addition to the individual efforts of few teachers and practitioners there is no true, systemic concern about fostering Montenegrin littoral zone rich maritime tradition and ensuring its continuity.

The students who have graduated at Faculty of Maritime Studies in Kotor (University of Montenegro) can find officially (mostly by individual efforts) the employment in the agencies and firms which are focused on different maritime affairs, as well as onboard foreign companies' ships.

Although the tradition of nautical and maritime studies in general is long lasting and rich one in Kotor, and along the whole Montenegrin littoral zone, the awareness of existing new and demanding requirements of the actual world living and working flows is necessary. Accordingly, the management of the Faculty of Maritime Studies (FMS) recently came up to the idea of introducing web based learning environment for the needs of the students, especially seamen among them, and all other persons being interested in this mode of education and knowledge transfer.

3.1 Enhancing blended learning (BL)

It is to be mentioned in this context that FMS, several years ago, has faced the necessity to adapt the curricula to the Bologna system, which recommends, among other things, presence of students at almost all classes during the semester. Though, if students are not present, or if they are usually absent from their classes, there is a risk that they will not pass the exams! - This is particularly case with students who have to sail, i.e. to work as seamen to earn their salaries, and to study simultaneously [5;6;7].
During the past few years, there were numerous requirements from their side to the FMS's management to organize for them condensed courses several times a year, or to develop and offer blended learning modules. Consequently, the FMS's management, in consultations with colleagues from some other high-educational institutions in Montenegro, decided to meet their requirements and to develop and implement an appropriate blended study program supported by web based e-learning system/resources as a kind of *added value* to the traditional education [1;8;11;12;13].
What in fact provide developing blended learning (BL) instructional modules at FMS, are the good will of few teachers at the Faculty, including some colleagues from other HE institutions (Mediterran University, e.g.) and their desire to enrich traditional channels of knowledge transfer - are three projects briefly presented below.

3.2 Project on BL I

The first one is the Tempus project (2010-2013): "Enhancing the quality of distance learning at Western Balkan higher education institutions"[1]. The objectives of this project are: to improve the quality and relevance of distance education at Western Balkan higher education institutions and to enable easier inclusion of partner country

[1] www.dlweb.kg.ac.rs

institutions into European Higher Education Area. These implies the specific objectives: to improve, develop and implement accreditation standards, guidelines and procedures for quality assurance of distance education study programs according to EU practices at national level in Western Balkan (WB) beneficiary countries; to establish the framework for improving distance learning (DL) quality assurance and e-learning methodology on higher education (HE) institutional level in WB countries; to provide training for relevant members of HE educational and public authorities responsible for accreditation and evaluation of DL programs and trainers involved in DL from each partner country, etc. The project leader is University of Kragujevac (Serbia). Owing to this large project, University's of Montenegro Center of Information System "set up" Moodle (1.9.4) server, what creates the opportunity for FMS to use its capacities in preparing and realizing web based educational activities. Through this project a few teachers and assistants from FMS also had opportunities to attend some short training courses being dedicated to e-learning, and to participate in discussion with experts from EU in this domain.

3.3 Project on BL II

The second considered project is a small project of bilateral cooperation realized between FMS and the Academy for New Media and Knowledge Transfer – ANMKT (University of Graz). This project entitled: "Developing an e-learning module at Faculty of Maritime Studies (Kotor, Montenegro) for the seamen educational needs" had as its main aim: conceiving a new web based educational program at FMS devoted primarily to the seamen (among the students) needs. However, this module should be used by all other potential users, besides seamen, who are interesting in such kind of acquiring knowledge. The University of Graz supported the project by bringing in perennial expert knowledge in novel e-based didactical methods and techniques. In return developed e-learning methods and tools were tested on the basis of a concrete case study. Within this project (2011-2013) experts from ANMKT transferred very useful practical skills on the use of Moodle Management Learning System (MLS) in the effective implementation of e-learning to the teachers and system engineers of FMS throughout several trainings organized in Montenegro.

3.4 Project on BL III

The third important project within this context is a follow-up of the previously described project of bilateral cooperation between FMS and ANMKT. This project entitled: "Distant learning implementation at the Faculty of Maritime Studies, University of Montenegro, as the additional mode of education" aims effective implementing and developing of web based learning system at the FMS as additional mode of knowledge transfer, devoted, again, primarily to the seamen needs. ANMKT was the partner in conceiving this web-based instructional module and through this project it supports its effective implementation. In the mean time, this blended learning (DL) module has been accredited by the Montenegrin National Council for High Education, and the study program started officially in September, 2012. This DL module is still implemented by Moodle platform, and currently it is available at the FMS's web portal[2].

The materials for some of the planned courses are uploaded at the platform, and they are currently available to the certain number of teachers and students who can test them on-line, and give suggestions toward their improvements. In this second phase of the project, possibilities of enriching on-line resources by introducing audio/video/screencapturing records shall be considered, as well. The possibilities of extending this e-learning aid toward the mobile-learning one, by the Windows 7 Phone [4;16] and some other similar applications, for mobile devices like i-Phones, shall be considered as well. This project is approved and it will be realized within the ongoing two years period (2014-2015).

These three projects are in fact perpetuators of implementing and developing web based learning system and instructional resources at the FMS.

[2] fzp.moodle.ac.me/login/index.php

4. MEASURING USERS' PERCEPTION OF BLENDED LEARNING AT FMS

From the very beginning of blended/e-learning introducing and developing at FMS, several surveys among the students (here e-learners) have been conducted in order to examine how their perceptions of the advantages and disadvantages of blended learning (BL) model correspond with the creators' of the project(s) ones. In total, 110 students at the postgraduate level have been interviewed (in academic 2012-2013 year). Specifically, the students were supposed to identify BL advantages and disadvantages, according to their perceptions, among the offered advantages and disadvantages [5;7]:

(i) *Advantages*

A1: The possibility of learning from home and working place (during the breaks);
A2: Reducing the traveling costs and time saving;
A3: Easier access to the instructional materials;
A4: Possibility of self knowledge evaluation through on-line tests;
A5: Ability to communicate via the net with teachers and other candidates; and
A6: More effective learning.

(ii) *Disadvantages*

D1: Lack of direct contact with teachers;
D2: Inability to put a question, and get the answer immediately, when there is some ambiguity in knowledge transfer;
D3: A nonstandard form of learning that requires a strong will, self-discipline, and high level of concentration; and
D4: Some exams are taken on-line, which is sometimes stressful, due to limited time, and present fear if the technique will/will not function properly.

What is indicative, more than 50% of the respondents agreed that the suggested advantages of BL system: A1, A2, and A3, are "indeed" benefits of BL, as it was assumed by the creators of the system (Fig. 4).

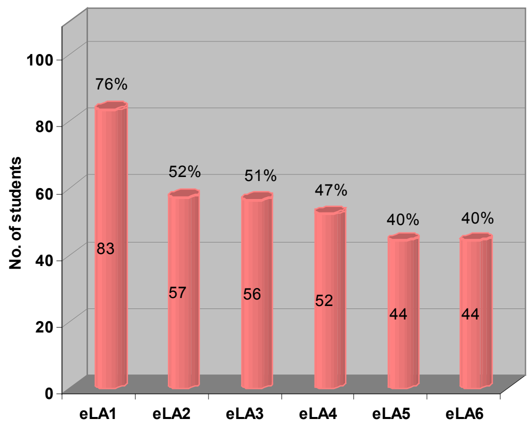

Figure 4. Number of users who opted for the offered BL advantages.

On the other side, among the disadvantages of BL system, more than 50% of respondents identified only predefined disadvantage D2 as "real" disadvantage (Fig. 5). How these obtained results can be interpreted? - Most of the surveyed students are still not convinced that the possibilities of self-controlling learning process, learning community activities, and more effective learning are the advantages of BL (A5 and A6 are lower than 50%). What does it imply? – It implies that students should be convinced into these BL system benefits, i.e. more intensive communication to the teachers and among the students themselves should be enabled, as well as more interesting and inciting self evaluation tests and educational games, etc. Consequently, the learning outcomes and the e-learners' satisfaction level should be greater.

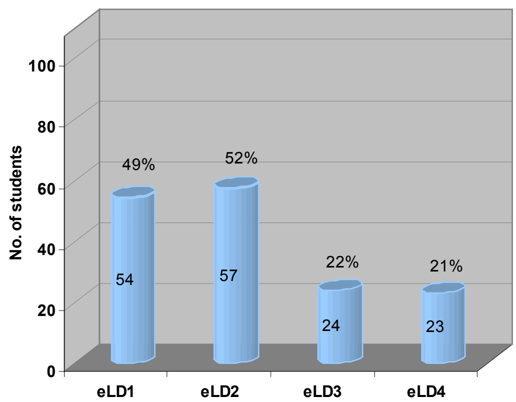

Figure 5. Number of users who opted for the offered BL disadvantages.

If we analyze further the supposed disadvantages of BL, the e-learners do not see as big problems: on-line testing, need for a strong self motivation, and lack of direct contact to the teachers, otherwise offered through the traditional classroom teaching/learning. But, what e-learners really need is undoubtedly more frequent consultations with the teachers, in accordance to *one-to-one* knowledge transfer approach, or more intensive teacher (supervisor) - student interaction. The last concluded directly corresponds to the previously identified disadvantage D2. On the other hand, by achieving the greater synergy on this relation, BL will give better results due to uprising learning effectiveness. Since this is only a preliminary study, it is to be extended throughout the future research activities planed by the authors, with the aim of scanning e-learners' satisfaction, and concerning the directions toward increasing the overall effects/outcomes of BL model.

In order to obtain as complete as possible feedback in the current moment on the realized BL system [14], besides the surveys among the students of the specialist studies at the FMS, one survey is conducted among teachers at the FMS and experts in developing new IT-supported didactic methods from the University of Graz (Austria). The poll conducted among the teachers and the experts has been based on the well-known and in literature extensively used Saaty's AHP (Analytical Hierarchy Process) method and the author's previous research papers [5;16]. This approach enabled us to rank some BL system categories, which have been in the context of this study identified as important ones. The final rank is as follows:

R1: Availability on-line and high quality of all necessary materials for preparing the exam in a subject;

R2: Stability and speed of the Internet connection (what is not always the case at the sea and in some ports);

R3: The existence of the tests for self evaluation of the acquired knowledge;

R4: Possibility of regular communication with teachers via forum, chat and/or e-mail;

R5: Possibilities of doing and evaluating tests and final exam on-line; and

R6: Conducting regularly students' surveys.

The rank is determined by the values of normalized average weight coefficients being previously calculated for each considered criteria [5;18;19], i.e. BL system feature. Certainly, the readers should not be limited by them in the sense that it is here underlined the need for further, more extensive and rigorous research in this domain. The obtained ranks of in the paper analyzed BL system features could be qualified in following manner:

- The teachers and the experts involved in this research assigned numerically by the largest marks, and gave consequently the greatest importance in the qualitative sense, to the availability on the web of the instructional materials (which implies their appropriateness and quality);
- In the second place, they positioned stability of Internet connection, which is understandable, since here examined BL model is devoted mostly to the seafarers. Namely, it is often not possible to establish Internet connection on the vast sea, or it is usually unstable. Another interpretation should be that the teachers and the experts consider a stable Internet connection fundamental pre-condition for BL model establishing;
- On the third position is the availability of tests for students' (here mostly seafarers') self-evaluation during the process of acquiring knowledge, what is also a very important segment of e-learning, which indirectly should involve the existence of *smart* educational games, as well;
- The fourth position is reserved here to the possibilities for the students to communicate to teachers via forum, chat, e-mail, etc, which is of course very important segment of e-learning, but it is sometimes difficult to achieve this due to the previously mentioned problems with Internet connection and its stability at the sea (and sometimes in the ports). On the other side, teachers are usually too busy, and they are practically sometimes *physically* prevented to devote more time to the communication to students; and,
- At the lowest positions are BL technical possibilities of doing exams on-line, and conducting regular on-line (or classical) surveys among the students, related to their degree of satisfaction with offered e-learning services, respectively. This is understandable, since the Internet as an *open* communication channel is not *perfect* for testing students on-line. In addition, even surveys

conducted among students are very important, in comparison with the previously considered components of e-learning they are for sure slightly less important. However, this does not mean at all that they should be ignored.

The conducted survey reflexes profoundly very subtle nuances in mutual positions of the analyzed e-learning features, and it remains us to associate them to the high degree of expertise and sensitivity of the responders in this domain [5].Further analysis should be directed toward evaluating e-learners' satisfaction with offered BL and this will be realized by multi-criteria evaluation technique based on Saaty's AHP [18;19]. Since the large number of respondents is necessary for conducting such analysis, the possibility of involving some other institutions that offer BL services shall be included. Namely, a large number of responders is a kind of guaranty that the survey will be successful and reliable, i.e. that the largest number of responds will be consistent in accordance to the Saay's AHP method requirements.

5. ON SOME TOOLS FOR CREATING BLENDED/E- LEARNING INSTRUCTIONAL MATERIALS

On the basis of the above presented rank of the analyzed BL features, it becomes evident that the availability and quality of the instructional materials are rated as the most important factors by teachers and experts in BL environment. Undoubtedly, the quality of the instructional material is one of the key factors for successful implementation of BL. Since the appropriate ICT solutions and tools are necessary in their creating, in this part of the article is given a short overview of some available up-to-date software tools for creating interesting and engaging instructional e-materials, along with the recommendations, based mostly on the experiences of experts in this field [6], which of them is the most appropriate for certain application.

Today, there is a quite large offer of different proprietary commercial and freeware application software which can be used for producing:

- ***Audio***: Audacity, NCH Wave Pod, Adobe Audition, Cubase Steinberg, Logic Studio, Kristal Audio Engine, etc.;
- ***Video***: Windows Movie Maker, Adobe Premiere, Avidemux, Magix Video, Video Spin, AVIedit, etc.; and,
- ***Sreencapturing***: Adobe Capticate, Capture Fox, Camtasia Studio, Jing, ActivePresenter, BB Flashback, BB Flashback Express, ScreenPresso, VirtualDub, etc.

Web can be used as a resource for further search [20]. Though, there are large number of software tools available on the market, proprietary commercial, as well as, freeware and shareware. Of course, there is also a difference concerning the available functions but it is definitely possible to produce up to professional results with selected freeware software. The following recommendations can be done according to the authors' experiences.

The open source software *Audacity* is the most powerful freeware tool for audio editing. It offers various effects and analyzing tools for the signal processing, e.g. powerful noise reduction (even adaptive noise reduction) and dynamic processing as well as equalizing, multi-track editing for sophisticated mixes and of course supports recording from any microphone or signal source connected to the computer. Professional commercial audio editing software mainly aims at professionals like sound engineers or sound designers. These professional tools provide further interfaces to audio hardware and various 3rd party plugins for high end audio editing;

In the field of video editing it is the freeware *Lightworks* that offers the most functions and editing tools. Even commercial movies have been cut and produced with that software but however it is not especially designed for beginners, so it requires time to get familiar with the production workflow. A more intuitive way and therefore more appropriate for beginners is the *Windows Movie Maker* (last built version is No. 12). It does support most of the latest video formats and has also build in effects to make transitions and/or color effects and animated titles. It also supports most picture formats so that the producer can combine still and moving pictures in the project. Background sound or speech can be added and mixed;

Screenrecording tools have become very popular as it is very easy to make engaging tutorials or presentations of what is happening on the monitor.

The freeware tools *Camstudio*, *Jing* and *AutoScreenrecorder* offer the general possibility to record the screen but do also include restrictions which can be watermarks, a limited time for recordings or not supported audio recordings along with the screenrecording. Also the choice of output formats is limited in freeware tools;

Two market leaders offer a professional tool that combines the above mentioned types of recording: *Adobe Captivate*, and *Camtasia Studio*. Camtasia Studio lets the user create professional screenrecordings, including other media like pictures, movies or sound. The footage can be arranged in multi track layers, with additional zoom or pan effects as well as highlighting options user can increase the professional look of the production [6].

When the technical dimensions of the issue are on board, it is of course to be noted that the implementation of web based learning system at the FMS has been based on Moodle platform (1.9.4). [17]. Since the currently released version of Moodle is 2.4 it has to be explained why at the FMS there is still a rather old version of the platform in use. When Moodle was installed at the FMS release 1.6 was the current version. This version was regularly updated until version 1.9.4. Since the program surface of Moodle rather changed with the release of Moodle 2.x FMS decided to stick to the older version. Mainly this is due to two reasons: (a) teachers and students are used to the look and feel of the 1.9.x versions and it seemed problematical for them to grow accustomed to a new surface especially at an early stage of working with the platform, (b) and the installation of Moodle 2.x demands an enhanced technical environment which is not totally available at the FMS at the moment [5].

6. CONCLUSIONS

This paper presents some key moments from the history of maritime affairs and seafaring in Montenegro, with a special emphasis on centuries of tradition in maritime education. It points the need for far better preservation, presentation and evaluation of Montenegrin cultural and historical heritage in this field. It is described briefly the current state of maritime business in Montenegro including of course maritime education and training. The weaknesses of the system are pointed along with the opportunities for its improvement, concerning development and implementation of new methods and techniques of e-learning in blended environment. The projects by means of which this is realized at the Faculty of Maritime Studies in Kotor (University of Montenegro) are described in some detail. The recommendations for the implementation of the appropriate software tools for creating and post-producing blended, i.e. e-instructional materials are given, as well. Throughout the results of the surveys being conducted among students, teachers and experts in this field highlighted the strengths and weaknesses of such contemporary way of students' (mostly future seafarers) education. Future research work in this domain should be directed toward more specific tests (surveys, interviews, or polls) on a larger sample (over more respondents), not just at one, but at several maritime high-educational institutions in Montenegro and in this part of Region of Mediterranean, in order to get more reliable data which are essential in the process of implementing and developing contemporary systems of maritime blended learning.

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    (currently October 2013)

GEOSPATIAL DATA IN MARINE SDI SERVICES

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ABSTRACT

The knowledge of spatial data is necessary for a large number of human activities. A Spatial Data Infrastructure (SDI) is a data infrastructure implementing a framework of geographic data, metadata, users and tools that are interactively connected. In Croatia much has already been written about SDI, but primarily from land-based perspective. In this paper marine dimension of SDI (MSDI) that encompasses marine geographic and business information in its widest sense is described. It is pointed out that hydrography, as modern applied science, plays very important role in measurements and description of oceans and seas. Hydrographic spatial data forms the key base reference layer for the sea space in MSDI data. There are a large number of MSDI stakeholders. MSDI should be established according global, regional and national conventions and policies.

KEY WORDS

marine geospatial data, hydrography, MSDI

1. INTRODUCTION

Spatial data is defined as the data or information that identifies the geographic location of features or objects, usually stored by geographic coordinates which is often accessed, manipulated or analysed through Geographic Information System - GIS (IHO, 2011). A Spatial Data Infrastructure (SDI) is a data infrastructure implementing a framework of geographic data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way. SDI is also the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data.

Total of Croatian marine geospatial area is 55349 km^2, what is 97.9% of Croatian land area (Leder & Filipović, 2007). Moreover, coastline of the Republic of Croatia consists of a mainland part 1880 km in length and an island part 4398 km in length, amounting to 6278 km (Duplančić Leder et al., 2004). It is the second best indented coast in the Mediterranean. The Republic of Croatia is committed to defining spatially its land and marine territory.

The aim of this paper is to present importance of a process of definition and implementation of geospatial data in Marine Spatial Data Infrastructure (MSDI).

2. HYDROGRAPHY

Literally translated, hydrography means water mapping, and hydrographic discipline is composed of parts of several sciences (multidisciplinary science). Hydrography provides the fundamental backdrop for almost everything that happens in, on or under the sea. It is becoming increasingly significant factor for spatial data and supports: safety of navigation, protection of marine environment, national infrastructure development, coastal zone management, marine exploration, resource exploitation, fishing, maritime boundary delimitation (UNCLOS), maritime defence and security and disaster management.

The IHO (2011) defines hydrography as *the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers, as well as with the prediction of their change over time, for the primary purpose of safety of navigation and in support of all other marine activities, including economic development, security and defence, scientific research, and environmental protection*.

