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Inspections of Ro-Ro Ships Operating on “Motorways of the Sea” Routes

Abstract

This paper analyses the inspections of Ro-Ro ships operating on the Motorways of the Sea routes. The analysis aims to determine the level of safety standards on ships operating on the Motorways of the Sea routes. In addition, it examines results of the inspections of various types of ships within the “Paris Memorandum” regime.

The paper describes inspection procedures and the parameters that indicate the level of safety and quality of the ship through indirect and direct indicators. Regarding direct indicators, ships were analysed by their age, ship’s flag and performance of the recognized organization. Regarding indirect safety indicators, an analysis of detentions and deficiencies found during ship inspections was carried out.

Key words: Motorways of the Sea, ship’s inspection, Paris memorandum, safety of Ro-Ro ships

1. Introduction

The Motorways of the Sea (MoS) denote a concept of transport involving a combination of rail, road, sea and inland waterway transport in order to reduce transport costs, increase the efficiency of transportation and, most important, to reduce environmental pollution [8]. In many aspects it is a part of the short-sea shipping concept, but it also includes road and/or rail transport [12]. It provides the “door to the door” service among member states of the European Union. After the introduction of the Motorways of the Sea concept, a decrease in CO₂ emissions, road congestions, and the road infrastructure consumption, as well as the noise level [8,18] was recorded. In establishing the MoS routes, particular attention should be paid to ships using these routes.

In order to ensure a satisfactory level of safety and quality of ships operating on the MoS routes, inspections are used (as defined in international conventions). Consequently, all participants in the maritime transport processes must be included: ships, ship operators, Flag States, Port States, recognized organizations, etc. It is only through mutual coordination and information exchange that the system can ensure safe and effective transportation of passengers and goods.

In this paper, the safety standards of ships operating on the MoS routes are analysed. The analysis also examines the types of ships and associated inspection procedures. Throughout the analysis of the outcomes, the general condition of the achieved ship safety standard is estimated. Based on deficiency categorisation, measures are proposed to reduce deficiencies and to improve safety.

2. Types of ships using the motorways of the sea routes

The transport policy of the European Union is focussed on the development of the Trans-European Transport Network (TEN-T), with the aim of redistributing the cargo and passenger traffic in Europe. With respect to the maritime transport, the main tool is a network of MoS routes. Consequently, these routes must be connected to sea ports and to main land transport corridors closest to the final destinations.

The establishment of the network is aimed at roads disburdening by redirecting traffic towards railways, maritime transport and inland waterways. In addition, a long-term development of such modes of transport will lead to standardization of traffic flows in Europe and to balanced use of all transport modes which will ultimately reduce the cost of transport [8].

According to the proposal made by the European Commission in the White Book¹ on transportation, which was adopted in 2001, and the legal and financial framework of the project developed by the European Parliament in 2004 with the adoption of the TEN-T guidelines, the main objectives of the TEN-T guidelines are to:

- reduce the overload of road transport through the redistribution of the cargo,
- increase transport connections and divert freight transport from land to sea.

The Guidelines also determine the four main corridors the projects of the European interest will be established on:

- 1) “Motorways of the Baltic Sea”, connecting the Baltic countries with the countries of Central and Western Europe.

¹ The European Commission in 2001 proposed in the White Book on the European Transport Policy (*European Transport Policy for 2010: Time to Decide*) a package of 60 specific measures to improve transport policies and the instruments for their implementation. Furthermore, in 2011 it published a new White Book on the European transport policy entitled *Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system* by which the European Commission presents its attempts related to the development of the European transport system until the year 2030.

- 2) “Motorways of the Sea of Western Europe”, leading from Portugal and Spain via the Atlantic arc to the Northern and Irish Sea.
- 3) “Motorways of the Sea of South-East Europe” (Eastern Mediterranean), connecting the Adriatic with Ionian Sea and Eastern Mediterranean, including Cyprus.
- 4) “Motorways of the Sea of South-Western Europe” (Western Mediterranean), connecting Spain, France, Italy and Malta, including the connection to the “Motorways of the Sea of South-East Europe” and the Black Sea.