Hydrographic survey data (see Figure 1) has four major components:

1. Positioning of the survey data;
2. Water depth (bathymetry) measured from a vertical reference surface (chart datum) to the seafloor;
3. Features which may be hazards to navigation (wrecks, reefs...);
4. Seafloor characteristics (mud, sand, bedrock,) necessary to determine anchorages.

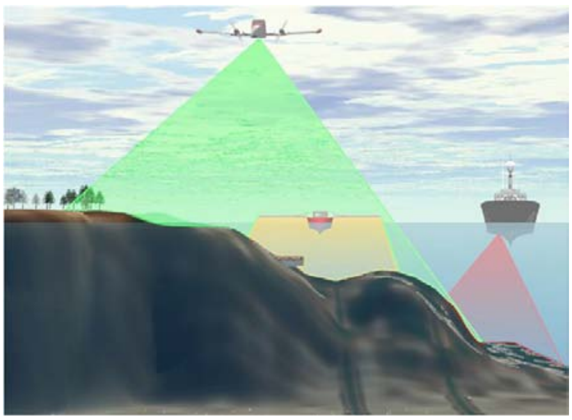

Figure 1. Hydrographic survey (source: Banic & Cunningham, 1998)

Hydrographic survey data forms the key base reference or geospatial layer for the sea space in global, national or regional MSDI data.

3. MARINE SPATIAL DATA INFRASTRUCTURE (MSDI)

Following global trends, IHO established MSDI Working Group (MSDIWG) in 2008 to identify the hydrographic community inputs to National Spatial Data Infrastructures (NSDI).

MSDI usually include physical and chemical datasets of marine water column, marine infrastructure (wreck, offshore installations, pipelines and cables), administrative and legal boundaries, areas of conservation, biological features of marine water column and habitats types (Duplančić Leder and Leder, 2009. All that data form spatial data base of marine component of national spatial data infrastructure.

According to IHO, Hydrographic Office (HO) is uniquely placed to play a central role in the development of the marine component of all SDI's (IHO, 2011). HO is official source for bathymetric data, seabed and sea-level informations. National Croatian HO - Hydrographic Institute of the Republic of Croatia (HIRC) is official provider of national hydrographic informations for the Croatian part of the Adriatic Sea waters.

MSDI is the component of an SDI that encompasses marine geographic and business information in its widest sense. This would typically include seabed topography (bathymetry), geology, marine infrastructure (e.g. wrecks, offshore installations, pipelines and cables), administrative and legal boundaries, and areas of conservation, marine habitats and oceanography (IHO, 2011).

It must be pointed out that for every maritime country marine administration has a very important role for implementation of MSDI, especially at highest political level.

Schematic presentation of the MSDI as "the marine dimension" of SDI is shown in Figure 2.

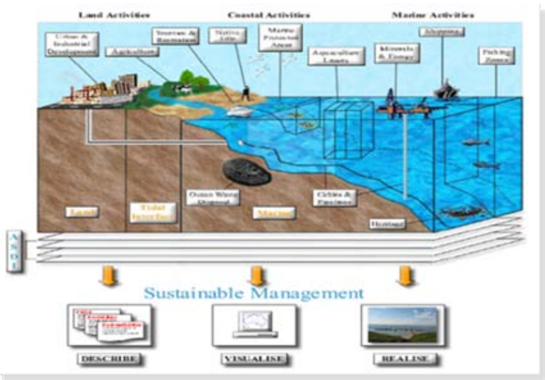

Figure 2. MSDI as marine dimension of SDI (source Binns & Williamson, 2003)

MSDI must follow global, regional and national conventions and policies, thus Croatian MSDI follow:

Global:

- UN Convention on the Law of the Sea – UNCLOS
- SOLAS
- IHO/IMO Strategy and Convention
- Regional (EU):
- INSPIRE Directive 2007/2/EC
- EU Integrated Maritime Policy (IMP)
- Marine Strategy Framework Directive (MSFD)
- Barcelona Convention for Protection of the Mediterranean Sea Against Pollution
- Mediterranean Action Plan (MAP)

National:

- Maritime law
- Law on hydrographic activity
- Marine Register and seaport law

Each maritime country need to develop MSDI mapping website (Web GIS tools services) established for collect, archive and distribute reference maps and other marine data sets especially spatial datasets produced by Hydrographic Offices.

3.1 Hydrographic data in MSDI

MSDI usually include data which present characteristics of marine waters (Quimbert et al., 2013):

Physical and chemical datasets:

- Seabed topography, Bathymetry
- Sea Temperature
- Ice cover
- Current velocity
- Upwelling
- Wave exposure
- Mixing characteristics
- Turbidity
- Residence time
- Salinity
- Nutrients, Oxygen.

Biological features:

- Phytoplankton, Zooplankton
- Benthic flora and fauna
- Fish populations
- Marine mammals
- Seabirds

Habitats types:

- Predominant seabed and water column habitats
- Special habitats

Metadata normalized:

- ISO 19115 and 19139 standards compliant
- OGC standard – Catalogue Services Web (CSW 2.0.2)

3.2 Marine Cadastre

Hydrographic Institute of the Republic of Croatia (HIRC), as official HO, recognized the importance of the MSDI concept. In article 15 of the Law on hydrographic activity (Official Gazette, 1998) it is defined as Marine Cadastre as follows: *Marine Cadastre shall keep records of the data on the sea, seabed and submarine area, relevant for the safety of navigation, except the data of interest to Defence*.
Marine Register shall include the data of the users, the way and proportions of exploitation of the sea, seabed and submarine area, as well as the records of objects, works and occurrences relevant for the safety of navigation, for each area of local self-governing unit and units of local government and self-government."
HIRC shall carry out, among others: *Describing and drawing of a geodetically defined border of sovereignty of the Republic of Croatia on sea,*

taking into consideration other acts which regulate the border, keeping up to date and managing the database of the official data on sea, in the following fields: navigation, hydrography (objects on sea and in the submarine area), cartography, geology, geophysics and oceanography (sea level oscillations, waves, currents, thermohaline, hydroacoustic and optical properties of the sea, hydrometeorology, etc.), as well as organizing and conducting the Marine Cadastre. Marine Cadastre is part of MSDI as described in Figure 3.

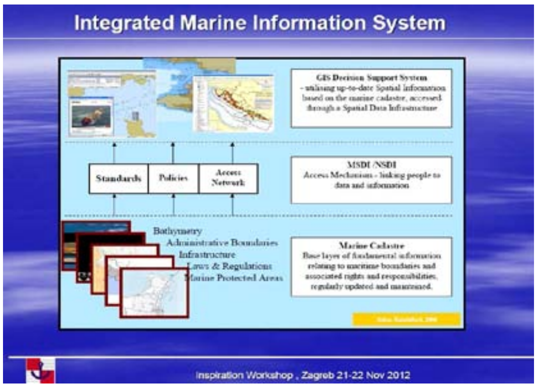

Figure 3. Marine Cadastre as a part of MSDI (source: Gržetić at al., 2012)

3.3 MSDI Stakeholders

MSDI portal manage, share and retrieve geographical marine information in order to support multidisciplinary studies (share of geographical information across disciplines environmental, socio-economical, regula-tions, geosciences) and support of decision making (management of usages and resources of coastal zone and fisheries, risk assessment, renewable marine energies).
There is a large diversity of interests, ranging from tourism and recreational activities such as diving and swimming to disposal of waste such as jarosite and chemical dumps. Marine cadaster, administrative and legal boundaries, rights and restrictions data have been very important part of MSDI. Table 1 shows the range of stakeholders and activities that occur within the marine environment. All that stakeholders are the potential MSDI user.

Table 1. Activities in marine enviroment

Activity	**Includes**
Tourism & Recreation	Diving, Swimming, Boating, Fishing
Marine protected areas	Marine National Parks Marine Sanctuaries
Shipping	Commercial Shipping Freight Haulage Passenger Ferries
Heritage	Shipwreck Indigenous Artifacts
Cables & Pipelines	Oil and Gas pipelines Telecommunications Electricity cables
Aquaculture Leases	Mussle Farms Abalone Farms Spat Gathering Areas Oysters Farms
Mineral & Energy	Mineral, Oil & Gas Exploration Resource Extraction
Native Title	Non-excusive access to the sea and sea-bed
Ocean Waste Disposal	Ammunition, Chemical & Jarosite Dumps Scuttled Vessels Land-based sources
Coastal engineering	Coastal structures Water front development Sediment transport & morphology Shoreline management Coastal flooding and erosion Dredging and spill management Cooling water recirculation Survey and monitoring

It must be pointed out that for every maritime country marine administration has a very important role for implementation of MSDI. Hydrographic Offices (HO) is official source for bathymetric data, seabed and water level information and official provider of national hydrographic informations.

4. CONCLUSIONS

Hydrography is the branch of applied sciences composed of several scientific disciplines. Recent technological changes (GPS, multibeam and LIDAR) have caused sudden and substantial changes in hydrography.
MSDI is the component of an SDI that encompasses marine geographic and business information in its widest sense. Hydrographic spatial data forms the key base reference layer for the in MSDI data.

MSDI usually include physical and chemical datasets of marine water column, marine infrastructure, sea boundaries and biological features and habitats types of marine water column. All that data form base spatial data of marine component of national SDI.
MSDI should be established according global, regional and national conventions and policies of each maritime country. There are a large number of MSDI stakeholders. Hydrographic Offices are official providers of hydrographic data in MSDI and play a central role in the development of the marine component of NSDI.

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IMPLEMENTATION ASSESSMENT OF AIRPORT COLLABORATIVE DECISION MAKING AT SPLIT AIRPORT

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ABSTRACT

The problem of aircraft delay within airport system has been present for the last few decades and represents a major generator of delay in the whole system of air traffic. Due to the complexity of operations at the airport as well as the number of participants involved in the process, there is a need for a unique collaborative system. The Airport Collaborative Decision Making (ACDM) system is based on two key elements: the predictability of events and on-time performance. Improving the two key elements in all phases of flight planning would allow participants in the air traffic system significant improvements in operation performing. The ACDM system is one of the five priority measures in the Flight Efficiency Plan, which was developed by the International Air Transport Association (IATA), Civil Air Navigation Services Organization (CANSO) and the European Organization for the Safety of Air Navigation (EUROCONTROL).
The paper will analyze the issue of traffic at the Split Airport in terms of delay and on-time performance. Also the paper will analyze the main causes of aircraft delay by IATA codes and according to participants in air transport. The results of the analysis will indicate the need for implementation of the ACDM system.

KEY WORDS

Airport Collaborative Decision Making, Split Airport, aircraft delay, aircraft on-time performance

1. INTRODUCTION

For departure aircraft operations, there are three types of delay indicators: total delay, five minutes or more, and more than 15 minutes delay.
Analyses indicate that the average delay time by the delayed flight (all causes) for departure aircraft operations in April 2012 amounts to 29 minutes, which represents a increase of 15% compared to April 2011 [1]. The percentage of delayed flights (delay five minutes or more) in 2012 grew by 2% compared to 2011, and reached 31%. Flights that are delayed more than 15 minutes for departure aircraft operations in 2012 increased to 17% compared to the previous year [1].
For the arrival aircraft operations the average delay time by the delayed flight (all causes) in 2012 were 31 minutes, which represents increase of 18% compared to the previous year [1].
The largest share of aircraft delays per single flight for 2012 represents a reactionary delay with 4.56 minutes, followed by the delay caused by the airline 2.56 minutes, airspace capacity with 0.81 minutes, the capacity of the airport's airspace with 0.73 minutes, etc.

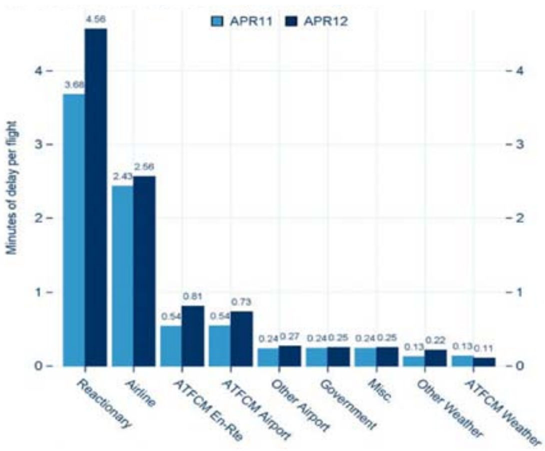

Figure 1. The relationship of various factors affecting air traffic delays, expressed in minutes per flight in April 2011 and April 2012 [1]

Figure 1 shows the relationship between different factors affecting air traffic delays in April 2012 and the trend compared to April 2011.

Generally speaking, total delay in air traffic can be observed with regard to four main factors that generate delay, such as: airline, ATM, airports and weather conditions. Figure 2 shows the relationship between four main factors that affect air traffic delays in April 2012 and the trend in relation to the April 2011.

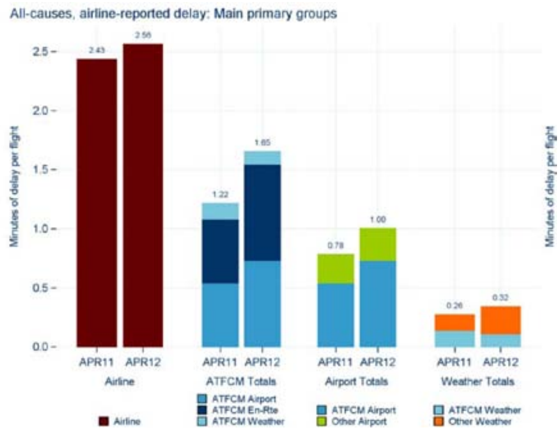

Figure 2. Relationship of four major factors affecting air traffic delays, expressed in minutes for April 2011 and April 2012 [1]

The analysis in Figure 2 indicates that the greatest proportion of total delay per individual flight in April 2012 was generated by airline with 2.56 minutes, followed by ATM with 1.65 minutes, airports with one minute and weather conditions with 0.32 minutes. Comparing trends in Figure 2 a slight increase in air traffic delays in all aspects can be observed.
Within Europe there are over 450 [2] international airports generating traffic of over 1.6 billion passengers [3]. The analysis of top 10 congested airports in terms of departure operations indicates lower total delay in 2012 compared to the previous year. The most common delays at all airports are delays due to late arrival of aircraft and crew from a previous flight and they account for an average of 30% of all delays (reactionary delay).
Figure 3 shows the main causes of delay in top 10 European congested airports from the perspective of departure aircraft operations for 2012, respectively for the following airports: Istanbul Ataturk (LTBA), Lisboa (LPAR), Porto (LPPR), Madrid Barajas (LEMD), Malaga (LEMG), London

Heathrow (EGLL), Toulouse Blagnac (LFBO), Paris Orly (LFBO), Nice (LFMN), London Luton (EGGW).

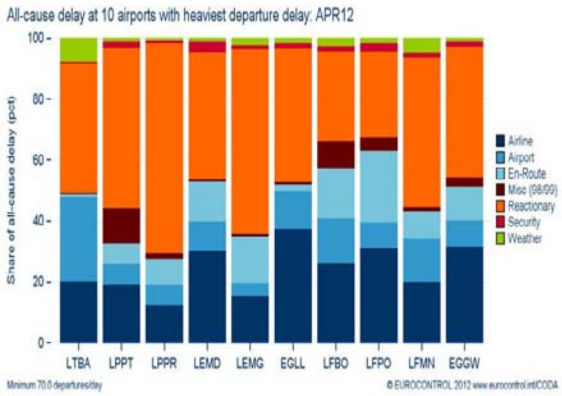

Figure 3. Overview of the main causes of delay in the top 10 congested European airports in 2012 [1]

2. CURRENT STATE OF AIR TRAFFIC IN THE REPUBLIC OF CROATIA

According to the number of aircraft operations air traffic ain the Republic of Croatia in the last few years has seen a slight increase.
Air traffic in 2012, according to the number of passengers achieved a growth of 7.2% compared to 2011 [4].
In terms of ATFM delay within the Croatian airspace trends show a decline in the recent years. In 2010 the average delay was 1.1 minutes, while in 2012 the average delay was 0.3 minutes [5].
The statistics show that at the Croatian airports in 2012 there were 95,876 aircraft operations recorded [4], out of which the Zagreb, Split and Dubrovnik airports generated approximately 75% of aircraft operations.

3. TRAFFIC ANALYSIS AT THE SPLIT AIRPORT

Delays analysis at the Split Airport indicates that the average delay time per delay flight for arrival and departure operations (for all causes) in 2011 was 23.5 minutes [6]. The average delay time per delay flight for the arrival and departure operations (for all causes) in 2012 was 22.8 minutes, which represents a decrease of 10% compared to the previous year.

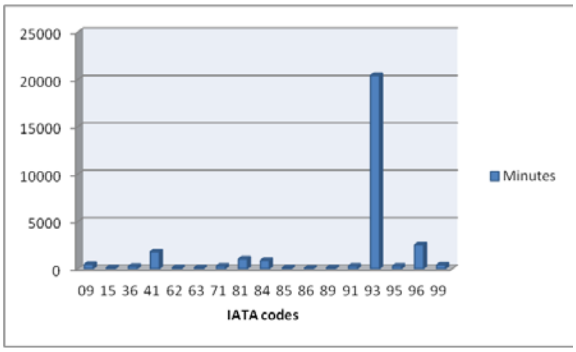

Figure 4. Delay (in minutes) of air carrier Croatia Airlines at Split Airport in 2012, according to IATA codes
SOURCE: authors' research [6]

The largest delay at the Split Airport is generated by Croatia Airlines with 1,330 delays (2012) making a total of 32,290 minutes of delay. The delay proportion by IATA codes for air carrier Croatia Airlines in 2012 is shown in Figure 4. For other air carriers at the Split Airport in 2012 (Figure 5) there were 2,397 delays with a total of 52,715 minutes of delay recorded [6].
IATA delay code analysis indicates that a large number of delays at the Split Airport represents reactive delay (IATA code 93) which in the total delay accounts for 68% for the national air carrier (Croatia Airlines) delay and 73% (other air carriers).

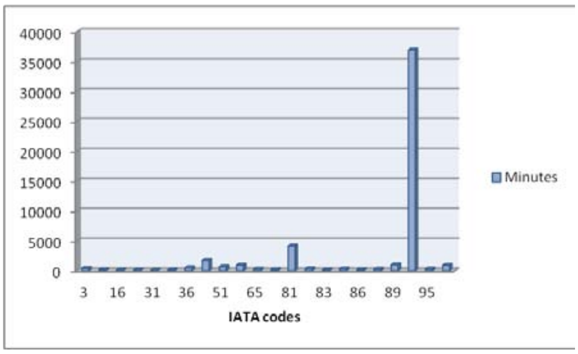

Figure 5. Delay (in minutes) of other air carrier at the Split Airport in 2012, according to IATA codes
SOURCE: authors' research [6]

4. AIRPORT COLLABORATIVE DECISION MAKING SYSTEM BASIC CONCEPT

Airport Collaborative Decision Making (ACDM) is an innovative system of collaborative decision-making based on the exchange of information between the various partners involved in air traffic. ACDM system was developed by the European Organisation for the Safety of Air Navigation (Eurocontrol) with aims to reduce delays, improve the predictability of future events and optimize existing resources [7].

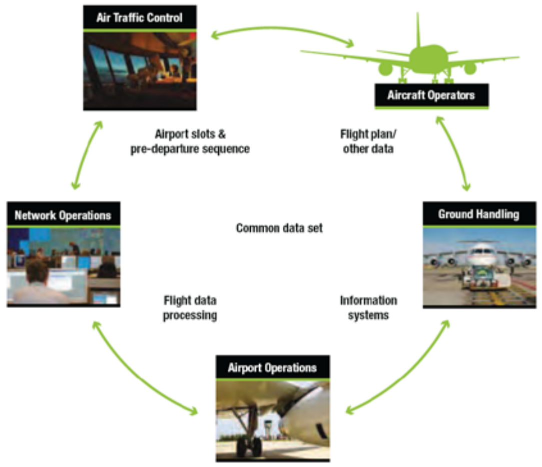

Figure 6. The interrelation of partners within ACDM system [7]

The ACDM system requires no additional investment in infrastructure or supporting technical means, but is based on better use of the existing resources. The partners involved in ACDM implementing process are: airport operators, air carriers, ground handling operators, operator providing air navigation services and the European Air Traffic Flow Management. The interrelation of the partners within the ACDM system is shown in Figure 6.