The project “Motorways of the Eastern Mediterranean” within the TEN-T program of the European Union, was carried out by Slovenia, Italy, Malta, Cyprus and Greece. The Republic of Croatia, together with the other Adriatic countries, launched the project *AdriaticMoS* (*Adriatic Motorways of the Sea - “Motorways of the Adriatic Sea”*), which should be an addition to the Master Plan of the “Motorways of the Eastern Mediterranean” [8].

The ships operating on the MoS routes are divided into the following categories:

- 1) Container ships,
- 2) Ro-Ro ships (including ferries),
- 3) Ro-Pax ships (Ro-Ro passenger),
- 4) Con-Ro ships (Container Ro-Ro ships) and
- 5) Multi-purpose ships (container and bulk cargo ships) [12].

Since the concept of the Motorways of the Sea is primarily designed as a process that moves cargo from roads to the sea, the concept assumes the use of Ro-Ro ships as the basic means of transport. Thus, in the following analysis, only Ro-Ro ships are considered.

The most important advantages of Ro-Ro ships are: the rate of cargo loading/unloading, reduction of port congestions, flexibility, independence from the port loading/unloading equipment and weather conditions, etc. These ships require utmost care in order to avoid accidents, mostly due to the lack of bulkheads,² of loading ramps with large openings at the bow and stern (located very close to the waterline), the possibility of the cargo shifting in ports or at sea [2]. In addition, a high freeboard on the Ro-Ro ships should be noted; it makes them highly sensitive to strong winds and heavy seas.

Taking all these together, functional characteristics of all ships used on the MoS routes demand full functionality of all the system components: hull and engines, equipment, cargo handling capabilities and crew, if accidents are to be avoided. Consequently, regular and targeted inspections are the most important external control measure ensuring the target level of safety and pollution prevention.

² A small number of bulkheads, providing efficient cargo handling, in case of flooding or fire represent a significant disadvantage.

3. Port state control system inspections

Ship inspections are carried out in accordance with procedures defined in the Memorandum of Understanding (MoU) on Port State Control (PSC). PSC main objective is to establish a safety net to identify and eliminate substandard ships. Every PSC MoU member state is responsible to maintain an efficient control system of ships arriving at their ports, in order to ascertain their compliance with the international regulation standards. [4]

There are different PSC MoU-s divided according to geographical areas³. This paper analyses the inspections of ships only in the Paris MoU⁴ regime area, as the main area of ships operating on the MoS routes.

Ship selection criteria are the first and one of the most important parts of the inspection process. Before the introduction of the new targeting system, at least 25% of foreign ships had to undergo an inspection (calculated on the basis of annual average number for the last three calendar years). With that selection system the quality and safety condition of the ship was not taken into account, resulting in excessive inspections of well maintained ships without any deficiencies.

In order to improve the ship selection and inspection process, a New Inspection Regime (NIR) within the Paris Memorandum was introduced on January 1st 2011. One of the main NIR objectives is to reduce the number of inspections on new and well maintained ships with good inspection records, and to increase the number of inspections on older and substandard ships [6].

The inspections are carried out by PSC inspectors authorized by the respective member state. The NIR selection process begins with the ships' verification in the THETIS⁵ system, according to the list of present and expected foreign ships at port. The THETIS PSC provides inspectors with the following: basic ship particulars, targeting factor (priority level of inspection), previous inspection records, messages related to ship, and information regarding the need for detailed or expanded inspection [4].

According to NIR, the selection of ships for inspection is based on the Ship Risk Profile (SRP). Using SRP ships can be categorized into:

- *High Risk Ships* (inspected every 5 to 6 months)
- *Standard Risk Ships* (inspected every 10 to 12 months)
- *Low Risk Ships* (inspected every 24 to 36 months). [14]

³ Paris MoU, Vina del Mar MoU, Tokyo MoU, Caribbean MoU, Mediterranean MOU, Indian Ocean MoU, Abuja MoU, Acuerdo Latin MoU o, Riyadh MoU, US Coast Guard.

⁴ *Paris Memorandum of Understanding on Port State Control*, 1982 (PARIS MoU 82) - applied in Croatia since January 1st 1997. Member states of the Paris MoU are: Belgium, Canada, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Lithuania, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovenia, Spain, Sweden, and United Kingdom.

⁵ THETIS – the internet inspection results database.

The SRP category is calculated using the targeting system based on inspection results in the last three years, by assigning an appropriate “negative” weighting point to the following parameters:

- **Ship’s type** – Two points are assigned to passenger ships, chemical and crude oil tankers, liquefied gas and bulk carriers.
- **Ship’s age** – One point is assigned to all ships older than 12 years.
- **Flag state performance** – A white, grey and black lists of flag states are established [5]. States are ranked on the inspection results basis of their ships over a three-year period. One point is assigned to a ship flying a white listed flag, and two points to ships flying other flags. [16]
- **Recognized organization (RO) performance** – RO is an organisation which issues the Certificate of seaworthiness and other ship certificates. ROs are divided into categories: high, medium, low and very low performance. One point is assigned to a ship whose Certificate of seaworthiness is issued by RO with low or very low performance category.
- **Company performance** – Company performance is determined comparing detention and deficiency number of all ships in the fleet with other companies. Two indexes are used: the index of detentions and deficiencies. The detention index is the ratio of detentions and the inspections of all ships in the company fleet in the last 36 months, compared to average ratio of detention for all inspected ships within the system. The deficiency index is calculated on the same basis. Using this procedure companies are divided into categories: high, medium, low and very low performance. One point is assigned to a ship owned by a company with low or very low performance category.
- **Detentions** – One point is assigned to a ship with two or more detentions in the past 36 months.

Table 1 Targeting system

General parameters		Weighting points
1	Type of ship	2
2	Ship older than 12 years	1
3	Ship under the flag ranked on the black or grey list	2
4	Ship under the flag ranked on the white list	1
5	Very low or low performance of a recognized organization	1
6	Very low or low performance of a company	2
7	Two or more detentions in the past 36 months	1

“High-Risk Ship” is considered a ship with five or more weighting points. A “Low Risk Ship” is considered a ship flying a white listed flag, using RO and owned by a company classified with high performance, with no detention and with five or less deficiencies in the last 36 months. All other ships are classified as “Standard Risk Ship” [6].

In addition to the above, the PSC inspector may receive additional information about the ship from any person having a legitimate interest in the safe operation of the ship, which can be used to determine the SRP.

There are several advantages achieved with NIR. Ships with the low risk profile have longer periods between the mandatory inspections, encouraging companies to keep high standards on their ships. PSC inspectors have a less demanding inspection process and a lesser number of inspections. In addition, the regime highlights the importance of keeping high level of safety standards among classification societies, companies and maritime administrations.

4. The analysis of the inspections under paris mou regime

The analysis of inspections was carried out for the period from 2010 to 2014. Results of the inspections on Ro-Ro and Ro-Ro passenger ships were examined.

In order to identify and explain safety standards on-board particular types of ships, individual parameters were taken into consideration that have a direct effect on the ship safety [3]. The parameters that were considered are:

- age of ship,
- performance of ship’s flag and
- performance of the recognized organization⁶.

The aforementioned parameters represent targeting factors in the ship selection process and are considered to be relevant to estimate the ships safety standards.

During the mentioned period, the PSC inspectors of the Paris Memorandum of Understanding conducted inspections on 4.142 Ro-Ro ships and 2.656 Ro-Ro passenger ships [14]. In the analysis, the results of those inspections are compared with inspections of ships operating on the MoS routes. The analysis was performed on 50 randomly selected Ro-Ro and Ro-Ro passenger ships operating on the following MoS routes: Helsinki-Aarhus, Gothenburg-Ghent, Kotka-Hanko-Antwerp-St. Petersburg, Helsinki-Travemünde, Helsinki-Kotka-Lubec-Rauma, Trieste-Ancona-Igoumentisa-Patris, Genoa-Porto Torres, Chivitavechia-Palermo, Zeebrugge-Bilbao, Hanko-Paldiski-Lubeck, Genoa-Barcelona, Stockholm-Mariehamn, Livorno-Malta, Dublin-Zeebrugge, Genoa-Malta, Purfleet-Zeebrugge, Göteborg- Immingham, Valenza-Ibiza, Gion- St.Nazaire, Chivitavecchia-Barcelona, Brindisi-Patris, Oslo-Kiel, Standefjord-Stomstad , Genoa-Livorno-Palermo, Salerno-Catania, Tangier-Livorno, Gdynia-Karlskrona, Tralleborg-Sassnitz, Cagliari-Valencia.

⁶ Data related to company performance were not available.