4.1 Factors required for realization of ACDM system

ACDM system base consists of six fundamental elements:

- Information sharing
- Milestone approach
- Variable Taxi Time
- Pre departure sequence
- CDM in adverse conditions
- Collaborative Management of Flight Updates

The information sharing system together with the Milestone approach makes the base of the ACDM system and allows upgrading of ACDM system with other elements. The aim of information sharing system is to provide various partners involved in air traffic with correct information at the right time.
The second element of ACDM system, Milestone approach, links a segment of the aircraft in the air along with a segment when the aircraft is on the ground, improving information flows and anticipated upcoming events. The objective of this element is to monitor the status of the aircraft from initial planning through to takeoff with a particular airport. The Milestone approach is divided into 16 points in which the most important times in aircraft operational process are recorded (Figure 7).

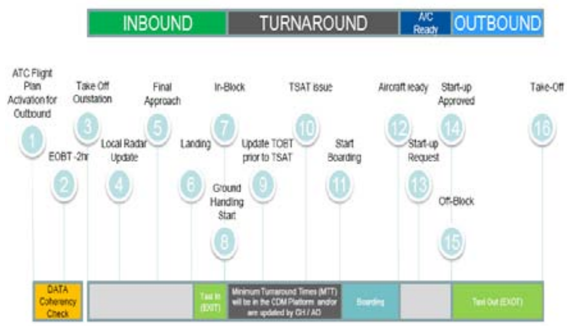

Figure 7. Preview of the status of aircraft in all phases through 16 points [7]

Variable taxi time represents the estimated aircraft taxi time between aircraft parking position and appropriate runway.
After introduction of the Information sharing system, Milestone approach and Variable taxi time the next element which upgrades ACDM system is the pre-departure sequence. In order to realize the pre-departure sequence it is necessary to fully implement the previously mentioned element of the ACDM system. The pre-departure sequence of departing aircraft is created based on the time received from the aircraft ground handling operator or aerodrome operator and by the type of aircraft.
CDM in adverse conditions is aimed at information sharing about adverse conditions between partners during periods of reduced capacity (airport maintaining, weather conditions ...).
The sixth and the final element of the ACDM system is the Collaborative management of flight updates, which has the task of quality improvement in information exchange between CMFU and CDM airport.

4.2 Benefits of ACDM system

The system of collaborative decision-making between partners within the air transport system is based on timely and accurate information as well as updated information. When information is transparently shared among all participants in the system the result is increased predictability of certain aircraft operations. In this manner, all participants of air transport: operators at the airport (ground handling companies, de-icing company), air carriers and ATM providers can operate at a higher operational level.

Results of the U.S. Federal Aviation Administration (FAA) study have shown that after implementation of the ACDM system, accuracy of aircraft operation performance grew by 15% as shown in Figure 8 [8].

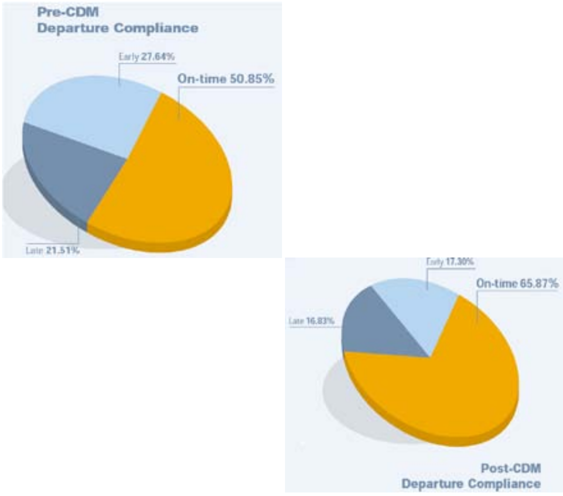

Figure 8. Relationship of aircraft operations before and after the introduction of the ACMD system [8]

In Europe, there are thirty-nine airports that have begun the implementation process of the ACDM system [9]. The ACDM system is currently fully implemented at eight airports. Ten airports are in the initial stages while at twenty-one airports the implementation process has started [9].
The aim of the ACDM system is to integrate forty airports within the dynamic management of the European airspace network.
Eurocontrol conducted analytical studies to determine the impact of the ACDM system on the European airspace network in case those forty-two airports implement the ACDM system.
Results of the study show benefits that can be achieved: increasing the sector capacity within the "core area" up to 4 percent (approximately 1-2 aircraft per sector), reducing en route delays from 33% to 50%, and reduction of ATFM delays by 18 to 23% [10].
The Munich Airport is the first airport in Europe that fully implemented the ACDM system and represents reference for the result analysis that could be achieved by implementing the ACDM system at certain airports.
Some of the key performance indicators at which the evaluation can be performed: waiting time at the runway, impact of arrival delays on departure delays, airport slot adherence, accuracy in defining the required duration of ramp handling process. Waiting time at the runway represents the time

that an aircraft spends at position until it receives takeoff clearance from air traffic control.
The statistics indicates that the waiting time at the runway is significantly reduced by implementing the ACDM system in 2007. The average waiting time at the runway was reduced from 4.39 minutes (in 2005) to 3.41 minutes (in 2007) when the ACDM system was implemented [11]. The airport slot adherence is slot compliance indicator. The analyses from the Munich airport indicated that adherence to the slots time increased from 78.9% before the ACDM system was implemented (in 2005) to 85.3% after the ACDM system has been implemented (in 2007) [11].
The impact of the arrival delay on the departure delay is an indicator first introduced in the ACDM system. Thus, there are no adequate data from the period before the implementation of the ACDM system and it is not possible to make a comparison of indicators. However, it was noted that after the introduction of this indicator about 50% of flights that were delayed in arrival are compensated through the ground aircraft operation and the aircraft arrived according to scheduled time without delay [11].
Accuracy in defining the required duration of ramp handling process represents an important segment of the ACDM system and has a significant impact on other ground aircraft operations. The Munich airport analysis indicates that the deviation between the planned and actual ramp handling time in most cases is between 1 and 5 minutes, which from an operational point of view is the acceptable deviation [11].

5. THE POSSIBILITY OF IMPLEMENTING ACDM SYSTEM AT SPLIT AIRPORT

The Split Airport has been developing since 1996 its own modular application solution that fully covers all activities on the airport airside. The software solution encompasses all phases of the aircraft ramp handling process, from initial planning to management and control. Software also has the ability for multi-purpose use of a central database and connection (interface) with other systems.
In 2013 the Split Airport developed and established regular updates of their own information on the planned traffic using EUACA (European Airport Coordinators Association) database. This database is the basis for the data exchange between the Split Airport and Eurocontrol, and is the basis for future strategic and tactical planning and better management of the European airspace network.
Taking into account further requirements for dynamic data exchange and ACDM system requirements, at this point it is necessary to consider the software solution in which the above requirements are to be implemented.

6. CONCLUSIONS

The current problem of the European air traffic network is the congestion of air routes considering the capacity of conventional air traffic control system as well as a lack of capacities of hub airports. Operational implications are reflected in the flight delays, with negative consequences for both airline operators and the airport.
The continued growth of air traffic and at the current level of delays, the capacity of air traffic control as well as airports will not be able to follow further growth trends, particularly in the safety and environmental aspects.
The analysis of the current European air traffic status indicates that the largest generator of delays in air traffic system is the delay of an aircraft due to the late arrival of the aircraft (and crew) from a previous flight.
The status of Croatian air traffic in terms of delays recorded similar trends as the European air traffic. The statistics from the Split Airport indicates that the greatest observed delay is the reactive delay. The greatest share of delays belongs to the national air carrier Croatia Airlines.
In order to reduce the delay, EUROCONTROL, the European organization for air safety, embarked on the development of collaborative decision-making (CDM), which would be performed through cooperation of various holders of air traffic services to reduce the overall delay. Since the system is not currently implemented at an optimal number of airports it is not possible to analyze the full implementation of the system.
The results obtained from the Munich airport indicate that the implementation of the ACDM system has led to a reduction in: taxi time, the waiting time at the runway and ramp handling

time. At the same time the Munich airport recorded a growth in: on-time operations performance, compliance with time slots, better communication among partners (airport operators, air traffic control, the company specialized in handling, de-icing ...) This created significant savings to the airport, the national airline (Lufthansa) as well as other airlines and air traffic control.
The implementation of the ACDM system at Split Airport is a time-consuming and complex process. However, in case it achieved the same or similar results to the Munich Airport, the implementation of the system has to be justified from the operational and economic point of view.

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CROATIAN MACRO ECONOMIC CONTEXT AND MARITIME SYSTEM DEVELOPMENT

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ABSTRACT

Croatia is strategically located in Central and Southeast Europe, bordering Hungary to the North-East, Slovenia to the North-West, Bosnia and Herzegovina and Montenegro to the South-East, Serbia to the East, and the Italy via Adriatic Sea to the South-West. The country covers a land area of approximately 56,594 km2 with a coastline of 6,278km (1,880 km is mainland coastline, while 4,398 km is island coastal length). The Croatian economy is still in recession. Current indicators and future forecasts point towards a continuing downward trend that will continue beyond 2013. Industrial production has dropped by 11.6% in 2011 compared with 2008, while financial intermediation, insurance and ICT sectors are generating a positive and steady growth in almost all segments. Key sectors of the Croatian economy are retailing and tourism, manufacturing and mining, and public administration. This is also mirrored in the number of employed workforce in each of these major sectors. Manufacturing and mining currently employs higher number of workforce in comparison to the retailing and tourism sectors. In terms of trade structure, merchandise trade accounted for almost 52% of the country's GDP in 2011, down from over 64% in 2008, which confirm the trend of deindustrialisation of the economy despite manufactured goods still dominating both merchandise exports and imports. Equally, the origin-destination pattern of Croatia's foreign trade is dominated by proximity trade with EU and CEFTA (Central European Free Trade Agreement) countries notably Italy, Bosnia and Herzegovina, Germany and Slovenia.

KEY WORDS

macroeconomic, Croatia, maritime, development

1. INTRODUCTION

Croatia is strategically located in Central and South bordering Hungary to the North-East, Slovenia to the North-West, Bosnia and Herzegovina and Montenegro to the South-East, Serbia to the East, and the Italy via Adriatic Sea to the South-West. The country covers a land area of approximately 56,594 km^2 with a coastline of 1,880 km long, or 6,287 km long when counting Croatia's 1,244 islands, islets, solitary rocks and reefs. Both the distinctive geographical shape and population distribution of the country affect the development of maritime transport infrastructure and services in Croatia. At the same time, the strategic position of Croatia in the Adriatic Sea and its connections to neighbouring countries show the vital significance of Croatia in regional development and the need to establish efficient maritime and intermodal connections with Central and East Europe.

2. MARITIME SECTOR

Due to its specific geographical position, the maritime domain of Croatia occupies a larger part of the country. The total length of Croatian coastal line is 4,058 km, including islands 5,835.3 km, which represents a priceless national treasure. Croatia, therefore, occupies 74% of the total length of the Adriatic and includes 97.2% of the Adriatic archipelago.

Indention of Adriatic Sea makes it very favourable for transit of goods from e.g. Far East to Europe and from European countries to far destinations. Developed network of road infrastructure enables good connections to other most significant Pan-European corridors. Apart from investments that are still needed in maritime sector, especially to modernise port infrastructure and heavy machinery, system of concession in ports is developed, as well as billing system in accordance to EU policies.

Croatian maritime position advantage is very good connection between regions, especially in the context of road infrastructure and the motorway network that connects Croatian inland and coastal part. Country's geographical position requires further investments in order to completely link to far south of the country and to fully integrate to Pan-European transport networks. Pan-European transport corridors V, VII and X and their branches intersect the territory of the Republic of Croatia. Due to its geographic position, Croatia is important in establishing effective links between the Western Europe and Balkan countries, as well as connections between Central Europe and the Mediterranean area.

Croatia has a long maritime tradition and significant part of the economy still relies on the maritime and port system. In addition to traditional maritime activities, attention is given to the protection of the Adriatic Sea, in order to keep it attractive to tourist industry. Due to it is one of the most popular Mediterranean tourist destinations, with long tradition of preserved natural and historical wealth, as well as UNESCO protected heritage, national parks, beautiful coast and islands. Various types of tourism are available, depending on the tourist region and local traditions: nautical, cultural, diving, religious, hunting, fishing etc.

In 2010, seawater and coastal transport transported 12.6 million passengers (8.9% of total passenger volume transported by road, railway, maritime and air transport) and 31 million tons goods (26.7% of total goods carried by road, railway, maritime, inland waterway and air transport).

The most important part of maritime sector is port sector. According to the official journal, there are 409 ports and small harbours open to the public in Croatia, of which 95 ports with a minimum of one line service. Six major ports (Rijeka, Zadar, Šibenik, Split, Ploče, and Dubrovnik), along with Pula which is classified as a county port, are all located along the mainland coast and can receive large ocean-going ships. All major ports are declared as national ports or ports of international economic interest. This paper examines the capacity and operational structure of Croatian ports, traffic and facilities, operations and services (marine services, stevedoring and terminal operations, port concessionaires). The port of Rijeka is the largest port in Croatia and benefits from the deepest natural channel in the Adriatic. Much of the port's traffic is transit cargo to/from its wider hinterland in Central Europe, and is dominated in volume terms by liquid and dry bulk cargo followed by container and general cargoes. Total port's throughput has almost doubled from 6.85 to 12.4 million tonnes in the period 2000-2008, with container traffic registering a dramatic increase of 1,600% in the same period (from 7,222 TEU in 2000 to 168,761 TEU in 2008). The impact of the economic crisis was evident and traffic has decreased accordingly with both total and container throughputs in 2011 still below their 2008 levels.

The port of Zadar is located at the central part of the Adriatic coast and is the second Croatian port for passengers. The port currently operates in two locations: city port for passengers and Gaženica port for cargo. Passenger traffic was 2.4 million passengers and around 350,000 vehicles in 2011, an increase of 65% from to 2001. Cargo traffic remains limited due to physical constraints and proximity to Rijeka.

The port of Split, also called gateway to the islands, is the largest passenger port in Croatia with over 4.2 million passengers and more than 640.000 vehicles in 2011, which places the port as the third most important passenger port in the Mediterranean (after Naples and Piraeus). The north port of Split specialises in cargo handling, although in small amounts.

The port of Šibenik is located on 430 ha of the Krka River estuary. The port specializes in bulk, timber, and mineral traffic notably phosphates transhipment. Cargo throughput was just below 600,000 tonnes in 2009. Šibenik also handles passenger traffic with an average of 550,000 passengers per year.

The port of Ploče is located in the southern part of Adriatic coast and consists of two locations: Ploče and Metković that occupies more than 230 hectares of land. Around 90% of the Ploče's activity is transit traffic since the port is the main maritime gateway to Bosnia-Herzegovina, Serbia and Montenegro, and it features as the endpoint of the pan-European corridor Vc. Dry bulk and general cargo dominate Ploče's traffic with the 2011 throughputs of 3.56 and 0.43 mill t, respectively, still below the 2008 levels.

The port of Dubrovnik, located at the far south of the Croatian coastline, has become in recent years one of the most popular destinations for cruise voyages in Europe. Dubrovnik's infrastructure has been significantly damaged during the war period and much of port development has been directed at the ferry and cruise terminals. The main port of Gruž, which is managed by Dubrovnik port authority, currently handles over 1.2 million passengers and 20,000 vehicles annually, of which 700,000 are cruise ship passengers. On the other hand, the old town anchorage in the city of Dubrovnik is currently managed by Dubrovnik's county port authority. The anchorage received 220 calls and handled around 200,000 passengers in 2012.

The analysis of port statistics shows different growth patterns between passenger and cargo traffic. In 2011, port's traffic amounted to 29.64 million passengers and 21.86 million cargo tonnes. Passenger traffic is dominated by national traffic (around 90%) on the ferries and boats between the mainland and the islands, and the traffic is double counted (the same passengers are counted twice when embarking and when disembarking). Given the stable demand and captured market for public coastal shipping, there has been no significant difference in the total passenger traffic for the past 3 years, despite an increase in international cruise traffic. Cargo traffic, on the other hand, is dominated by international traffic (around 86%) of liquid bulk, dry bulk, and general cargo / container goods.

3. ECONOMIC DEVELOPMENT AND INDICATORS

Following the implementation of an economic stabilisation programme in 1993, Croatia had sustained a good economic growth and low levels of inflation, managed to recover the tourism sector and attract foreign investment, and successfully negotiated and became EU member state in July 2013. However, the global crisis has had a major effect on the Croatian economy. Economic growth slowed significantly from 5.5% in 2007 to 2.4% in 2008, and in 2009 the economy contracted by 6% followed by a further contraction of 1.4% in 2010. After a period of economic stagnation in 2011, the GDP is expected to contract by 1.5% in 2012 before growing by a modest 0.7% in 2013. Economic forecasts point towards an average growth of 2% for 2013-2017 where the GDP will return to the 2008 level, practically meaning 10 years of economic stagnation. To reduce the deficit and recover the economy, the Government of Croatia has taken a series of austerity measures such as lowering state subsidies and cutting public sector wages. Even though, the ratings agency Standard & Poor reduced Croatia's credit rating to junk status in December 2012 due to what they saw as insufficient fiscal reforms. Furthermore, the IMF forecasts point towards a budget deficit of above 3.5% of GDP in the medium term and a public debt that could exceed 60% of GDP (the Maastricht criterion), or 75% if public guaranteed debt is included.

Table 1. GDP Forecasts

Year	2012	2013	2014	2015	2016	2017
GDP (current prices US$ billions)	57.49	58.50	60.96	63.76	67.02	70.47
GDP growth (constant prices US$ %)	-1.45	0.75	1.50	2.00	2.50	2.50
GDP per capita (current prices 1000 US$)	57.49	58.5	60.96	63.76	67.02	70.47
Volume of imported goods & services (% change)	-1.97	1.83	2.96	3.40	3.41	3.58
Volume of Imports of goods (% change)	-4.80	1.37	2.86	2.87	2.00	2.45
Volume of exported goods & services (% change)	0.33	1.73	2.88	3.50	4.07	3.94
Volume of exports of goods (% change)	0.97	2.28	3.06	3.92	4.78	4.63

Source: IMF, World Bank, EUROSTAT, Croatian Bureau of Statistics

While the tourism industry has shown a great resilience with an average growth of 5% during 2008-2012 (tourism makes up around 19.5% of GDP), the manufacturing and export sectors were hardest hit by the economic downturn. Due to the economic setbacks in EU and East European countries coupled with a weak domestic consumption, Croatia has seen its exports contract by 2.5% and industrial production fallen by 11.6% from 2008 to 2011. Merchandise trade accounted for around 52% of the country's GDP in 2011 down from over 64% in 2008. However, even before the recession, Croatia's industrial and export markets were underperforming. Over the past decade, the country's global export market share remained stagnant with industrial investment averaging only 20% and capital flows mostly directed towards non-tradable sectors (finance, construction, public services).

High current account deficit is considered to be the greatest challenge for external balance. Since the early 1990s, Croatia is faced with continuous growth of trade deficit, which in 2007 reached $13 billion (exports: $12.6 billion, $25.6 billion), while retaining coverage of imports by export less than 50%. The main characteristic of the external Croatian balance - strong growth in trade deficit and current account as well as high external debt, together with solid international solvency, point to high external vulnerability of the Croatian economy and potentially high sensitivity to external shocks, which could result in economic stagnation or even recession. Although the trade deficit decreased in last three years, the current situation does not allow advancement and development of the economy. Foreign investments as a catalyst for structural changes are essential for Croatia, regardless in which form they come, to boost the activities of Croatian economy. It is necessary to take measures to encourage foreign investment and to create a positive investment climate.

Table 2. Main economic indicators

Year	2007	2008	2009	2010	2011
GDP current prices (billion$)	59,33	69.91	63,43	60,85	63,85
GDP PPP (1000 $)	18,72	20,31	19,82	19.,3	20,03
GDP per capita (1000 US$)	13,37	15,77	14,32	13,77	14,49
Real GDP growth (annual % change)	5,1	2,2	-6,0	-1,41	-0,01
Current account balance (% GDP)	-7,3	-8,7	-4,8	-1,6	-0,7
Inflation (annual % change)	2,9	6,1	2,4	1,0	2,3
Industrial production (growth rate %)	4,9	1,2	-9,2	-1,4	-1,2
Unemployment rate (%)	14,8	13,2	14,9	17,4	18,0

Source: IMF, World Bank, EUROSTAT, Croatian Bureau of Statistics

The structure of the Croatian economy shows the dominance of wholesale and retail trade, repair of motor vehicles and motorcycles, hotel and catering industry sector but also an ongoing shift towards financial and insurance activities, as well as information and communication sector, which are continuously growing since 2008. There is an ongoing trend of deindustrialization with the level of industrial production dropping by 11.6% in 2011 in comparison to 2008.

Main sectors of Croatian economy, with the largest GDP share include wholesale and retail trade, repair of motor vehicles and motorcycles, hotel and catering industry; followed by manufacturing and mining industries (trend of decline since 2008), public administration, real estate, construction, professional, scientific and technical activities, financial and insurance activities and information and communication. Continuous growth since 2006 is recorded in financial and insurance activities, as well as information and communication sector.

Table 3. Sectoral analysis: % share of GDP and number of employed workforce

Year	2007	2008	2009	2010	2011
Agriculture, forestry and fishing	4.8	4.9	5.1	5.0	5.0
	26,775	27,662	25,270	24,049	24,511
Manufacturing and mining	21.2	20.7	19.9	19.9	19.8
	255,607	258,615	230,790	220,422	217,171
Construction	7.9	8.3	7.9	6.8	6.2
	96,041	101,20	97,503	85,345	82,189
Wholesale and retail trade; repair of vehicles and motorcycles, hotel and catering	23.3	23.0	21.8	21.7	20.9
	213,531	224,869	209,477	186,627	180,715
Information and communication	5.0	5.1	5.3	5.3	5.3
	N/A	N/A	29,864	30,340	31,556
Financial and insurance activities	6.2	6.4	6.9	7.3	7.4
	34,574	36,330	37,098	35,497	36,239
Real estate	9.0	8.9	9.6	9.8	9.9
	4,694	5,629	4,921	4,811	5,117
Professional, scientific and technical activities	6.7	6.8	6.5	6.6	6.8
	43,256	45.706	51,655	49,615	48,802
Public administration	13.3	13.3	14.2	14.6	14.8
	104,731	104,83	105,293	105,265	106,825

Source: IMF, World Bank, EUROSTAT, Croatian Bureau of Statistics

Export activities increased by 45% in the period of 2002-2011. At the same time import activities increased by 2008, after which the value of import decreased by 5 billion EUR. Foreign trade deficit amounts to $ 6.7 billion, while in 2008 it amounted to 11.2 billion EUR. Republic of Croatia has to start economic activity, encourage export and reduce the high dependence on import.

Table 4. Main Trade Statistics

	2008	2009	2010	2011
Merchandise trade (% of GDP)	64.14	49.93	52.35	51.19
Manufactured exports (% of merchandise exports)	69.62	66.40	67.80	66.85
Exports of goods and services (% of GDP)	41.66	35.43	38.32	38.29
Imports of goods and services (% of GDP)	49.93	39.36	38.83	38.45

Source: IMF, World Bank, EUROSTAT, Croatian Bureau of Statistics

4. CONCLUSIONS

Croatia's maritime sector plays a key role in connecting the country's islands and improving access and mobility to its citizens. In a similar vein, the maritime sector is a major catalyst for the overall economic and social development of the country where the aggregation of maritime activities and associated industries generates direct socio-economic wealth as well as indirect trade, logistics, and spatial benefits. The main strategies for port sector are to strengthen the growth potential and competitiveness of Croatian ports in the region and to develop and support intermodal transport and integrated logistics services. The main actions suggested for port sector in Croatia are: support ongoing national port infrastructure projects, elaborate a national port strategy and development plan, implement investment programme in nautical ports, develop intermodal transport services and provide adequate rail infrastructure and to link port planning and development with intermodal and rail plans and TEN-T corridor development. Since the global crisis has had a major effect on the Croatian economy. Economic growth slowed significantly from 5.5% in 2007 to 2.4% in 2008, and in 2009 the economy contracted by 6% followed by a further contraction of 1.4% in 2010, it is expected that economic growth will encourage development of maritime sector and related industries in 2014 and 2015.

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TOWARDS THE MODEL OF OPTIMAL ALLOCATION OF OIL POLLUTON RESPONSE UNITS

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ABSTRACT

Massive catastrophic oil spills on Baltic Sea such as Baltic Carrier focus public attention on the damage caused by oil. Such large disasters occur relatively rarely, but when it comes to a major spill, negative effects may be felt for years. In the event of an oil spill rescue action should be taken to collect the pollution. Such action should proceed smoothly and its duration should be as short as possible. Such actions involve the dispatching of cleanup equipment. This paper presents a model algorithm designed to optimize the deployment of response resources to combat oil spills due to the cost of oil spill fighting action.

KEY WORDS

oil spill, allocation, optimization, evolutionary programming

1. INTRODUCTION

The increase in oil production brings risk of an oil spill, especially in areas with heavy traffic of tankers. To these belong Baltic Sea, which is particularly sensitive area. Numerous shallows and straits which in winter are covered by ice, make these areas difficult for navigation.
HELCOM statistics show that in the period 2002-2011, 7% of all accidents in the Baltic Sea ended with pollution. In 2011 there has been 121 accidents, of which 11 (9%) resulted in a spill. These spills occurred during the transfer of fuel, the only exception was a leak caused by damage to the engine (Fig. 1). Ships involved in these cases is 6 tankers, 4 bulk carriers and 1 passenger ship (Fig. 2).

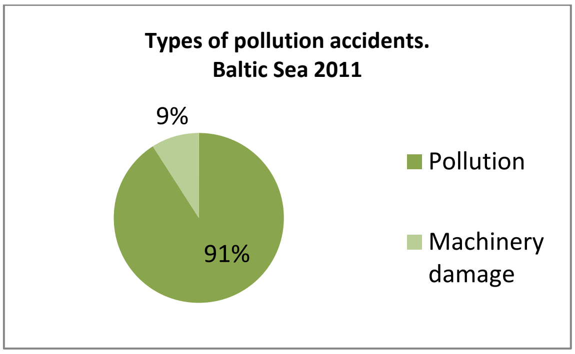

Figure 1. Types of accidents resulting in pollution in 2011. *(Prepared on the basis of the HELCOM Report on shopping accidents In the Baltic Sea area Turing 2011)*

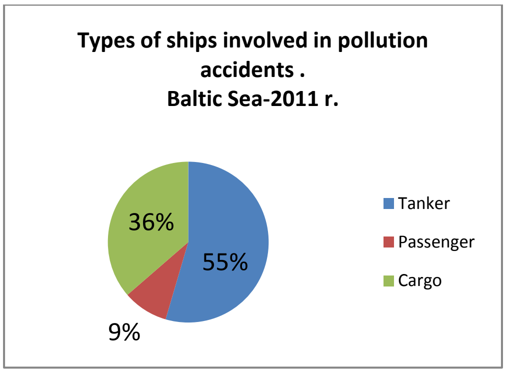

Figure 2. Types of vessels involved in incidents ended pollution of the Baltic Sea in 2011 (*Prepared on the basis of the HELCOM Report on shopping accidents In the Baltic Sea area during 2011)*

In the past, attempts have been made to formulate mathematical solutions to the problems of strategic and tactical planning rescue operations in the case of an oil spill. One of the attempts to solve the problem of optimal distribution of emergency equipment made Harilaos & Psaraftis and Babis & Ziogas in 1985. They have developed optimization procedure in order to support the decision-making process by the resort land. The objective function has been described as minimizing the costs incurred and the damages caused by the oil spill. The inputs to the model are the information about the type of leak, availability and performance of available equipment, as well as transport and equipment operation on scene. The algorithm is based on linear programming, however, gives only approximate results. The creators of the algorithm are divided into the decision making process by the hierarchical structure for the analysis of business systems [Anthony 1965] at three levels: strategic, tactical and operational.
Ziogas and Psaraftis algorithm refers to the tactical level of response and assumes that the strategic action plan has been completed. Of course, the decisions taken at the level of tactical planning are limited by the problems identified at a lower level.
Iakovou E. and others [1996] whereas the present model for the strategic level of response based on linear programming. This model determines the optimal number of bases rescue, which should be constructed and the number and type of equipment. The objective function consists of fixed costs associated with the construction of the on land facility, the cost of equipment storage and transportation costs of the equipment from the base to the spill site. Similar attempts have been made during the search for the best arrangement of police stations, ambulance and fire brigade. Church and Revelle [1974] propose a solution to the problem of deploying posts by greedy strategy using linear programming. It consists of successive partial coverage areas of databases, each of which is limited to its range of action.
The issue of Location-Allocation (LA) is a strategic issue in the decision making process of choosing the best arrangement of production centers and transport network connecting them with buyers. General definition of the problem is the choice of the optimal LA arrangements subset of the set of all possible combinations to meet the demand nodes [Rabbani M., Yousefnajad H 2013]. Sometimes this definition is extended to formulate CAL (called *Capacited AL),* which is a problem AL with restrictions, such as a specific budget, which amounts to placing production facilities in existing locations and / or the creation of new locations, where they can be placed.

2. MODEL OF OPTIMAL ALLOCATION

Model of optimal allocation refers to the strategic level of response action and is designed to fit the deployment of such a rescue ships in sea rescue bases, in which the time of arrival of ships at the spill site, the cost of the shares and the environmental impact as a result of a failed rescue operation will be as small as possible (Fig. 3).

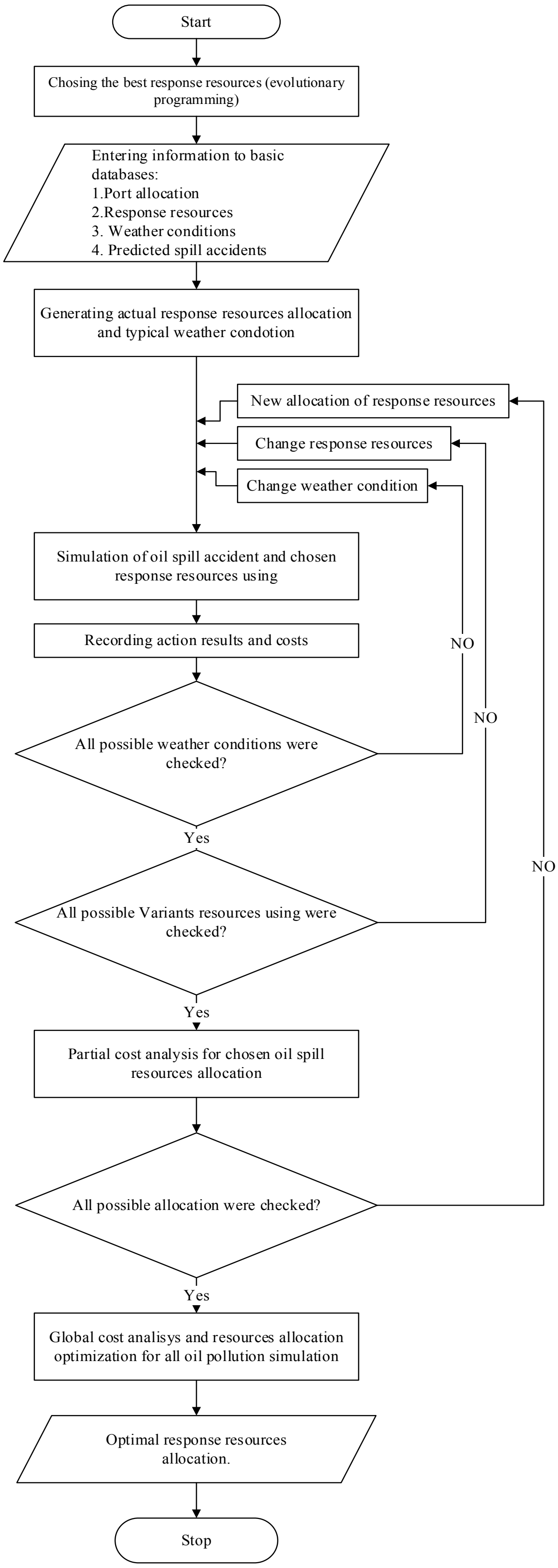

Figure 3. Block diagram of optimizing the allocation of response resources.

There we have I ship S_i to be deploy in J ports Pj coordinates (x_{pj}, y_{pj}). One ship can be assigned to only one port, one port can accommodate more than one ship, and the limit of its capacity is determined by the capacity of the port p. Ships are designed to combat K spills R_k located at positions (x_{rk}, y_{rk}) along the shipping routes between points of shipping lanes T_l.

It is so deploy ships to minimize the sum of the following costs:

- total cost of reaching the spill site,
- the total cost of collecting the spillage by involved vessels,
- cost of contamination on the environment as a result of a failed action,
- the cost of establishing a new port (if needed),
- the cost of buying new ships and their equipment (if none of the proposed arrangements vessels does not provide complete removal of the spill),
- cost of maintaining the ships in the harbor,
- maximize profits from the use of ships for other purposes such as tugs (multi-criteria optimization).

Other assumptions and limiting model:

- does not create a new port (location),
- it is assumed that all ships come together to spill site - the next step development of the model to the spill should be sent to the number of vessels, which has the ability to remove the filling of established supply such as 50%,
- each vessel must be assigned to the one port,

spills do not move and do not take into account the dispersion of oil.

The number of possible arrangements I vessels in the J ports is: any vessel can be assigned to only one port so is J opportunities for I ships, which gives $N = J^I$ the possibility of deploying ships.

It was therefore the following objective function:

$$Min \quad \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K} t_{ijk} c_{ik} x_{ij} y_{ik} + \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K} t_{ik} c_{ik} x_{ij} y_{ij} \qquad (1)$$

the restrictions:

$$\sum_{i=1}^{I} x_{ij} = 1; \quad \forall i, \tag{2}$$

(Each vessel must be assigned to a port)

$$\sum_{j=1}^{J} y_{ik} = 1; \quad \forall j, \tag{3}$$

(All vessels are involved in the action)

where:

$t_{ijk} = d_{jk} / v_{ij}$ -time to reach the spill site,

c_{ik} -the cost of operations of the vessel.

3. THE USE OF GENETIC ALGORITHMS IN A MODEL

Genetic algorithm (or its variant evolutionary algorithm) is a type of algorithm, the searching space of alternative solutions to the problem in order to find the best solutions due to the criterion (time, cost, profit). Genetic algorithms are generally used to solve complex optimization problems. Application of genetic algorithm to speed up the process of searching for the best solution of the problem deployment of forces and means.

Evolutionary algorithm for the approximate stochastic algorithm that uses mechanisms inspired by biological evolution process, such as selection, reproduction and mutation. The relevant population of individuals working pressure of natural selection forced and controlled environment with a predetermined objective function. Only the fittest individuals have the opportunity to launch a new, usually improved population. In an evolutionary algorithm, a problem to be solved is an environment in which "lives" a population of individuals. Each subject may be a potential solution to the problem. Evolutionary algorithm usually tends to gradually create more and better solutions, it is often used to solve optimization problems, because the optimization process involves searching the space of potential solutions to the problem in order to find the best solution.

The author's model of optimal allocation of resources using the following algorithm based on a simple evolutionary algorithm in the form of:

0 Start
1 Random initialization first: *Population1*
2 Rate: *Population1*
3 Until *GenerationNumbers* <= *MaxGenerationNumbers* follow:
 3.1. Copy *Population1* to *TemporaryPopulation*
 3.2. Crossing individuals *TemporaryPopulation*
 3.3.Mutation individuals *TemporaryPopulation*
 3.4. Copy: *TemporaryPopulation* to *ChildPopulation_i*
 3.5. Rate: *ChildPopulation_i*
 3.6. Save and draw data from *Generation_i*
 3.7. *GenerationNumbers* = *GenerationNumber*+1
4 End

Encoding of chromosomes

To solve the task using the following way of coding chromosome, which contains both the information about the ship and its location in the Port:

Ship	1	2	3	4	5	...	*I*
Port	**1**	**1**	**3**	**3**	**3**	**...**	**...**

Ship No. 1 - Port 1
Ship No. 2 - Port 1
Ship No. 3 - Port 3
Ship No. 4 - Port 3
... etc

Assumed that the ship must be assigned to a port. Chromosome therefore consists of a set of natural numbers between 1 and the number of ports. Chromosome length is equal to the number of vessels. The order of the genes is determined by the order in the list of vessels.

This chromosome is coded as real numbers in the form of a vector: X={1, 1, 3, 3, 3,...}. Thus, a single bit of a chromosome x ranges from 1 to the maximum number of ports.

Genetic Operations

Choosing of parent population

The decision on the crossing of two individuals taken on the basis of a single Bernoulli trials with probability of success equal to the adopted Pcrossing. Roulette rule applied, ie more accustomed were elected to the crossing, in practice, first elected prospective parents and then randomized or crossing was to take place and were allowed to cross, and if not elected the next two potential parents.

Crossing

The simple one-point crossover operation. Were first selected with uniform probability of 1 to a maximum length of the chromosome (the number of vessels) crossing point and at that point dissected chromosomes as follows. Assuming that you have selected two candidates to cross (K1 and K2) and have their chromosomes in the form of:

K1 = {1,2,3, 2,3,4,1}
K2 = {2,4,5, 6,7,3,2}

a crossing point has been chosen as = 3 descendants have the following chromosomes:

P1 = {1,2,3, | 6,7,3,2}
P2 = {2,4,5, | 2,3,4,1}

Mutation

The mutation was performed with the probability of mutations on chromosome progeny (Bernoulli trials have also been used with success probability equal to Pmutation). If successful, the procedure follows:

- elected by the uniform distribution allele that is in our case the ship in the form of a number from 1 to the length of the chromosome (number of vessels),
- randomized (also with the uniform distribution) from 1 to the number of ports and attributed to the point of the chromosome.

The interpretation of such activity is random positioning of the vessel in port.

4. THE RESULT OF GENETIC MODEL

To ensure the efficient and rapid search for the best possible allocation of vessels to combat oil pollution created an application based on an evolutionary algorithm. You have the ability to change parameters such as:

- The number and location of ports,
- Number of vessels
- The number and location of possible spills.

The application is composed of three windows presenting the results of the simulation (fig. 4). The first window (1) presents a graph of the cost of the rescue operation for the following variants of the deployment of ships in ports. The next window (2) shows the location of ports and spills. The last window (3) is a summary of the simulation results in text form.

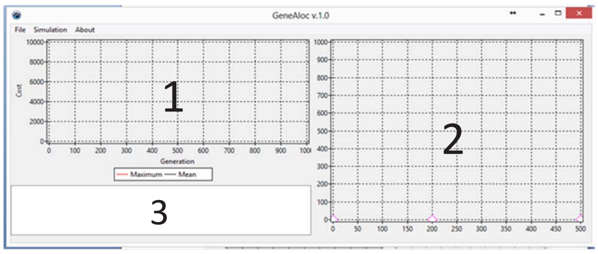

Figure 4. Main window of optimizing the allocation application

5. GENETIC MODEL RESULTS

5.1 Scenario no 1

- Number of ports: 5,
- number of vessels: 9,
- number of possible spills: 4,
- size of population: 20,
- number of generations: 400
- Pcrossing: 0.45
- Pmutation: 0.02.

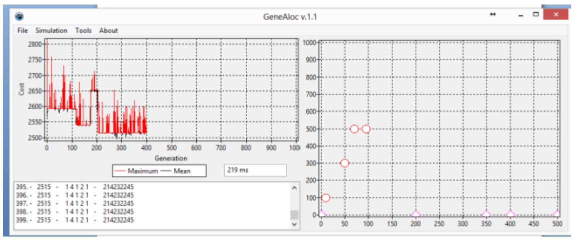

Figure 5. Results of simulation no 1.