An overview of the age of Ro-Ro and Ro-Ro passenger fleet, as well as the age of Ro-Ro and Ro-Ro passenger fleet operating on the MoS routes is presented by the following figures.

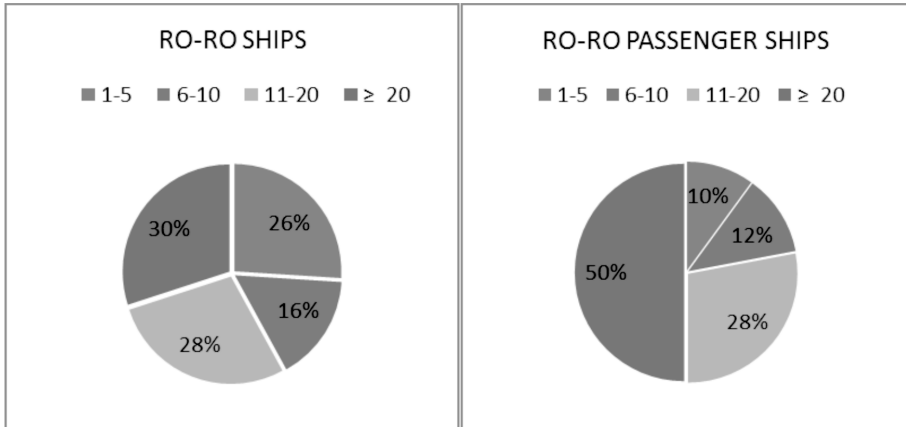


Figure 1 – Age distribution of inspected Ro-Ro and Ro-Ro passenger ships in Paris MoU ports (2010-2014)

Source: Authors according to [14]

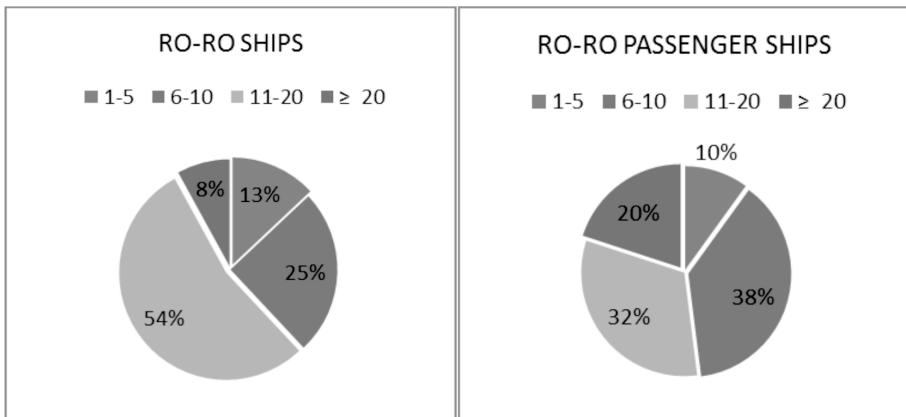


Figure 2 Age distribution of inspected Ro-Ro and Ro-Ro passenger ships operating on the MoS routes in Paris MoU ports (2010-2014)

Source: Authors according to [14]

The figures indicate that the Ro-Ro and Ro-Ro passenger ships are generally relatively old. More than 50% of the inspected Ro-Ro passenger and 30% of Ro-Ro ships were older than 20 years. Contrary, ships operating on the MoS routes are twice

younger than all inspected Ro-Ro ships within the Paris MoU. Since the age of the ships is one of the important factors of safety of navigation, the following figure provides an overview of all ships detained according to age distribution.

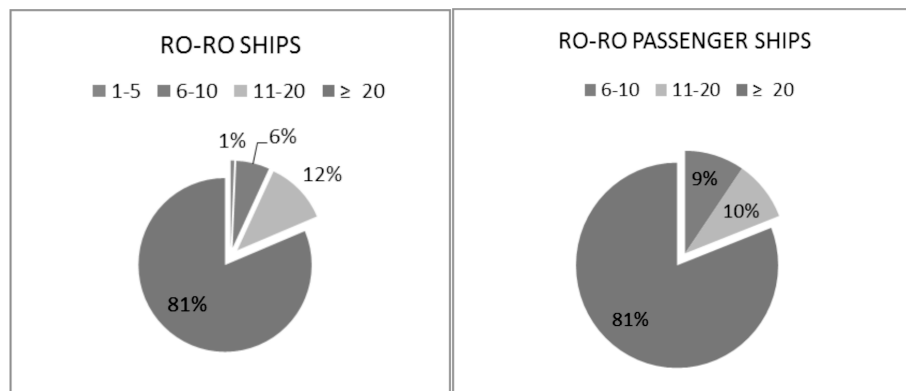


Figure 3 Age distribution of Ro-Ro and Ro-Ro passenger ships detained in Paris MoU ports (2010-2014)