In the first simulation there were available five ports and nine vessels that had so deploy in ports by the time they reach the spill site was the smallest, which is the total cost (fig.5). In this case, the lowest cost associated with deployment of the following vessels:

- Port no.1 – 1 vessel,
- Port no. 2 – 4 vessels,
- Port no. 3 – 1 vessels,
- Port no. 4 – 2 vessels,
- Port no. 5 – 1 vessels.

5.2 Scenario no 2

- Number of ports: 6,
- number of vessels: 9,
- number of possible spills: 4,
- size of population: 20,
- number of generations: 400,
- PCrossing: 0.45,
- PMutation: 0.02.

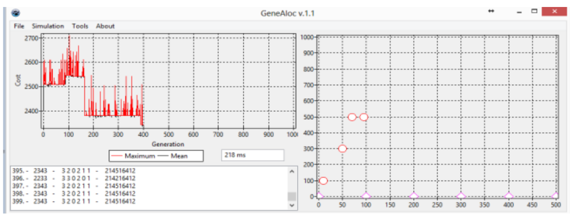

Figure 6. Results of simulation no 2.

In the second case, the disposal was 6 ports, 9 vessels and four possible space filling (Fig.6). Here the result is as follows:

- Port no. 1 – 3 vessels,
- Port no. 2 – 2 vessels,
- Port no. 3 – 0 vessels,
- Port no. 4 – 2 vessels,
- Port no. 5 – 1 vessel,
- Port no. 6 – 1vessel.

6. CONCLUSIONS

Planning and organization of rescue is quite a complicated process, especially if you plan to use the available resources in a local optimum. Therefore, it was decided to create a model to find the best possible solution for the question of the allocation of emergency. Model of optimal allocation of resources can improve the decision making process at the level of planning rescue operations. It is intended primarily for the effective implementation of the rescue vessels in various ports. The application described in this article is in the process of expansion and fulfillment of new features.

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HIGH-SPED MARINE DIESEL ENGINES TUNING AND DIAGNOSING USING VIBRATION METHOD

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ABSTRACT

Results of studies that aim was to develop a diagnostic method for high-speed marine diesel engines are presented in this paper. High-speed marine diesel engines are used to drive small vessels or more often to drive ships' generators. Polish Navy is operating significant number engines of this type. Motors of this type do not have indicator valves, which complicates the assessment of their technical condition in exploitation. These engines also, some of them because of their age, are relatively poorly equipped with control and measurement devices. In the era of cost reduction in operation of marine equipment there is a tendency to reduce the cost of maintenance and repair works on diesel engines too. One of the ways to avoid malfunction of such engines can be systematic and/or permanent monitoring of the technical condition of selected critical systems on these engines using reliable diagnostic methods. Polish Naval Academy (PNA) in Gdynia for years has been doing research on methods of diagnosing marine internal combustion engines. In recent years, a diagnostic method for high-speed marine diesel engines based on the analysis of envelope of vibration accelerations generated by valve gear mechanism and fuel system has been developed. Some tests results made on Mercedes-Maybach MB820 and WOLA-Henschel engines types are presented in the paper.

KEY WORDS

Transport, maritime transport, marine high-speed diesel engines, tuning, diagnostics

1. INTRODUCTION

Polish Navy operates on board ships different types of marine diesel engines. Conditions of exploitation of these engines are changed lately[1] mainly because of the maintenance costs reductions. Crews are still less responsible for repair works and overhauls as it is more often meter of shipyards. One of new tools which could be useful in everyday engines monitoring and exploitation are diagnostic methods based on vibration signals analysis [2-8]. This article presents one of possible methods worked out for diagnosis of high-speed marine diesel engines used in the operation. The method based on the angular selection of vibration signal emitted by the engine running components which may be useful for diagnosis of high-speed engines fuel system and valve gear, which are not fitted with cylinder pressure valves. Typical diagnostic methods which base on vibration signals amplitude or frequency analysis are sensitive to engine load and speed changes. In the paper a diagnostic method which was worked out in Technical Institute of Ship Construction and Maintenance of PNA is presented. The method was tested on compact high-speed marine diesel engines type MB820 and marine WOLA diesel engines type H which are used on submarines and small vessels as propulsion prime movers or generators.

2. OBJECTS OF THE RESEARCH

This paper presents chosen results of tests carried out on PNA laboratory stands and on engines mounted on board of Polish Navy vessels. In tests WOLA family engines and Mercedes-Maybach MB820 engines were involved. Valve gear mechanism and fuel injection systems were researched as sources of vibration signals which could be used in assessment of technical condition of the engines. Values of parameters measured on stopped and cold engine such as angles of valves closing and opening and fuel injector opening angle are used in typical technical condition assessment procedure. Values of these parameters in static conditions for both types of tested engines are shown in Table 1.

Values of angle parameters given in Table 1 are specific for “static” measuring conditions. That means that they are measured on stopped engine and at engine temperature equal about 20°C. For such measurements values of clearances are also changed to get exact values of angles. Engine monitoring or diagnostic system needs values of these parameters characteristic for operating and loaded engine. Aim of the research was to check if in vibration acceleration signals generated by the chosen engine systems and components are such parameters which are unequivocal, strongly connected with different object structure parameters, easy to asses and measure. Another aim of the research was exploration of the exact values of engines “dynamic” tuning parameters that are necessary in engine technical condition assessment when using on-line measuring systems on working engine. The WOLA engines are very popular as source of power in marine generators in Polish Navy. Total population of these engines systematically decries but in exploitation are still more than fifty units. WOLA diesel engines type H used in Navy have two types of configurations – six cylinders in line “L” and twelve cylinders in “V” form. WOLA engine with 6 cylinders is a unit for small ship propulsion system but engines tested on board a ships are typical 12 cylinder units for generators.

The MB820 type submarine engine (Figure 1 and 2) is a high speed four stroke diesel engine of light compact design that works on the pre-chamber combustion process. The pre-chamber is connected with the cylinder space through the holes in the burner.

Figure1. Polish Navy submarines Foxtrot, Kilo and Kobben

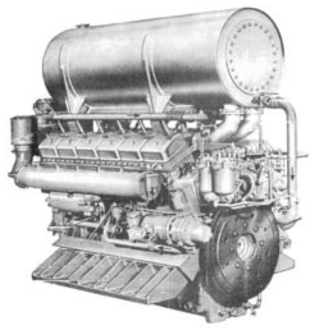

Figure 2. Marine diesel engine MB820 type from Kobben class submarine

The engine has 12 cylinders which are arranged in two banks inclined at an angle of 60° to one another. Each cylinder has 2 inlet and 2 exhaust valves, the stroke of which is controlled by a camshaft common to both cylinder banks, by means of tappets, push-rods and rocker arms. The inlet ports of individual cylinders are connected to a manifold on each side, at the front end of which a wet air filter is mounted. The exhaust ports on each side lead to a water cooled exhaust manifold. The two exhaust manifolds are connected to the silencer. The crankcase consists of a sturdy block which carries on up to the cylinder head in V form. Each cylinder head has separate cover fastened by the screws. Engine general technical data and static tuning parameters are given in Table 1.

Table 1. Basic data of diesel engines WOLA – Henschel type and Mercedes-Maybach MB820 type

Engine type	WOLA – Henschel 57H6Aa Four-stroke, turbocharged	MB820 Four-stroke, not turbocharged
Combustion chamber type	Open chamber	Diesel pre-chamber
Turbocharger type	WSK–Holset 4MD	-
No. of cylinders / Configuration	i=6 / „ L"	i=12/ „V"
Nominal output	Pn= 155 kW at 1500 rpm	Pn=440 kW at 1400 rpm
Cylinder bore	D= 135 mm	D=175 mm
Piston stroke	S= 155 mm	S= 205 mm
Compression ratio	ε= 1:14,0	ε= 1:18,5
Total displacement volume	Vss= 13,3 dm^3	Vss= 59,2 dm^3
Firing order	1-5-3-6-2-4	1-8-5-10-3-7-6-11-2-9-4-12
Number of valves per cylinder	z= 4	z= 4
Fuel injection pressure	pw= 19,4 MPa	pw= 17,0-17,5 MPa
Angle of intake valve open	45 ± 6 deg before TDC	14 deg before TDC
Angle of exhaust valve open	45 ± 6 deg before BDC	48 deg before BDC
Angle of intake valve close	45 ± 6 deg after BDC	56 deg after BDC
Angle of exhaust valve close	45 ± 6 deg after TDC	19 deg after TDC
Angle of fuel valve open	32-36 deg before TDC	24-36 deg before TDC Adjustment range of automatic injection timer
Inlet and exhaust valves clearances	0,3 mm	0,40 / 0,45 mm

3. METHOD AND RESULTS OF INVESTIGATIONS ON WOLA– HENSCHEL ENGINES

To assess proper and efficient diagnostic parameters on the base of vibration signal analysis some basic and more advanced research were made. At first with using the Brüel & Kjær PULS system on the test bed with 6-cylinder WOLA engine accelerations of vibration signal in time domain was registered as it is shown in the Figures number 3 and 4. Vibration sensor was mounted on cylinder head number 2. During engine operation the section number 2 of fuel high-pressure pump which delivers fuel to the cylinder number 2 was suspended in upper position what results in vibration signal pattern as it is shown in Figure number 4. For normally operated engine (and fuel pump) vibration signal pattern was as in Figure number 3.

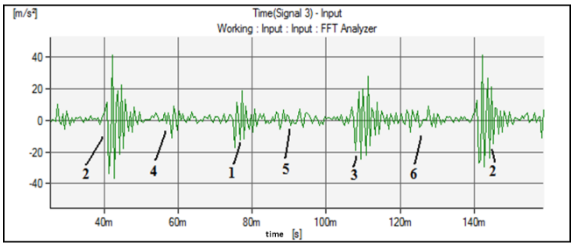

Figure 3. Acceleration vibration signal measured on cylinder head number 2 in time domain - engine fairing order 1-5-3-6-2-4, plunger of the second section of fuel pump in normal operation

On the basis of that tests and other researches maden on test engine in PNA it was shown that observerd vibration signal is sensitive enough to observe malfunctions in engine fuel system. The special method and dedicated engine analysier has been constructed [7-9].

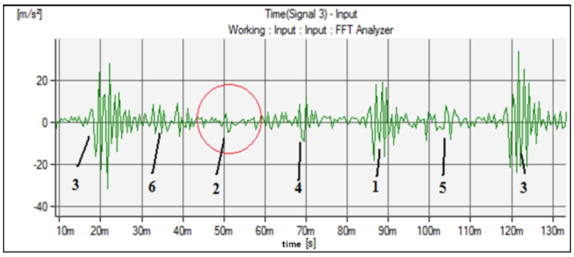

Figure 4. Acceleration vibration signal measured on cylinder head number 2 in time domain - engine fairing order 1-5-3-6-2-4, plunger of the second section of fuel pump is blocked in upper position

The method based on envelope of aceleration vibration signal followig which is automatically or manually analised in engine crank angle domain – Figure number 5. Obsevered signals of vibration acceleration envelopes measured on engine six cylinders are medium values from several followed traces. There are many ways of determining the envelope of signal[9]. One of them is the use of a Hilbert transform. For the course of x (t) it is defined as:

$$H[x(t)] = \frac{1}{\pi} \int_{-\infty}^{+\infty} \frac{x(t)}{\tau - t} d\tau$$

Analytical signal is called a complex signal described by the equation:

$$z(t) = x(t) + jH[x(t)] = a(t)e^{j\phi(t)}$$

where: a (t) and φ (t) are respectively the amplitude and phase of the generalized signal. The study used a signal analyzer, which handled the envelope of the vibration signal on the analog way. To add the signals and calculate and show their mean value vibration signals are trigegered by the signal from pressure curve which was measured only on cylinder number 2 by dismantled air starting valve. These envelope curves represents signals which are simultanously measured and averaged from several folloved vibration cycles closed by the trigger (marker) on the pressure curve. In the Fig. 5 signals from cylinders 1,6 and 3,4 and 5 are moved respectively by 120, 240 and 360 cranck angle (CA) degrees to achieve the same location of the signals according to TDC of cylinder number 2 on which pressure sensor was mounted.

Special analyser softwer solution enables to enlarge parts of the diagrams and make easier for the operator to assess accurate values of angles characteristic for fuel valve and exhaust and intake valves opennig and closing. Possibilities of analyser "zoom" mode are shown in the Figure 6 where angles of openning for six engine fuel valves are marked. As it is seen values of angles varies from 12 to 8 CA degrees before TDC.

During the laboratory tests some engine malfunctions have been simulated. In the figures number 7 and number 8 results of such simulation are presented. Figure number 7 presents situation when fuel valves on cylinders number 2 and number 5 have set nominal pressure value which opens fuel valves. In the Figure number 8 fuel injector on cylinder number 2 has set lower fuel pressure value equal 13,0 MPa not 19,4 MPa which is a proper value.

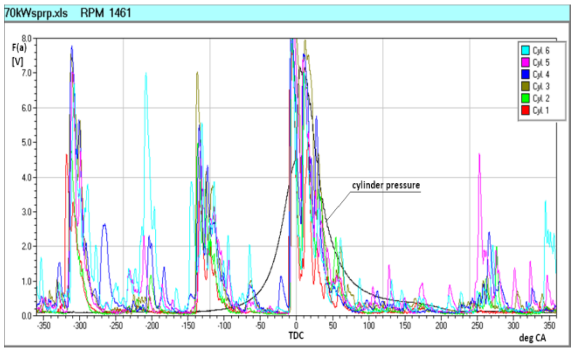

Figure 5. Envelopes of vibration acceleration signals registered on the laboratory six cylinders diesel engine WOLA type 57H6Aa – engine speed =1461 rpm, engine load = 70 kW = 50% of nominal load

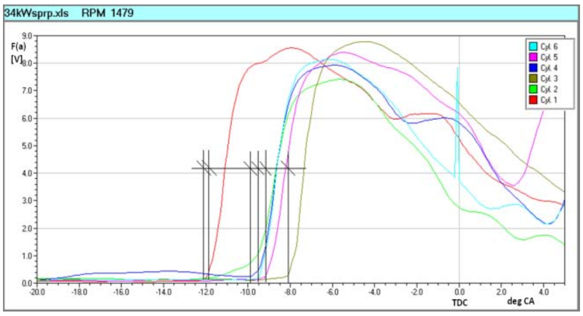

Figure 6. Envelopes of vibration acceleration signals registered on the laboratory six cylinders diesel engine WOLA type 57H6Aa in „zoom" mode - angles of fuel velves opens
– engine speed =1479 rpm, engine load = 34 kW = 25% of nominal load

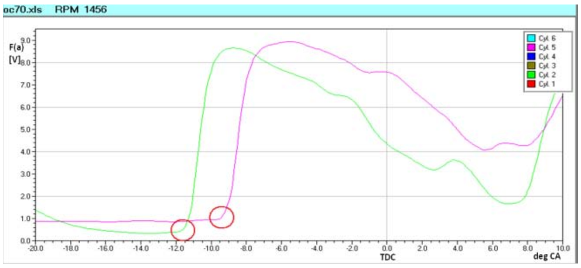

Figure 7. Envelopes of vibration acceleration signals registered on the laboratory six cylinders diesel engine WOLA type 57H6Aa in „zoom" mode, red circles - angles of fuel velves opens– engine speed =1456 rpm, engine load = 34 kW = 25% of nominal load

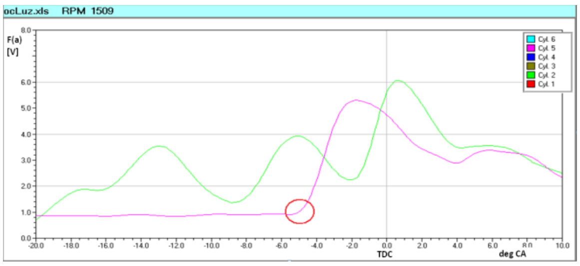

Figure 8. Envelopes of vibration acceleration signals registered on the laboratory six cylinders diesel engine WOLA type 57H6Aa in „zoom" mode, red circle - angle of fuel velves open
engine speed = 1509 rpm, engine load = 34 kW = 25% of nominal load

It is seen that when fuel valve settings are changed the character of whole vibration curve is changed and momentum of fuel valve opening and fuel valve closing are not clearly seen (fig. 8). Circles in Figures number 7 and number 8 shows places when fuel valves becomes opened during engine operation. In case of fuel valve which has lower fuel opening pressure (Figure number 8 – green line) this point is not easy to determine.

4. METHOD AND RESULTS OF INVESTIGATIONS ON MERCEDES – MAYBACH MB820 ENGINES

Examples from vibration signals measurements taken on submarine diesel engines MB820 and methods of their visualization are shown in figures number 9 and 10. Cylinder pressure signals taken from decompression valves were used as a reference signal to trigger the vibration signals on MB820 engine cylinder heads. The most important parts of the vibration traces are shown in "zoom" mode. The points where curves sheer goes upwards are recognized as a start of fuel injection or as moments of valve opens and closes. The differences between fuel valve opens presented in the Fig. 9 for left engine bank of cylinders differ in 1.75° of crankshaft revolution range. The difference between "static" and "dynamic" angle of fuel valves opens has about 16.5°CA.

In the Fig. 10 signals generated by inlet valve opens in the same engine bank are presented. It is visible that angles of valves opens differ in broad range of 5.5° CA and signals patterns differ much more according to the amplitude.

Almost every change in the engine mechanical structure will be detected in the vibration signals pattern sequence.

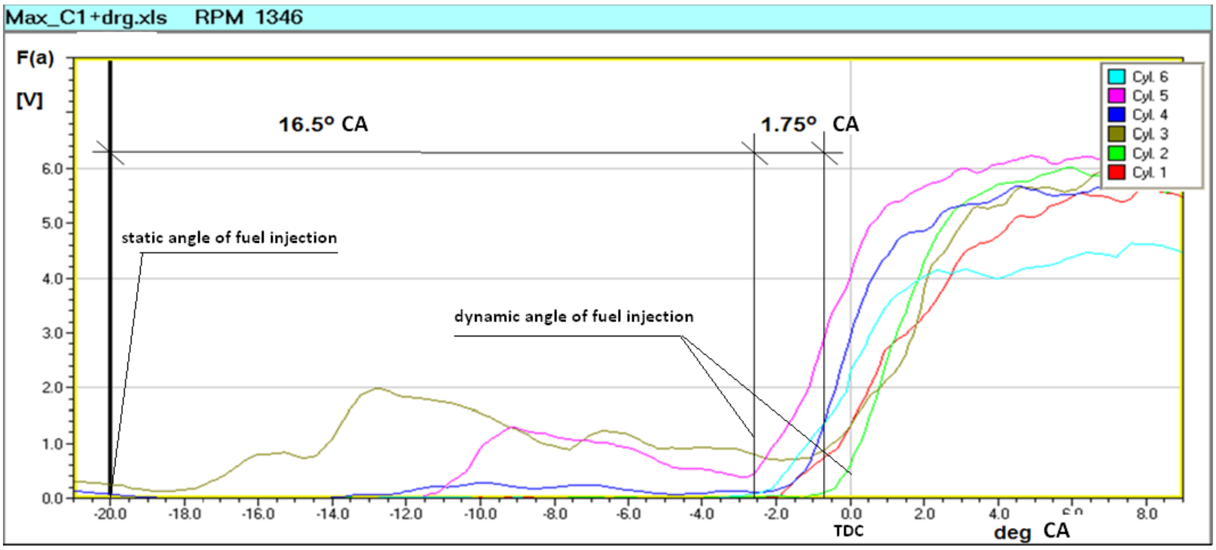

Figure 9. Dynamic and static angles values of start of fuel injection in high-speed diesel engine type MB820

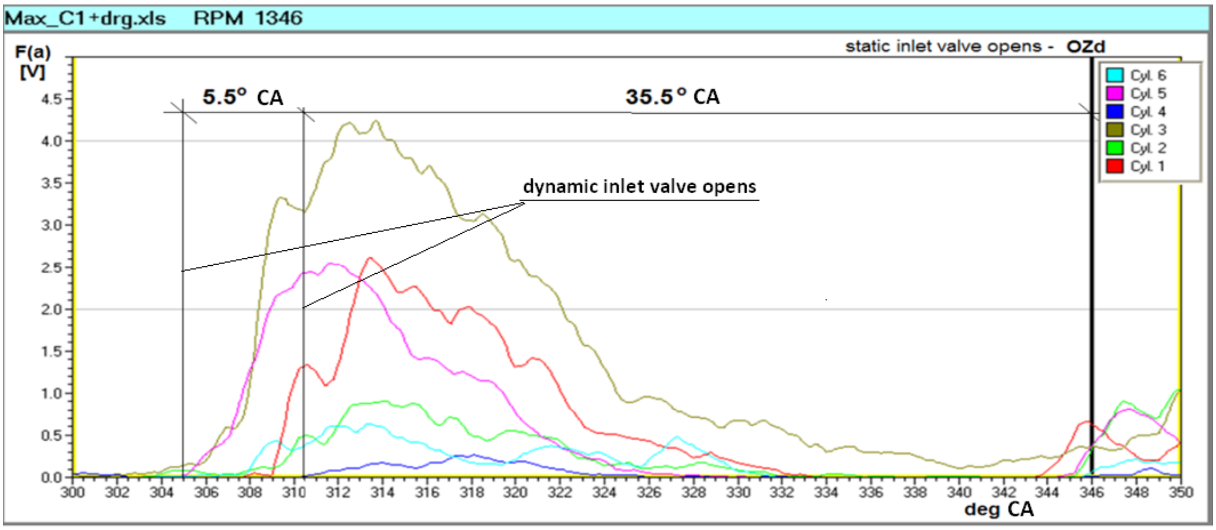

Figure 10. Dynamic and static angles values of inlet valve opens in high-speed diesel engine type MB820

Using the vibration acceleration envelope waveform analyzer equipped with the "zoom" function operator can zoom in each part of the vibration curve and use the cursor to read-out the dynamic parameters such as characteristic engine timing points. Using the cursor operator of the analyzer can determine the beginning of the opening angles of the fuel injectors, opening and closing intake and exhaust valves of a cylinder in the engine with enough to adjust (or check the status of regulation) accuracy (Figures 9 and 10).

5. CHOSEN RESULTS OF INVESTIGATIONS WHICH WERE MADE ON 12 CYLINDERS WOLA ENGINE UNIT

These chosen research results were achieved on 12-cylinder diesel-generator units on the one of the Polish Navy vessels. Engines were loaded up to 50% and 100% of the nominal load during the tests. Observed on analyzer's screen patterns of envelope of vibrations for one bank of cylinders are shown in Figure number 11. To achieve better signal visualization followed signals are moved-up by a few volts. In signal pattern at 100% nominal engine load opening and closing points of fuel valves are seen. Also angles of intake and exhaust valves closing are easy to observe.

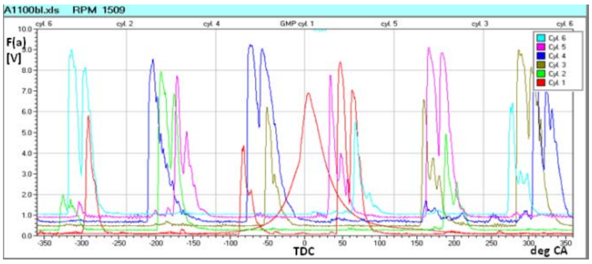

Figure 11. Envelopes of vibration acceleration signals registered on one of the banks of auxiliary diesel generator engine WOLA H12 – engine speed = 1500 rpm, engine load = 100% of nominal load

Values of fuel injectors angles of opening and closing for 12-cylinder WOLA H12 engine are shown in "bar" form in Figure number 12. Average value of fuel valve opening angle for 12 cylinders at 100% engine load in operation mode is about -17 ° CA ("-" means before TDC). Average value of fuel valve closing for the same engine operation mode is about -1 ° CA. Differences between cylinders are less than ± 2 ° CA. Fuel injection period at engine full load has about 16 ° CA. At this same engine working mode values of intake valves closing angles were read out and registered. Results of these measurements are shown in the Figure number 13. Values of intake valves closing angles are varying from -152 ° CA to -143 ° CA before TDC. Values of differences are lower than acceptable margin of error given by engine manufacturer (± 6 ° CA)

During engine tests on the one of diesel generators situation as shown in the Figure 14 has occured. On the cylinder number 9 angle of intake valve closing was about 16 ° CA earlier than on other cylinders. It is sugesting situation when after valve timing control valve clearence on that cylinder has not been changed on value 0,4 *mm* from 1,0 *mm.*

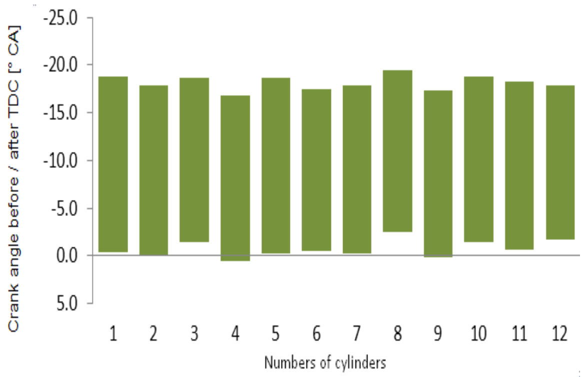

Figure12. Values of fuel injectors angles of opening and closing for auxiliary diese-generator engine WOLA H12
engine speed = 1500 rpm, engine load = 100% nominal load

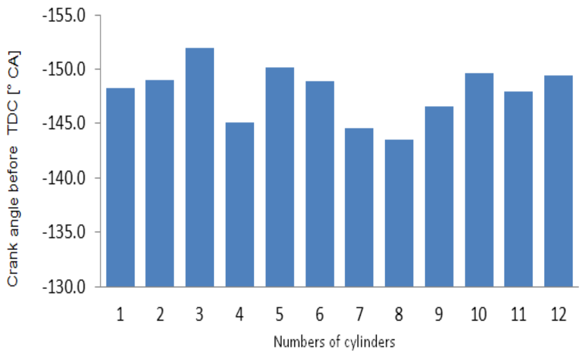

Figure 13. Values of intake valves angles closing for auxiliary diese-generator engine WOLA H12 engine speed = 1500 rpm, engine load = 100% of nominal load

6. CONCLUSIONS

Assessment of technical condition of marine internal combustion diesel engines in operation is a very complex process. So for this purpose all available methods which are effective and not too expensive are used. Most of the malfunctions in marine engines are generated by the fuel system and valve gear mechanism. Following the instructions engine rooms crews are obliged for relatively frequent inspections the technical condition of these engine systems.

Presented diagnostic method is effective in the evaluation of the technical condition of a high-speed marine diesel engines.

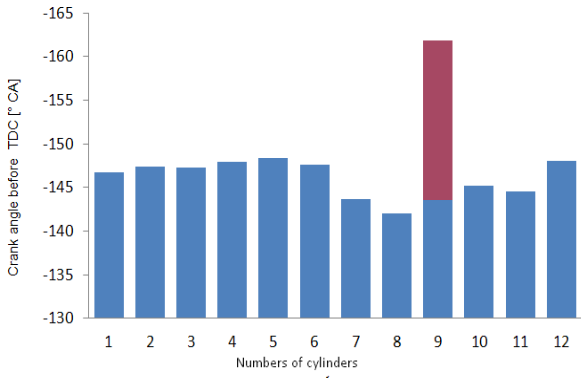

Figure 14. Values of intake valves angles closing for auxiliary diese-generator engine WOLA H12 engine speed = 1500 rpm, engine load = 100% of nominal load

Engines without of indicator valves can be tested using this method. The method developed in the laboratory has undergone a positive verification in the marine exploitation conditions. Values of dynamic angles of opening and closing of the fuel injectors on the running engine can be define with using this method. The method allows determine angles of intake and exhaust valves closing on the running engine. Despite some limitations resulting from the very essence of the method and design of marine internal combustion engines presented method can be useful for marine and not-marine high-speed engines diagnosing, especially when they are not fitted with indicating valves.

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AN ANALYSIS OF VARIANCE OF FISHING VESSEL REFRIGERATING SYSTEMS FAULTS

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ABSTRACT

We have performed an analysis of variance to verify the hypothesis that independent variables differentiate the number of faults and frequencies of faults occurring in refrigerating systems installed on board fishing craft. The analysis specifies a probability with which identified factors may cause differences between values of observed category means. The grouping factors used in the analysis are: year of fault occurrence, fault category and a type of fishing vessel. We have tested hypotheses that mean numbers of faults or mean frequencies of fault occurrence are approximately equal in each group of independent variable. The examined faults of refrigerating system components, derived from data collected in the years 2007 - 2011, have been divided into seven categories and analyzed statistically. We have gathered and estimated 235 faults of refrigerating system components from 25 fishing vessels of the Polish fishing fleet. The vessels are divided into two types depending on the refrigerant used in their systems.

KEY WORDS

analysis of variance, refrigerating systems

1. INTRODUCTION

Polish fishing fleet operating on the Baltic Sea from domestic ports is characterized by a variety of vessels and their age. Over many years of their operation, many vessels have been modified, which included the refrigerating systems. Fishing vessels have varied refrigerating systems, i.e. different technologies of storing and transporting fish. The operational performance of those systems directly affects the quality of fish, which translates into market value and higher demand on the fish market. The operators of obsolete shipboard refrigerating systems are haunted with frequent defects due to leaky refrigerating installations, resulting in spills of the refrigerant, as well as failures of refrigerating units, condensers etc [1-6]. One specific reason for some faults is unsatisfactory condition in refrigerating systems due to temporary repairs or conversions, installation of new equipment, often fitted in a hurry and without proper tools. Those modifications have often been a response to breakdowns during the operation of fishing vessels. Finally, some changes have been necessitated by obligatory replacement of specific refrigerants due to their adverse effect on the environment.

Some damage to refrigerating systems may be also be caused by insufficiently qualified personnel. This is particularly true in case of new vessels with modern, often complex, refrigerating plants using acceptable environmentally friendly refrigerants. A large number of refrigerating units used in Poland and in the world still depletes the ozone layer and thus contributing to the creation of the greenhouse effect. Ozone in the upper layer of the atmosphere protects us before harmful ultraviolet radiation. Ozoning in the refrigeration practice was used to prevent development of micro-organisms in refrigerated chambers [3, 5-9]. We have witnessed a steady drop of the ozone level in the protective layer of the Earth for decades now. The phenomenon was mainly initiated by the appearance in the atmosphere of large amounts of chlorofluorocarbons (CFCs) and nitrogen compounds, making up what we call greenhouse gases [8, 10]. Although these gases are needed in the atmosphere to sustain life on the planet (without the gases temperature would drop much below zero), due to uncontrollable growth of average air and ocean temperatures, we record excessive melting of the glaciers and ozone explosions, as the gas is unstable and explodes in the presence of hydrogen, iron, copper and chromium. These undesired phenomena are caused by a number of factors, inter alia, refrigerant leaks or improper energy management. The warmer climate is expected to lead to increased water level of the seas and consequent flooding of areas lying low above the sea level, often densely populated areas. As a result of the warming of the climate, winters will be warmer and, summers dramatically hotter, which will lead to such effects of more intense ultraviolet radiation as reduction of chlorophyll in plants, climate changes, restricted development of phytoplankton in the oceans, more cases of skin cancer and eye diseases in people and animals.

The use of refrigeration equipment and installations calls for skillful and experienced operators. The proper operation of refrigerating units with minimized number of failures can only be achieved by qualified personnel and the application of high quality materials and components. Despite constant increase in the reliability of refrigerating systems, we cannot prevent faults from occurring. Therefore, if operational faults are properly anticipated by determining their probability of occurrence, users will avoid situations where a defect of one component will negatively affect the work of an entire unit.

2. THE RESEARCH - ONE FACTOR ANALYSIS OF VARIANCE

We have adopted seven categories of faults of refrigerating system elements for the purpose of determining the probability of these faults [9-11]:

1) leaks of refrigerants in refrigeration installations,
2) defects of compressors,
3) damage to heat exchangers (condensers and evaporators),
4) control system faults,
5) defects of ventilators,
6) damage to water / brine / oil pumps,
7) defrosting system faults.

From data gathered in the years 2007–2011 we have evaluated 235 occurrences of faults in refrigerating systems of 25 vessels belonging to the Polish fishing fleet [11]. Two types of vessels have been analyzed. The analysis has covered two groups of vessels, divided by the type of refrigerant used in them [10]:

1) vessels herein denoted as X; these vessels use an old type of refrigerant belonging to the hydro chlorofluorocarbon compounds (HCFCs) (refrigerating system faults in 16 vessels have been analyzed).
2) vessels denoted as Y; these vessels are equipped with modernized or original refrigerating systems running on refrigerants other than HCFCs or CFCs (we have examined refrigerating system faults in nine such vessels).

A one factor analysis of variance has been done to find out the probability with which the factors: year of occurrence, fault category and the type of vessel may cause variation between observed group mean values.

We have verified a hypothesis [12] that independent variables differentiate two kinds of variables: number of faults and frequency of faults occurring in refrigerating systems of fishing vessels. In ANOVA, an analysis of variance used, our classifying factor is the year in which a fault occurred, the category of fault and the type of vessel. We have tested hypotheses that mean numbers of faults or mean frequencies of fault occurrence are equal in particular groups of independent variable. The test results are given below.

A test for the variable number of faults (in refrigerating systems of fishing vessels) in each category:

H_0: $m_1 = m_2 = \ldots = m_7$, against an alternative hypothesis

H_1: not all m are equal.

The value of testing statistic and a critical level of probability p are given in Figure 1.

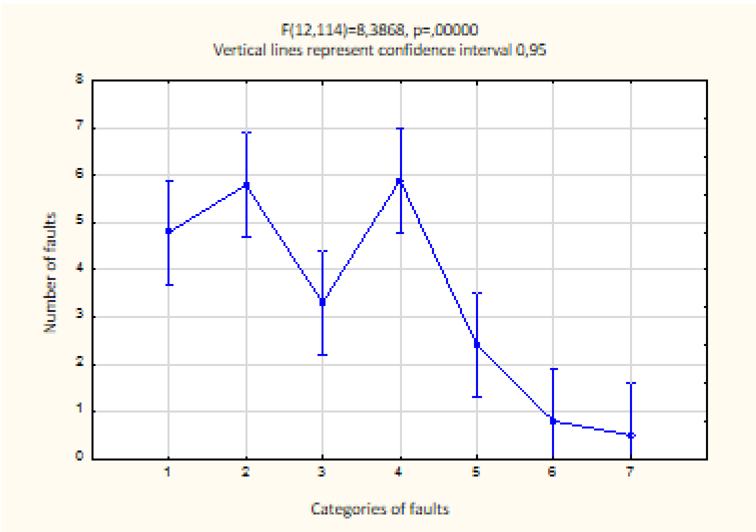

Figure 1. ANOVA for the variable number of faults against categories of faults occurring in refrigerating systems of fishing vessels

Assumptions that independent variables differentiate variables of the number of faults and frequency of faults of refrigerating systems of fishing vessels have been verified by means of a one factor analysis of variance, where the classifying factors were: year of occurrence, fault category and the type of vessel. We have tested hypotheses that mean numbers of faults or mean frequencies of fault occurrence are equal in particular groups of the independent variable. The results of these tests are given below.

A test for the variable 'number of faults' of refrigerating systems of fishing vessels in each category:

H_0: $m_1 = m_2 = \ldots = m_7$, against an alternative hypothesis

H_1: not all m are equal.

The value of testing statistic and critical level of probability p are shown in Figure 1.

At the significance level $\alpha = 0.05$ we reject the null hypothesis on the equality of means, which is interpreted as follows: variable category of faults differentiates the number of faults, and it can be observed that the greatest mean numbers of faults are those for categories 2 and 4, while the smallest means fall on categories 6 and 7. A test for the variable frequency of faults in each category:

H_0: $m_{c1} = m_{c2} = \ldots = m_{c7}$, against an alternative hypothesis

H_1: not all m are equal.

The value of testing statistic and critical level of probability p are shown in Figure 2.

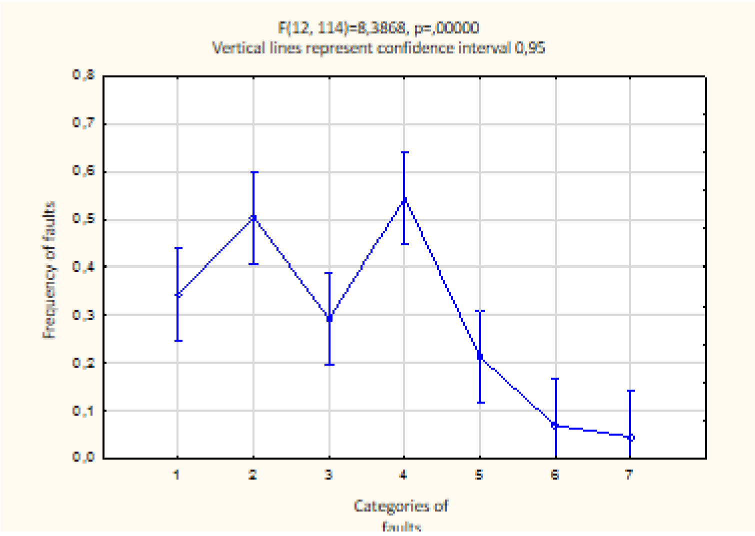

Figure 2. ANOVA for the variable frequency of faults against categories of faults occurring in refrigerating systems of fishing vessels

At the significance level $\alpha = 0.05$ we reject the null hypothesis on the equality of means, which is interpreted as follows: variable category of faults differentiates the frequency of faults, and it can be observed that the greatest mean frequencies of faults are those for categories 2 and 4, while the smallest means fall on categories 6 and 7.

A test for the variable number of faults in successive years:
H_0: $m_1 = m_2 = \ldots = m_5$, against an alternative hypothesis
H_1: not all m are equal.

The value of testing statistic and critical level of probability p are shown in Figure 3.

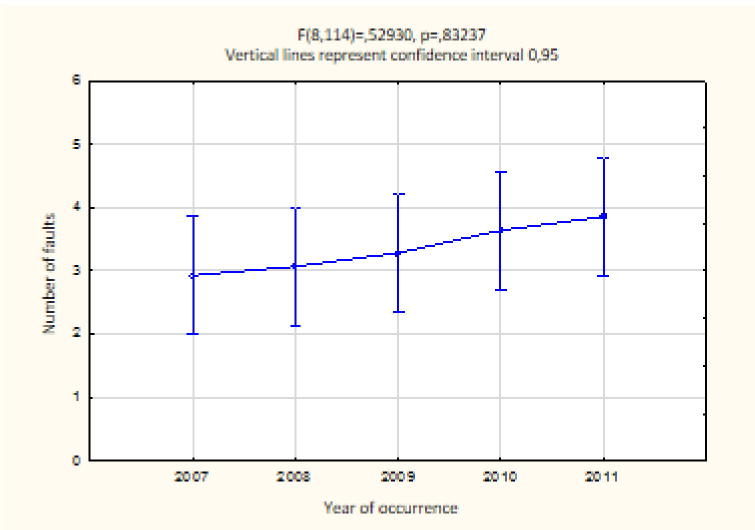

Figure 3. ANOVA for the variable number of faults against the independent variable year of occurrence

At the significance level $\alpha = 0.05$ there are no grounds to reject the null hypothesis on the equality of means, therefore the variable year of occurrence does not differentiate the number of faults.

A test for the variable frequency of faults in successive years:

H_0: $m_{c1} = m_{c2} = \ldots = m_{c5}$, against an alternative hypothesis

H_1: not all m are equal.

The value of testing statistic and critical level of probability p are shown in Figure 4.