Source: Authors according to [14]

80% of ships detained were older than 20 years. There was no recorded any detentions among Ro-Ro passenger ships in the category from 1 to 5 years of age. Such results indicate that the detentions of ships are closely related to the age of ships.

The second parameter of the inspections analysis was flag state category distribution. The following figure shows to which of the flag state category Ro-Ro and Ro-Ro passenger ships belong to.

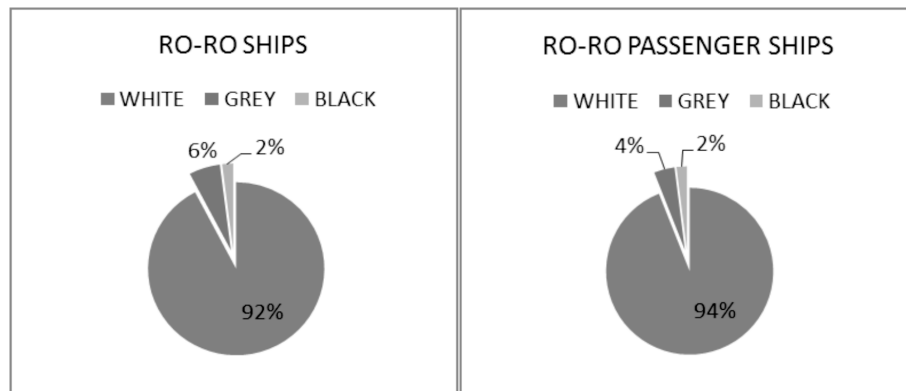


Figure 4 Flag state category distribution of inspected Ro-Ro and Ro-Ro passenger ships in Paris MoU ports (2010-2014)

Source: Authors according to [14]

More than 90% of the total number of ships inspected and all the ships operating on the MoS routes were white flagged ships⁷. The results show better safety conditions and performances of ships inspected but also confirm the positive and higher standards of safety on ships operating on the MoS routes.

The emphasis should also be put on the influence of flag state as the targeting factor for ship inspections where white flagged ships indicate ships with low risk profile.

The third parameter of the analysis is related to the performance of a recognised organization. According to the analysis, 97.8% of all the inspected Ro-Ro ships are certified by a recognised organisation with high performance status, and 2.2% by a recognised organisation with medium performance status. The results for the Ro-Ro passenger ships are nearly identical, with 98.8% of ships certified by a recognised organisation with high performance status and with the same ratio of 0.6% of ships certified by a recognised organisation with medium and low performance status [17].

The analysed ships that operate on the MoS routes are certified by a recognised organisation with high performance status⁸. This parameter also indicates relatively high and satisfactory safety standards of ships operating on the MoS routes.

In addition to the presented analysis, the indirect indicators used to estimate the safety standards and quality of ships were examined. Indirect indicators denote the number of detentions and the number of deficiencies found during inspections. The following figures show the ratio of the ships inspected and detained in the Paris MoU ports.

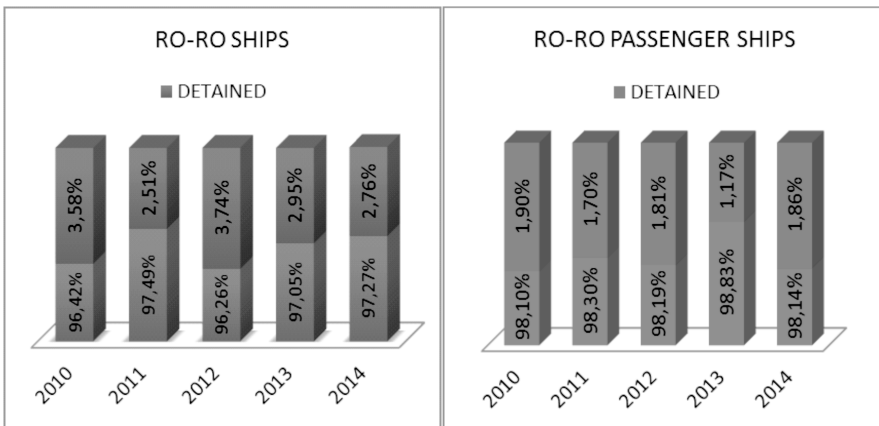


Figure 5 Detentions of Ro-Ro and Ro-Ro passenger ships in Paris MoU ports

Source: Authors according to [14]