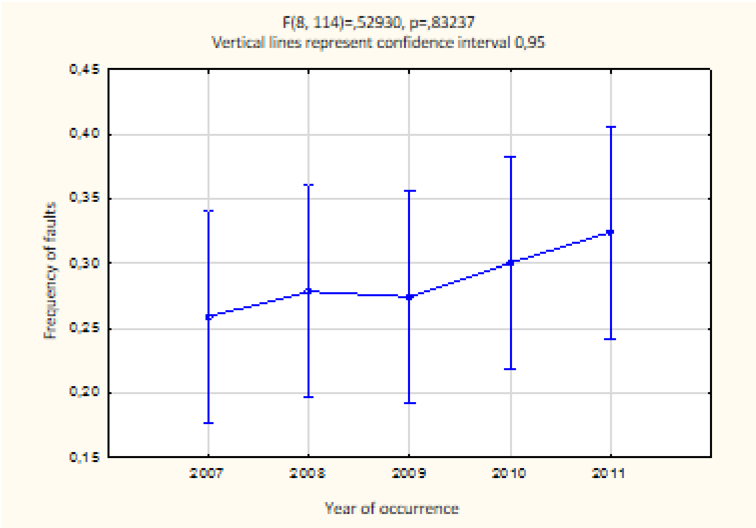

Figure 4. ANOVA for the variable frequency of faults against the independent variable year of occurrence

At the significance level $\alpha = 0.05$ there are no grounds to reject the null hypothesis on the equality of means, therefore the variable year of occurrence does not differentiate the frequency of faults.

A test for the variable number of faults for two types of vessels:

H_0: $m_1 = m_2$, against an alternative hypothesis,

H_1: $m_1 \neq m_2$.

The value of testing statistic and critical level of probability p are shown in Figure 5.

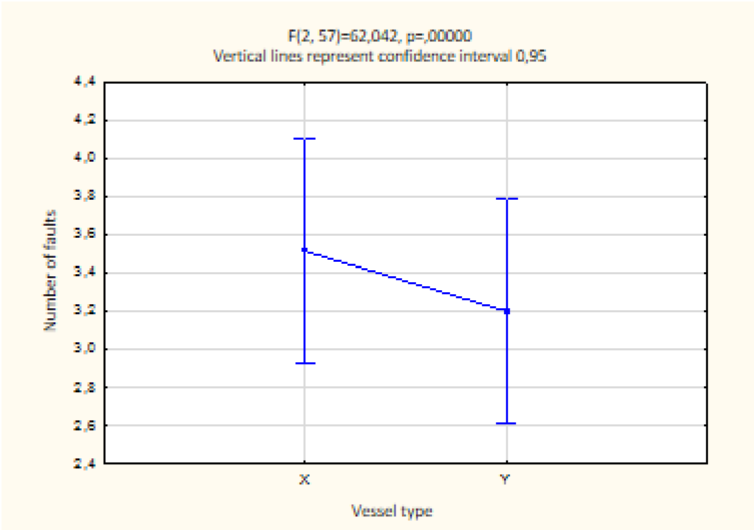

Figure 5. ANOVA for the variable number of faults against the vessel type

At the significance level α = 0.05 we reject the null hypothesis on the equality of means, which is interpreted as follows: variable vessel type differentiates the number of faults, and it can be observed that more faults occur on vessels X.

A test for the variable frequency of faults for two types of vessels:
H_0: $m_{c1} = m_{c2}$, against an alternative hypothesis,
H_1: $m_{c1} \neq m_{c2}$.
The value of testing statistic and critical level of probability p are shown in Figure 6.

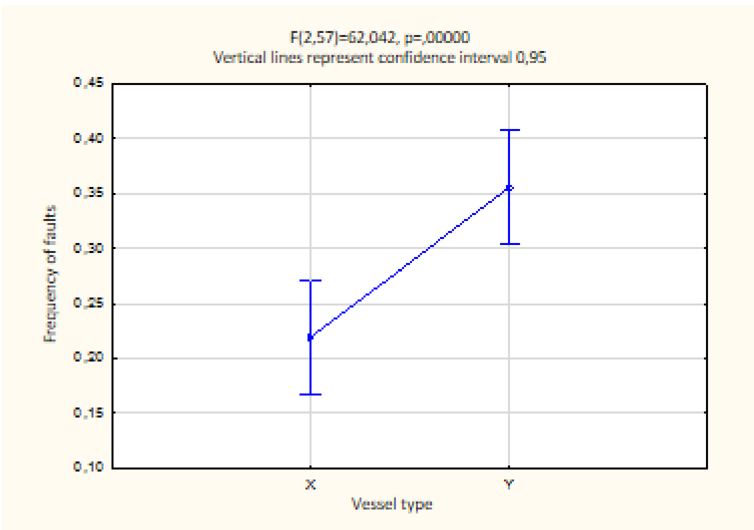

Figure 6. ANOVA for the variable frequency of faults against the vessel type

At the significance level $\alpha = 0.05$ we reject the null hypothesis on the equality of means, which is interpreted as follows: variable vessel type differentiates the frequency of faults, and it can be observed that faults occur more frequently on vessels Y.

3. SUMMARY AND CONCLUSIONS

The method described in the article, used for the determination of the probability of fault occurrence in refrigerating systems, allows to characterize the operation of such systems quickly and objectively, and to define interrelations between specific decision groups. The ANOVA analysis has confirmed that the variable 'fault frequency' does not depend on the year of occurrence, which means each year the number of faults was similar. It does depend, however, on the category of fault depending, in turn, on the vessel type X and Y. Additionally, the analysis has indicated that the number of refrigerating system faults in fishing vessels does not depend on a year of occurrence but it depends on the category of faults and the type of vessel, which in this case is related to the kind of refrigerant used.

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TRANSPORT AND SPATIAL CORRELATION OF REGIONAL DEVELOPMENT

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ABSTRACT

The paper is intended to analyze transport and spatial correlation in strategic context of European regional development, which assumes the all levels of regional planning, and especially with regards to integration role of cities as nodes of cohesion policy. Additionally, the paper discusses transport function in urbanization and transport sector as one of the main sector of green economy.

KEY WORDS

Transport, cohesion policy, urbanization, regional development, green economy

1. INTRODUCTION

The special requirement in the process of strategic transport planning is articulated through the sustainability of the existing and new forms of land and transport usage. This refers both to indicative impacts which the conventional transport modes have on the environment and to the complex interactions between transport, land use, and human activities.

Based on Deakin's definition, sustainable transport is considered as transport that satisfies the needs of mobility with simultaneous preservation and promotion of the human health and eco-system, economic development and social equity now and in the future. Planning of sustainable development is directed to achieving all three targets simultaneously and in a fair manner regarding accessibility and mobility. Furthermore "...the idea of sustainability has come to be understood as a collective process for considered decision-making and action, and not simply a particular end-state or outcome. Also, the concept is broad enough to include a variety of initiatives – ranging from cleanup and redevelopment of brownfields to inner city revitalization to energy-efficient transportation – and planning for sustainable development increasingly involves strategic coordination of efforts along all of these lines." [1]

2. ROLE OF TRANSPORT IN COHESION POLICY

In the political debate on European spatial development, accessibility and mobility are marked as the preconditions of regional economic development.

The regions of high accessibility to raw materials, suppliers and markets are, as a rule, economically more successful and more competitive on the global market. Optimization of the infrastructural network is the main instrument of regional economic policy.

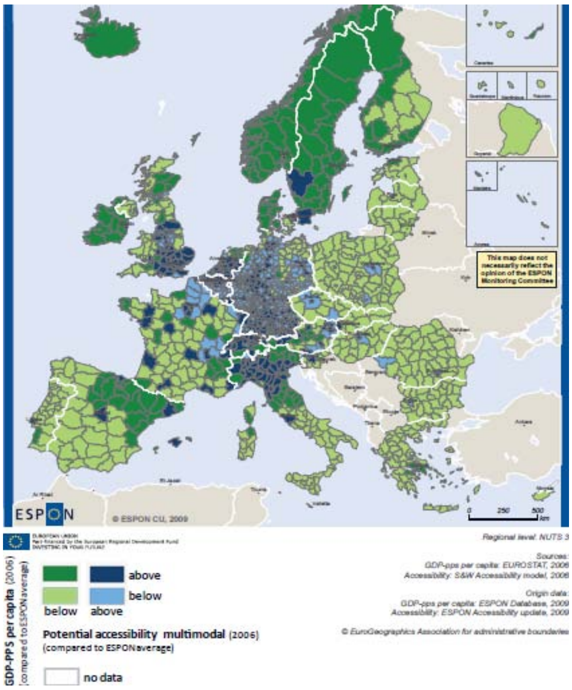

Figure 1. Gross domestic product per capita versus multimodal accessibility [2]

Multimodal accessibility of the European core and periphery contribute to the polycentric spatial development, which is to a great extent assured by the accessibility of air transport and extensive railway transport, which is characteristic for big and capital European cities.

The possibility of one-day travelling based on actual travelling times and six-hour stay at the destination clearly reflects the capacity of the accessibility of the European core and periphery and confirms the advantage of the railway for inter-metropolitan transport connections.

High level of territorial and transport integration is imminent to the European economic core, the so-called "Pentagon" including a large part of Great Britain.

The Iberian Peninsula is connected with the core, and the connections between the core and the countries such as Poland and Hungary are visible; however, the intensity of these connections is significantly lower in comparison to the connections within the European core.

The possibilities of one-day trips from or to the Baltic region – Estonia, Latvia and Lithuania, the region of south-eastern Europe – Romania, Bulgaria and Greece, as well as Turkey, do not exist at all.

About 75 percent of the European population lives in urban environments. The urbanization trend in Europe is worrying. Almost one quarter of the European Union territory is directly included in urban usage, and by 2020 eighty percent of the population will inhabit the urban areas with most diverse needs of land use in and around cities.

Every day the conflicting changes of land use are visible, and they lead to spatial degradation and disturbance of the landscape. [3]

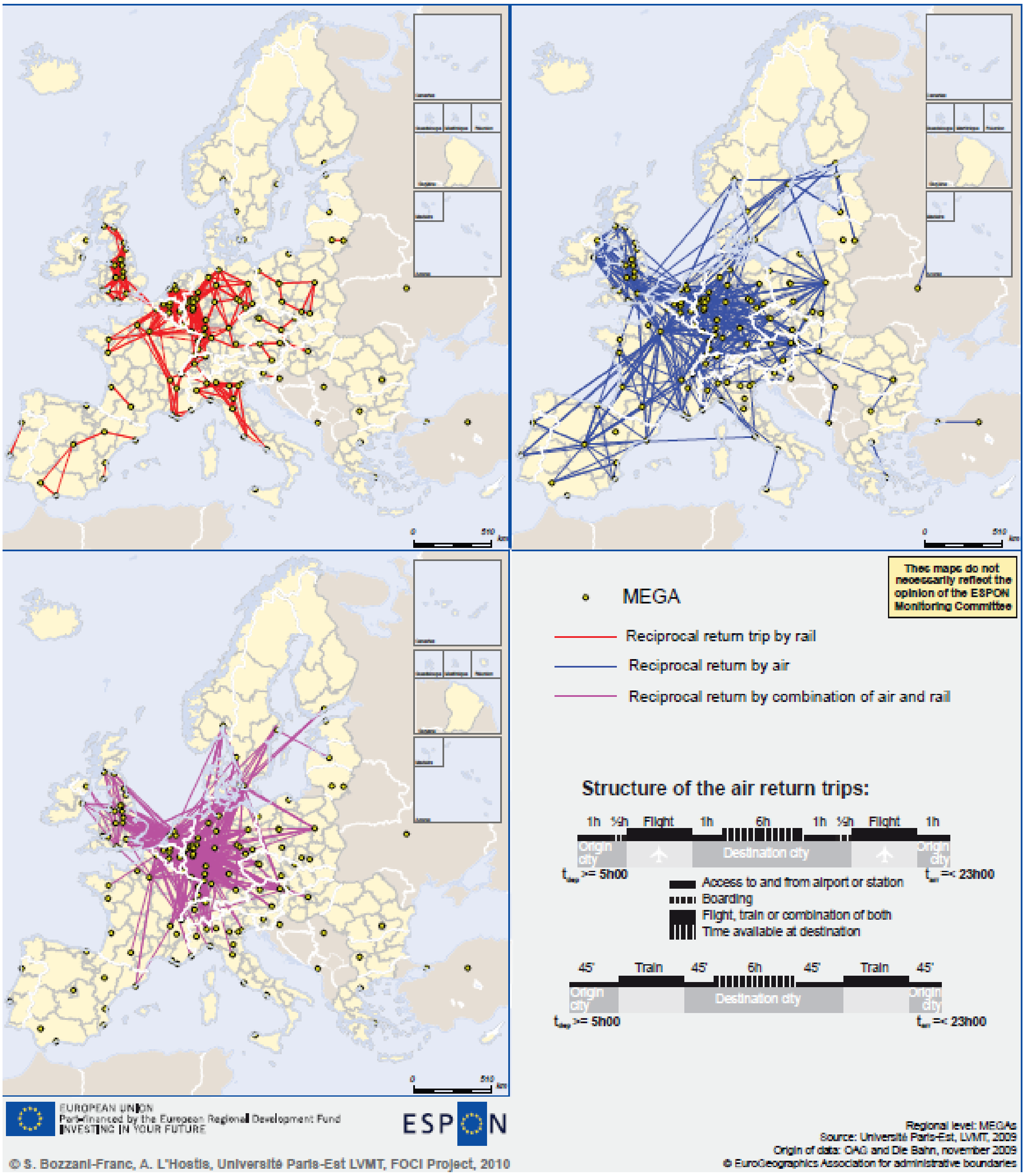

Figure 2. Network of cities for one-day business trips [4]

The increase of multimodal accessibility in the regions of Eastern Europe has positive impact on the competitiveness of these regions and territorial cohesion on the European plan. However, as the share of urban population increases, the share of the population in the rural area proportionally decreases. The entire complex of negative consequences of the population and consequently traffic concentration in the European cities is primarily manifested on the environment and human health.

The problems of transport development, and particularly of the transport infrastructure development, similarly to other important infrastructural sectors – energy and water-supply – are marked by extreme specific characteristics, which directly connote the role of the state, public and private sector in their development and management [5]:

- At national and metropolitan levels the transport infrastructure is closely correlated with the spatial planning and has high impact on the spatial structuring of the overall economy. These are the areas of the most important state responsibility, which require proactive planning as addition to adequate policies of prices and taxes.
- The transport activity, especially in the road branch, has substantial negative external effects – congestion, environmental pollution and casualties, which internalization directly into the structure of infrastructure usage prices and charging is hard to achieve in sense of common practice. This means that the interventions of state in the improvement in allocation of financial resources are necessary.
- Transport infrastructure along with efficient maintenance tends to have a long lifetime so that economic investment priorities in it depend to a great extent on the uncertain projection of demand in the future. Additionally, the capital charging often represents regarding size the highest share of the total costs of services and therefore it is necessary for the state to absorb certain risks in the realization of the desired structure of spatial and economic organization of regions.

The intention in the development of regions and local communities is the achievement of the transport system configuration which respects four vital dimensions [6]:

- Transport dimension – adequate balance between public and private share in satisfying the needs of all the market segments;
- Ecological dimension – retaining of the overall volume of pollution caused by the transport modes at an acceptable level;
- Economic dimension – potential of creating new financial resources by the solutions of giving “value for money” and the capacity for inducing the desired behaviour (demand) of users through fair charging mechanisms (without discrimination);
- Social dimension – provision the citizens with transport system which meets their needs.

Since it is difficult to achieve the optimal system, in modeling the public transport it is possible to accept also the solution of establishing certain compensation between these domains in compliance with the social and economic and cultural reality of each specific area, and conditioned political option and related financial support as the result of interaction between the local, regional and national level of interventions. The applicable model is, therefore, in the function of the strategic level of defining the objectives as response to individual and social interests of the participants.

The problems of strategic transport planning are most closely related to the insufficiency of the sector coordination at the level of state administration and executive functions, which are delegated to lower levels of management, and manifested as weakness in the decision-making processes, equally in the developed European Union countries, as well as in the transition countries.

Transport policy in the future has to solve the problem of compatibility with climate and energy policy in a comprehensive manner, which is at the same time physically dispersed. The potentials of transport de-carbonization refer to:

- reduced need for the mobility of people and goods,
- improvement of efficiency of the existing transport network,
- shift in the modal structure of traffic, which will reduce the transport load and support the ecologically acceptable and sustainable transport modes for cleaner environment and healthier society,
- new technological solutions for the reduction in the usage of fossil fuels and the CO_2 emission levels in road transport.

It is necessary to improve the connecting of primary and secondary transport networks, especially in new members of the European Union, so as to balance the standards of accessibility at the national levels of the respective regions.

The de-concentration of external transport connections of the European Union understand the development of:

- new seaports for the overseas transport and routing of sea highways in the Mediterranean;
- intercontinental airports outside the domicile space of the European Union,
- continental connections, primarily of railway transport towards Asia, and towards the Maghreb countries.

Although the transport policy has substantial impact on the spatial development, especially by instruments of investments into the infrastructure and instruments of the pricing policy, the strategic attribution is related to comprehensive continental nature of the development of internal and external accessibility, and reduction of external costs in transport. In this sense the European Commission has not got the sufficient capacity of impact due to excessive dispersion of investing into transport projects, primarily by accession countries, and due to substantial difference in the development challenges of old and new members of the European Union.

The objectives of transport development of the developed European Union countries are to the greatest extent directed towards improvement of intermodality of the network and efficiency of the transport systems, whereas the dominant development preoccupation of the countries of mid-eastern and south-eastern Europe is the improvement of accessibility of the transport networks.

3. GEO-TRANSPORT RELATION IN URBANIZATION AND REGIONAL DEVELOPMENT

Complex interactions between land use and human activities have stipulated the specific morphology of the cities and urban areas which, depending on the level of synergy inter-sector planning at the local, regional and national level, manifests itself differently in the economic, ecological and social dimension of urban development.

Urbanization means continuous process of designing settlements, heterogeneously in time and space; therefore, unique observation of completely different geneses in which different phases of the process, as well as geographical and historical specifics of a certain urban region are reflected is not adequate.

In principle, general development correlation of demographic and spatial structure of cities can be identified. Cities have specific position in the migration processes, and strategic planning of urban development predetermines the level of polycentricism of the territorial development and consequently the social and economic cohesion.

Depending on the constellation in urban hierarchy this process is reflected at different levels – demography of the capital cities has influence at the national and increasingly at international level, of the cities of lower hierarchy characteristic at regional level, and of small cities at local level. The problems of intra-urban dynamics are focused on two paradigms of spatial and social cohesion – suburbanization and gentrification.

At inter-regional plan, the long-term urbanization cycle started long ago by the urbanization phase led by the rural-urban migrations and industrialization.

This was followed by the phase of suburbanization, during which the peripheral settlements grew faster than the urban core. During the third phase, the suburbanization was intensified and acquired the characteristics of counter-urbanization, i.e. process characteristic for the most densely populated areas. In this phase the place of residence shifts to the urban periphery towards small or mid-size places of less urbanized metropolitan environment, with the population and labour market being proportionally reduced in the urban core. The last phase is re-urbanization led by the policy of revitalizing the city centers and the social and cultural development.

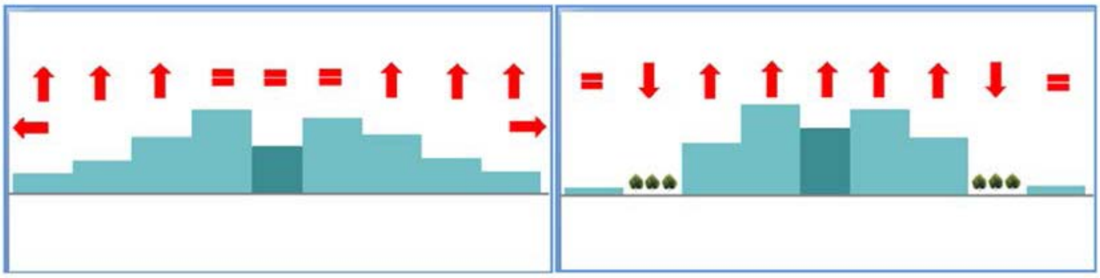

Figure 3. Development scenarios of urban expansion and urban concentration [7]

The urbanization cycle recognizes two scenarios of the shift in the spatial structure of the cities. The first scenario is the extension of the city without restrictions in the way of intensive suburbanization of peripheral city areas, resulting in landscape fragmentation due to the transformation of the functions of agricultural and natural areas into the residential areas, and specialized zones of industrial, commercial or transport infrastructure, and on the other hand to deterioration of the urban centers. Such development trajectory suits on the one hand the spatial fragmentation and atomization and on the other hand the social segregation.

The second scenario is restricting or preventing urban expansion towards the periphery by way of concentrating all human activities and functions of public services on a smaller consolidated area, and preservation and cultivation of natural green areas. This development path understands the control of the disorganized process of urbanization by means of revitalization of the city and increase in the population density within the urban structure, and re-naturalization of the parts of the territory, which parries all the strategic aspects of sustainable development.

The theoreticians distinguish two categories of agglomeration growth in urban development. The first is the category of continuity, which includes models of modular constant growth of urban parts which are multiplied with the same homogeneous characteristics and repeating structure or cellular stochastic growth according to the classical development algorithm.

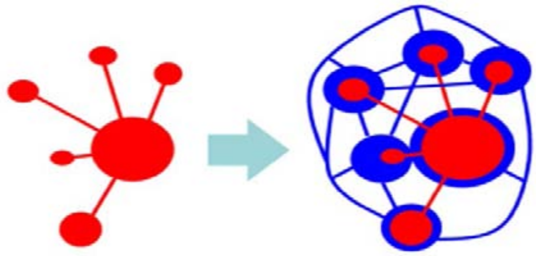

Figure 4. Change of paradigm in organizing urban space: from city to metropolitan area [7]

The second one is the transformation category, which understands the model of city transformation into a metropolis in the manner of the transformation of one-way flows into two-way or tangential flows, which do not pass through the city nucleus any more (Figure 4).

In the analysis of the relation of the urban and rural region, and the relation of the urban centre and peripheral settlements the specific categories of space with the potential of functional symbiosis can be distinguished – urban core, internal and external populated parts form the urban area of the city; suburban areas include villages in the close vicinity of the cities under the influence of uncontrolled urban expansion and suburbanization processes, and villages in the city periphery. The third circle of scope is the rural hinterland. Smaller and mid-size settlements in the hinterland can exist with the potential for connecting with the major city centre. Figure 5 shows a simplified model of different spatial categories with the examples of topical interests of rural – urban cooperation.

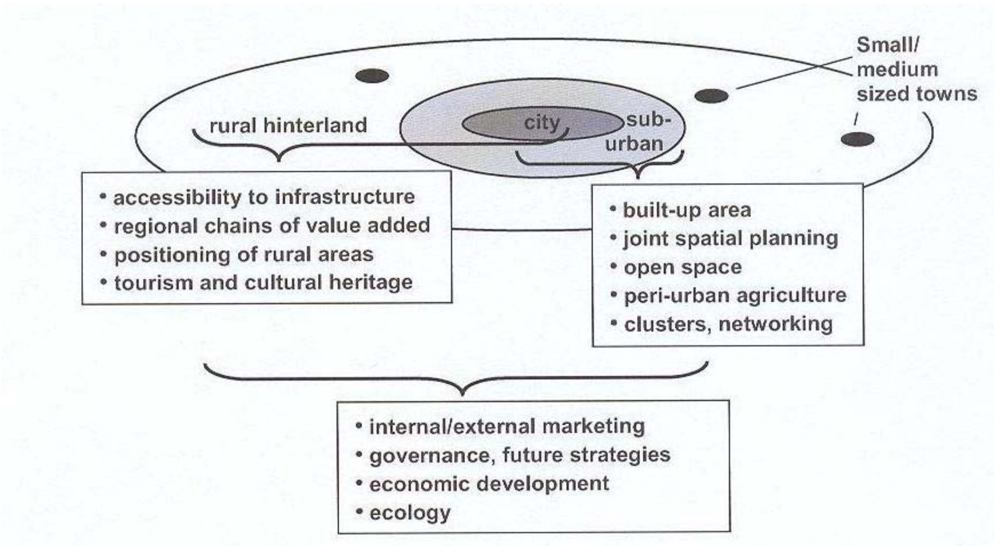

Figure 5. Topics of rural – urban cooperation [8]

The location and distance between the agglomerates pre-supposes the selection of the topics for collaboration of local and regional significance.
In central parts of the cities the topically relevant issue is the control of urban expansion and provision of open public spaces.
In parts with related activities and public functions the priority is the design of clusters and networking.
In peripheral parts the interest is on rural – urban cooperation in providing better accessibility to urban infrastructure and public facilities or valorization of the landscape and cultural assets for the needs of recreation or tourism.
In the entire metropolitan region the joint interest is related to marketing in the market placement, complementary strategies and sustainable development.

The problems of peri-urban development connote the strategic contents of sustainable development with the focus on spatial dimensioning and distribution of metropolitan functions, which will allow from the aspect of economic growth functional networking of the cities and their market competitiveness at global, regional and national level, from the aspect of the protection of the environment and nature alleviate the landscape fragmentation and climate changes, and from the aspect of social advancement prevent social segregation and ensure fair participation of all the population groups in the life of urban community.

The strategically postulated European spatial development is reflected in the concept of the polycentric urban development, which is based on the complementary aspects of urban morphology (number and hierarchy of cities) and functional relation between urban areas (networks, flows, cooperation), and opposes the concept of mono-centrism and urban expansion to peri-urban areas of natural spaces and resources.
Such polycentric development has been delegated to different spatial level with specific objectives:

- at the macro-level of Europe – promotion of several global integration zones next to the existing "pentagon";
- at inter-regional level – integration of urban regions and stimulation of functional complementarities;
- at intra-regional level – optimization of economic performances by improving the connections and better cooperation.

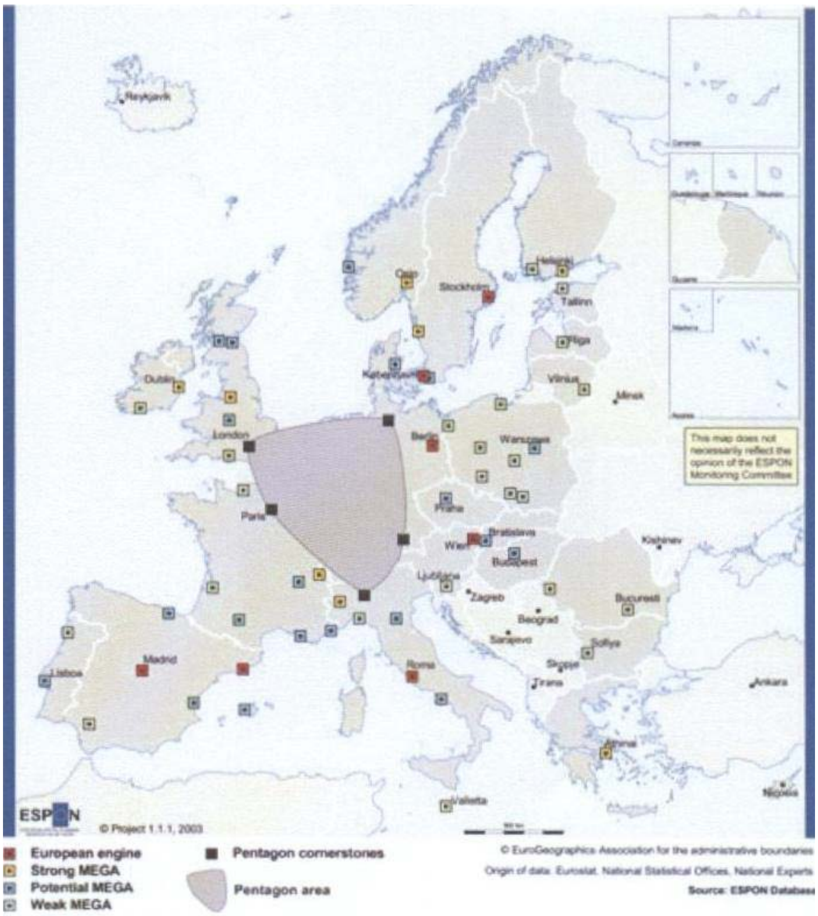

Figure 6. Development potentials of global integration zones [9]

Extreme potential is obvious in the region of pentagon area extension to the region of Central Europe which regarding population and space can match the scenario of the global integration zone development.

In this sense the interregional cooperation of the capital cities of the region in functional complementary development is of crucial importance, particularly the strategically harmonized development of intermodal transport network and provision of accessibility of infrastructure at intra-regional and national level.

4. CITIES AS CARRIERS OF GREEN ECONOMY

On the track of Green Economy Initiative (UNEP, 2008), Green Growth Strategy (OECD, 2010), the Development Strategy of Smart, Sustainable and Inclusive Growth of the European Union (Europe 2020) and the accompanying Initiative for Resource-Efficient Europe – the transport has been identified conditionally, principally, and functionally as one of the main development sectors.

Green economy, according to UNEP definition understands a new model of synergy action at all levels, which is based on the ecologically compatible usage of resources, economic efficiency and social equity.

The transport acquires the attribute green when it supports the environmental sustainability in a way of protecting the global climate, eco-system and bio-diversity, public health and natural resources.

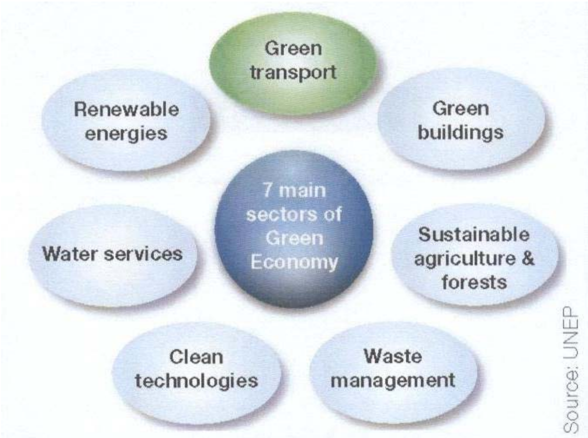

Figure 7. Main sectors of Green Economy

The objectives of green transport are not only the reduction of greenhouse gas emissions, air pollution, noise and space consumption, but rather also reduction of poverty and support to economic growth.

In parrying the set objectives the development approach is promoted which apart from efficient technologies includes also smart urban planning, development of the public transport system of high quality and efficacy, comprehensive infrastructures for bicycle and pedestrian traffic, and efficient logistics.

By analyzing the existing strategies, policies and networks at the European and transnational level, there are numerous different documents and initiatives, which may represent frames of development of joint agendas and collaborative projects of metropolitan areas.

In this sense it is strategically of extreme importance that the geo-transport position of Croatia is evaluated in the context of its territorial belonging to the region of Central Europe, and as result of elaboration of development projections that the integration in the global competitive Central European macro-region is insured. [10]

The cohesion policy of the European Union is the main instrument of implementing the objectives of economic, social and territorial cohesion. It consumes the second largest part of the European Union budget, including several funds, and it is adjusted to the umbrella strategy of the European Union for the growth and employment.

The shift from the traditional concept of cohesion policy as the redistributive instrument towards the concept of allocation perspective of the "on the spot based" policy with the target development mission, represents the essence of the cohesion policy after 2013. In the fifth cohesion report of the European Commission the focus is on the functional and flexible approach. Depending on the case, adequate geographic dimension is ranked from the level of macro-region, such as the region of the Baltic Sea or the Danube region, to the metropolitan region or cluster of the rural areas and commercial places. Such flexible geography can optimize the positive and negative effects of concentration, reinforce the connections and facilitate cooperation and be more efficient in further territorial cohesion.

In 2010 the European Commission adopted the Strategy for the Danube region as a comprehensive strategy of the target macro-region of eight European Union member countries – Germany, Austria, Hungary, the Czech Republic, Slovakia, Slovenia, Bulgaria, and Romania, and six countries that were not European Union members – Croatia, Serbia, Bosnia and Herzegovina, Montenegro, Ukraine, and Moldavia, which considers a number of challenges, requires better coordination and cooperation in the priority areas of economic, ecologically sustainable and social regional development, including the priority of improving the mobility and intermodality.

The development strategy of the European Union Europe 2020 for smart, sustainable and inclusive growth, which was adopted in 2010, identifies the priorities of the economic, sustainable and social development and management of financial resources.

Within the strategy, the internal market, global competitiveness, cohesion and environmental protection, mainly de-carbonization of transport, are the development objectives that require holistic approach and balanced solving. The set priorities and development guidelines have to be included in the sector planning strategies and strategic projects on all territorial levels.

The source document Territorial Agenda of the European Union from 2007 was the first step in the

institutionalization of the territorial cohesion as shared responsibility of all the European Union members.
The amendment of the Territorial Agenda for 2020 the promotion of the polycentric and balanced territorial development is identified as the main cohesion element to strengthen the economic competitiveness of the European Union.
The cities have to design innovative networks to improve their global competitiveness and promote sustainable development.

The polycentric development is necessary at all levels – macro-regionally, cross-border, national and intraregional. The polarization between the capital cities, metropolitan areas and small and mid-size places has to be prevented, and the policy must contribute to the reduction of territorial polarization and regional inequality addressing the bottlenecks for the growth in compliance with the development strategy Europe 2020.

Trans-European transport network TEN-T is a project of developing intermodal transport network of the European Union countries, that was accepted by the European Parliament in June 1996 with the task of improving the economic and social cohesion, connecting the islands, inaccessible and peripheral regions with the central regions of the European Union, by means of interconnections and inter-operability of national transport networks of the ground, air, sea and inland waterway transport, including the European satellite navigating system Galileo.

In the light of the debate about the new TEN-T regulation initiated by the adoption of the Green Paper on the Process of Reviewing the TEN-T Policy 2009, the working documents of the European Commission propose redefinition of the development plans of the so-called Core Network with horizon up to 2020 and Comprehensive Network with the horizon up to 2050, which means also the new two-layer approach in the methodology of planning and implementation of future TEN-T projects.
Comprehensive transport network means wider platform for adopting legislation and technological development and the means of further promotion of spatial integration and regional accessibility.

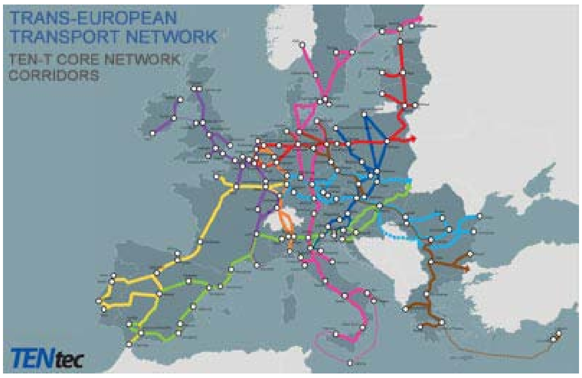

Figure 8. Redefined TEN-T Core Network

Core transport network is the carrier of strategic planning of the most important transport infrastructure, which has to include the main nodes (cities, agglomerations, ports, airports, and intermodal platforms) and connections, integrate all the transport modes, allow sustainable, efficient, safe and protected transport services in passenger and cargo flows. The development of the core transport network is the continuation of the past decision and achievement of the European transport policy, priority TEN-T projects and the main European projects of developing intelligent transportation systems or interoperability, recognising the needs of stronger connecting of the transport and infrastructural policy and openness for the technological and operative innovations.

By accession of Croatia into the European Union, the city of Zagreb has been included as the main hub of the core network, and the port of Rijeka as the main port of the core network in Croatia.
Before the accession into the European Union, Croatia participated in the work of the South-East Europe Transport Observatory. The importance of the SEETO comprehensive network as the basis for the evaluation of the necessary investments into the development of the transport infrastructure of the South-eastern Europe is specially connoted in recent documents of the European Commission [11]. The establishment of an integrated transport information system TENtec for South-eastern Europe has been planned. The importance of the cooperation of the European Union, international financial institutions and regional participants in the selection and preparation of the project

documentation for the main regional infrastructural projects has been emphasised.

The document of the European Commission [12], which refers to defining of the budget until 2020, proposed the establishment of a special body for stimulating infrastructural development of Europe – Connecting Europe Facility, as part of which the means for financing the Trans-European corridors with the planned budget of around 40 billion Euros for the period from 2014-2020 would be provided.

On the trail of the European transport policy it would be necessary to develop a Transport study of South-East Europe with defined development guidelines and the Regional Transport Strategy with target measures of sustainable transport system and improvement of mobility, safety and efficiency.

Another regional initiative is CENTROPE as joint initiative of the regions of Austria, the Czech Republic, Slovakia and Hungary, which was established in 2003, with the aim of creating the Central European region, in which cross-border cooperation will become common in all the areas of life, and especially in the four specific areas of development – region of knowledge, human capital, spatial integration, and culture and tourism.

Finally, the initiative Cities for Cohesion has been started in response to the Green Paper on Territorial Cohesion, and it deals with urban dimension of cohesion policy insisting on the implementation of the macro-regional approach.

The cities and metropolitan areas included in the network, including Vienna and Prague from the Central European region, require increased cooperation outside the regional and national borders through the municipal authorities, which would be strengthened by the European Commission through structural funds.

5. CONCLUSIONS

The regional transport development, including the development of the Croatian transport system, apart from spatial dimensioning of infrastructural network, has to be harmonized with the reference strategic guidelines of the European transport and environment policies, which understands inclusion of the principles of integration, intermodality and sustainability.

Transport is one of the key challenges of the Strategy of Sustainable Development of the European Union. Although the strategic objectives of the transport development do not change, the context of the conditions of their implementation is variable. Unpredictability of the prices of fossil fuels on the market, progressive globalization processes, war crises, and terrorist threats, enlargement of the European Union, economic recession and the related crises – all these are the specific risks that affect the need to review the strategic documents, adaptations of instruments of the transport policy and dynamics of implementing the innovative technological, operative and economic models.

Master-planning of integrated intermodal transport operations with the accompanying network of logistics and distribution terminals, investment prioritization of using the existing corridor capacities of regional transport network and affirmation of the transport function of natural resources and ecologically acceptable transport options are the necessary frames of the transport policy in responding to the requirements of sustainable development – economic growth, ecological balance and social advancement.

Management of flows at the integrated intermodal transport network by applying the intelligent transport systems represents a challenge but it is also a necessary strategic option of common transport policy in Europe. The realization of regional projects, for instance the development and implementation of the satellite system Galileo requires multilateral and global harmonisation and cooperation.

Transport remains in any case the key factor of integration processes both in the spatial and in the economic sense, but the emphasis is on the request to change the structure of transport operation per transport modules (modal shift) and qualitative upgrading of the transport network with adequate interfaces of the transport modes and smart systems of management.

The social and economic efficiency of the transport system is not only indicated by technical elements of the transport network or the volume of the transport operation, expressed by the length and density of network or transport production, but rather also by the qualitative aspects of transport demand management, which are articulated through transport safety and environmental protection, and finally by spatial, demographic and economic cohesion of the region.

In all European strategies, the cities are the carriers of regional integrations and cohesion development, and functional alliances of the cities are the prerequisite of the economic competitiveness at all levels. In this sense the transport sector plays the dominant role in providing accessibility and mobility.

The connectivity of the nodes, networks and corridors has to be strategically planned in a holistic way of intra-regional, inter-regional and macro-regional urban integration.

The development of Croatian cities has to be therefore strategically considered comprehensively at all levels and sector-integrated. At intra-regional level, strategic planning of development is most closely connected to the concentration of the urban functions and functional cooperation with the cities and settlements in the catchment zone, in order to ensure development of the entire region. The spatial urban planning and transport development have to be interconnected in program development and operatively, and in making operational plans it is necessary to include as partners the private sector and the citizens.

The revitalisation of the urban core and settlements on the city periphery, as well as the re-naturalization of the peri-urban area can be implemented exclusively by supplying an efficient public urban transport, mainly the rail transport. It is also necessary to develop a green infrastructure for bicycle and pedestrian traffic.

In the wider catchment zone, all the suburban settlements and small and mid-size cities in the hinterland need to be efficiently connected by transport, first of all by rail transport and rapid-buses.

The development of the metropolitan regional network means inter-county and intercity cooperation. One of the examples of the best practice is the SprintCity project of regionally integrated development of the settlements along the railway stations, which promotes the transit-directed development, interaction of the spatial development and mobility as well as coordination and cooperation of various stakeholders – regional/city administration, operators, and citizens. The transport connections of the cities in surrounding, as well as the settlements in the interspaces, should be strategically designed by means of two-way and tangential connections.

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