⁷ Malta (3), Denmark (5), Finland (9), Italy (14), Sweden (4), Netherlands (1), United Kingdom (5), Estonia (1), Luxemburg (1), Lithuania (1), Belgium (1), Cyprus (1), Norway (3), Germany (1)

⁸ Germanischer Lloyd (1), Registro Italiano Navale (20), Det Norske Veritas (11), Lloyd's Register (14), Bureau Veritas (4).

During the observed period there were no significant differences, on an annual basis, between the ratios in the total number of inspections and the number of detentions of Ro-Ro and Ro-Ro passenger ships. However, the number of detentions of Ro-Ro ships is twice as high as the number of detentions of Ro-Ro passenger ships. For comparison, with Ro-Ro and Ro-Ro passenger ships operating on the MoS routes during the observed period, there was only one case of detention.

One of the reasons for such good results could be seen in increased safety measures applied on the Ro-Ro passenger ships. More than a third of lives lost at sea took place on Ro-Ro passenger ships. This is the reason for the expansion and improvement of safety standards applied for this type of ships. In the last decade, a numerous regulations and conventions were amended regarding this topic. For Ro-Ro passenger ships the IMO A794 resolution (19) also recommends additional inspections beyond the standard schedule. The increased safety measures can also be observed in the application of mandatory additional training of crews on Ro-Ro passenger ships.

In general, regulations relating to the safety of Ro-Ro passenger ships in international, as well as in national voyages, exceed to a great extent the safety standards that are applied to Ro-Ro ships of the same size [1].

Beside the number of detentions, other indirect indicators of safety standards and quality of the ships denote the number of deficiencies found during inspections. The following figures indicate inspection results according to deficiencies observed during inspections.

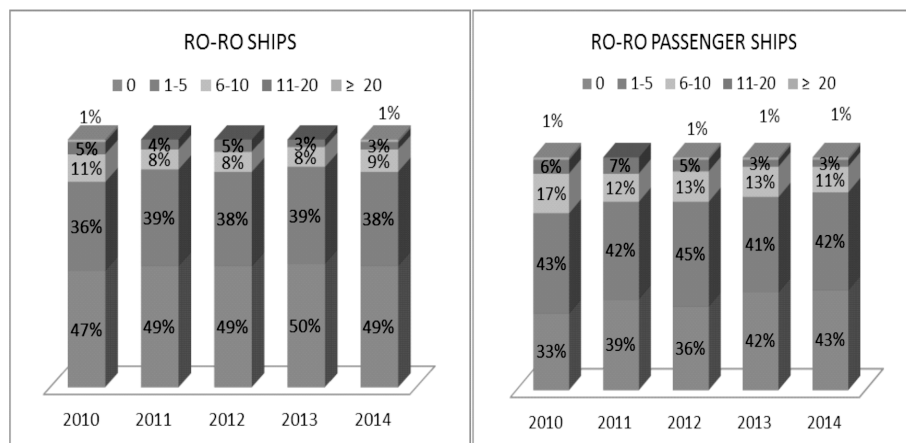


Figure 6 Deficiencies recorded on Ro-Ro and Ro-Ro passenger ships inspected in Paris MoU ports

Source: Authors according to [14]

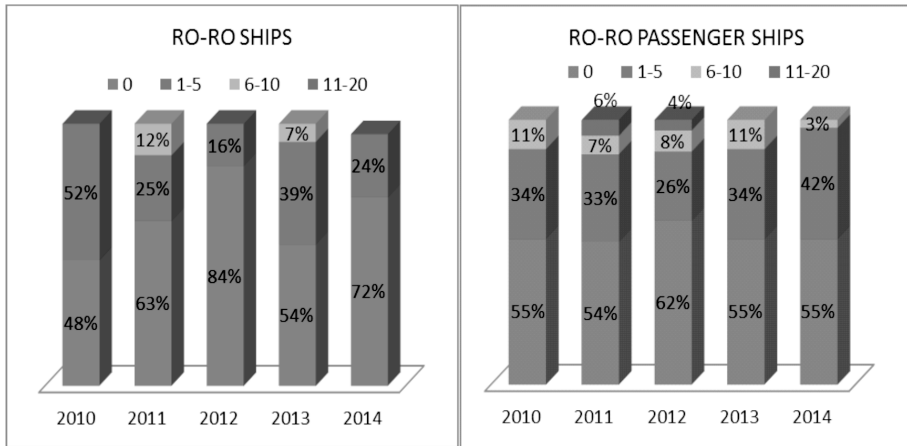


Figure 7 Deficiencies recorded on inspected Ro-Ro and Ro-Ro passenger ships operating on the MoS routes in Paris MoU ports

Source: Authors according to [14]

It can be summarised that Ro-Ro ships have better inspection records; more precisely, a larger number of ships inspected were found without deficiencies. The main reasons for that might be higher age distribution of the Ro-Ro fleet and the increased safety measures on Ro-Ro passenger ships. By comparison between all the Ro-Ro ships inspected and the Ro-Ro ships operating on the MoS routes, a significantly higher number of inspections without deficiencies can be noticed on board ships operating on the MoS routes. During the analysed period, deficiencies were not found on more than one half of the inspected ships operating on the MoS. The reasons for this certainly lies with higher quality standards of ships, relatively low aged ships as well as the well-trained crew. Ships operating on the MoS routes have a precisely fixed sailing schedule, which greatly facilitates ship maintenance by the crew. The navigation regimes allow for a planned maintenance, which in turn reflects on a lower number of deficiencies and a higher quality of ships.

5. Deficiencies on ships operating on the motorways of the sea routes

The number of deficiencies is considered to be one of the main indicators for quality and safety standards on ships. From 2010 to 2014, ships operating on the MoS routes were inspected 313 times with 424 deficiencies found [14]. The comparison between the average number of deficiencies found on MoS ships (1.4 deficiencies) and all the Paris MoU ships (2.7 deficiencies) in the same period [15] indicates that the safety standards on MoS ships are twice as better.

According to MoU, any deficiency found upon PSC inspection is categorized to a specified area with an appropriate code.⁹ The following figure presents the ratio of deficiencies per area found on ships that operate on the MoS routes.

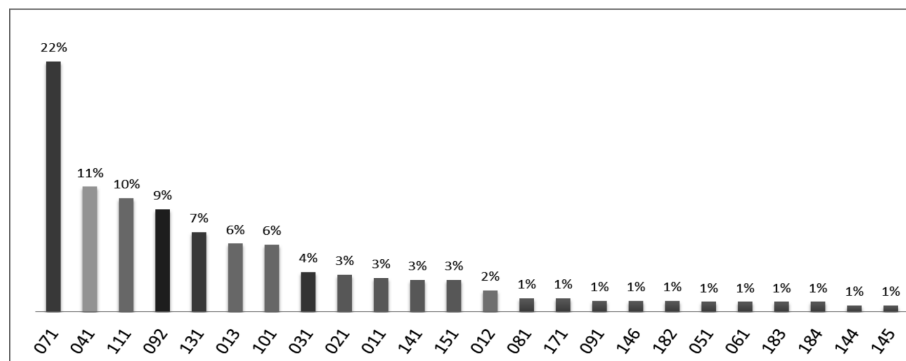


Figure 8 Ratio of deficiencies per category on Ro-Ro and Ro-Ro passengers ships operating on the MoS routes (2010-2014)

Source: Authors according to [14]

The following table presents five most frequently recorded individual deficiency types on MoS ships and all the Paris MoU ships, within the observed period.

Table 2 The most frequently recorded types of deficiency

MoS ships		Paris MoU	
1	Emergency lighting, batteries, and switches	1	ISM
2	Fire doors, openings in fire-resisting division	2	Nautical publication
3	Cleanness of engine room	3	Charts
4	Fire dampers	4	Fire doors, openings in fire-resisting division
5	Fixed fire extinguishing installation	5	Oil record book

Source: Authors according to [14]

⁹ 071-Fire safety, 041-Emergency Systems, 111-Life saving appliances, 092-Living and Working Conditions, 131-Propulsion and auxiliary machinery, 013-Documents, 101-Safety of Navigation, 031-Water/Weather-tight conditions, 021-Structural Condition, 011-Ships Certificates, 141-Emergency System, 151-ISM, 012-Crew Certificates, 081-Alarms, 171-Other, 091-Living and Working Conditions, 146-Pollution prevention-MARPOL Annex V, 182-Labor conditions-Conditions of employment, 051-Radio Communications, 061-Cargo operations including equipment, 183- Labour conditions-Accommodation, recreational facilities, food and catering, 184-Labor conditions- Health protection, medical care, social security, 144-Pollution prevention-MARPOL Annex IV, 145- Pollution prevention-MARPOL Annex V.

The analysis clearly indicates that most common deficiencies on ships operating on MoS are related with fire safety.

One of the most contributing elements to these results is the structural design of Ro-Ro ships. Large cargo spaces require a rather complex constructional design and fire-extinguishing systems. In many cases the fixed fire-extinguishing systems for cargo cannot be properly maintained by ship's crew. In those cases, support by the professional shore based personnel is required during ship's stay in port or at shipyard. With the improved quality, design, access and maintenance requirements of fixed fire-extinguishing systems and emergency lighting, the most prominent disadvantages would be reduced and the safety standards of these ships would certainly improve.

Due to the importance of fire protection, additional efforts are needed to improve the maintenance procedures for the existing fire protection equipment as well as further training and education of the crew.

6. Conclusion

The results of inspections conducted on Ro-Ro ships operating on the MoS routes indicate in general rather high safety standards in comparison to all the other ships in the Paris MoU area.

In analysing the direct and indirect safety parameters related to PSC NIR in the Paris MoU area, an interrelation between ship type and operation type was found. Conclusions indicate that Ro-Ro ships operating on the MoS routes are younger on the average than the other inspected Ro-Ro ships. All the inspected ships have been listed as white flagged implying better operational and safety control by the flag state. Furthermore, all the analysed ships operating on the MoS routes are certified by recognised organizations with high performance status. In general, the analysis confirms better safety standards on ships that operate on the MoS routes than on all the other inspected Ro-Ro and Ro-Ro passenger ships in the Paris MoU area. The reason for this are certainly high quality standards of ships, comparatively low ships' age and well-trained crews.

The analysis of indirect indicators revealed that more than 50% of inspected ships that operate on the MoS routes have no deficiencies recorded. High standards of those ships are additionally confirmed by almost no detentions.

The most frequent deficiencies identified are related to fire protection systems, such as cleanness of engine room, fire doors, fire dampers and fixed fire-extinguishing installation. The main contributor to these deficiencies is the structural design of Ro-Ro ships with a large undivided cargo area, regularly one of the most common locations of fire sources.

In general, inspections on ships operating on the MoS routes show that safety on board can satisfy the standards required by international regulations, in spite of the challenging ship design in terms of safety. It can be concluded that MoS ships have better safety standards, with higher ratio of positive inspection results, than other ships of the same type.

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Inspekcijski pregledi Ro-Ro brodova koji plove pomorskim prometnicama

Sažetak

U radu se opisuju rezultati analize inspekcijskih pregleda brodova koji koriste pomorske prometnice (Motorways of the Sea).

Analiza rezultata pregleda provedena je s ciljem utvrđivanja stanja sigurnosti i kvalitete brodova koji plove pomorskim prometnicama. Dodatno, provedena je usporedba rezultata pregleda različitih vrsta brodova unutar režima nadzora luke države "Pariškog memoranduma o razumijevanju" i brodova koji plove pomorskim prometnicama.

Rad opisuje postupak inspekcijskih pregleda i čimbenike koji ukazuju na stanje sigurnosti i kvalitetu brodova analizom izravnih i neizravnih pokazatelja sigurnosti. Glede izravnih pokazatelja, brodovi su analizirani prema starosti, zastavi pripadnosti i učinkovitosti priznate organizacije dok su, s obzirom na neizravne pokazatelje sigurnosti, brodovi analizirani prema broju zadržavanja i nedostataka utvrđenih tijekom pregleda.

Ključne riječi: pomorske prometnice, pregled brodova, Pariški memorandum, sigurnost Ro-Ro brodova.