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Ship Causalities – Reasons and Statistical Analyze

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ABSTRACT: The paper deals with most recently damages caused ship accidents and their number in the World Ocean. A lot of them are a result of bad technical condition or human mistake. The first reason is due to ship age, non- qualitative maintenance and non- qualitative repair of ship hull thought its life cycle, while the second reason is mainly of labour safety neglect. Analyzed period covers 27 years, from 1994 up to 2021. The analyze is done for two ships group- merchant and special ships. The paper described damages on ship hull and its structural members caused ship accidents and environmental pollution in relation with age of ships. The number and degree of marine causalities are analyzed. Moreover, statistical analysis presents the often causalities and areas in the World Ocean by ship and damage types. Finally, probabilistic density distributions of damages were shown by Fisher distribution curve. The damages on Fisher distribution curve are presented independent one another.

1 INTRODUCTION

A lot of ship accidents in the world ocean were caused mainly by two reasons, human onboard mistake or bad ship hull technical condition. The second reason was due to ship age, non- qualitative maintenance and non-qualitative repair of ship hull thought its life cycle.

There were a couple of scientific publications analyzed different ship damages and reasons resulted in accidents. Literature review of cause for ship accidents was done in [6]. The authors of this publication summarized the factors caused ship accident which goal was to detect its root cause with the aim of applying appropriate corrective actions to reduce the rate of ship accident and the risks posed. According their review the main factor for ship accident is human factor, but it is not just its.

Statistical analysis of ship accidents occurred in the period 1990-2012 and assessment of safety level of different cargo and passenger ship types was done in [5]. Analysis shows that most recent damages with lost of human life are in passenger and cruise ships. Cargo ships damages and lost human life are with lowest frequency.

In [4] was developed and analyzed method for protecting hull structures by means of cathode polarization from local corrosion damages at the potential of the uncharged surface on the juvenile surface steel. This method was applied for different steel grades used in shipbuilding and ship repairing. The results of experimental data shows that this will allow increasing inter docking period of ships and marine structures.

2 HULL DAMAGES.

The damages in ship life cycle are unavoidable event as much as careful to be a crew. They can be divided into two main groups:

– Damages on ship plating and
– Damages in ship structural members;

Damages on ship plating can be caused by:
– Heavy corrosion;
– Collision;
– Cracks;
– grounding etc.

While damages on structural members can be caused by:
– Collision;
– Grounding;
– Mainly by buckling;

The cracks of structural members are the next level of buckling development process. Buckling process is widely described in modern classification organizations rules. This process is entrained to bad hull condition damages from one side and increase ships age and material fatigue from other. The figures from 1 to fig.5 clear shows typical ship hull damages.

Figure 1. Ship collision[9]

Figure 2.Crack in ship hull[10]

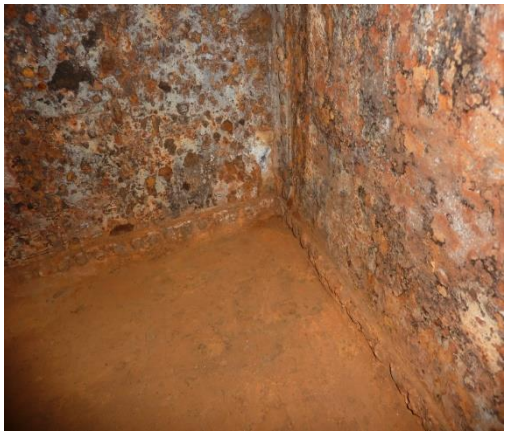

Figure 3. Intensive ballast tank corrosion[7]

Figure 4. Intensive weld seam corrosion[8]

Figure 5. Intensive plating corrosion[8]

3 STATISTICAL DATA AND ANALYZE OF SHIP INCIDENTS.

The number of serious accidents for the six years period (2014-2020) is 25%, very serious is 3% and less serious is 57%, fig.6.

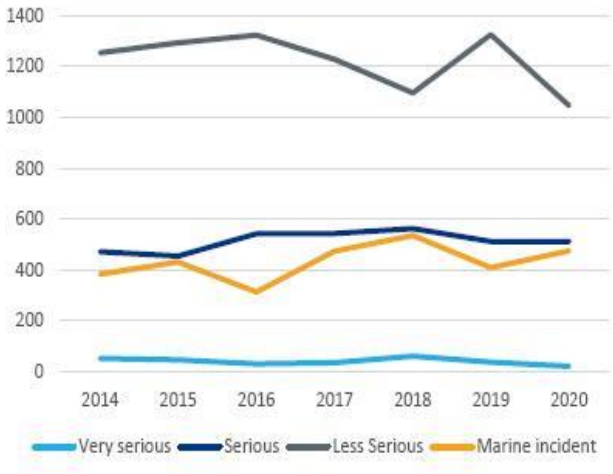

Figure 6. Types of causalities[2]

Reduction of serious causalities was noticeable in 2020, while the number of marine incidents was increased in same period. The peak number of serious causalities was noticeable between 2016-2018.

Main ship types involved of marine causalities and accidents were classified in several main group: cargo ships, fishing vessels, passenger ships, service ships and other. For six years period 2014-2020 cargo ships are most recently involved in marine accidents and causalities, followed by passenger ships.

During six years period the number of cargo ships causalities take first place, followed by passenger ships. The fishing vessel causalities take third place.

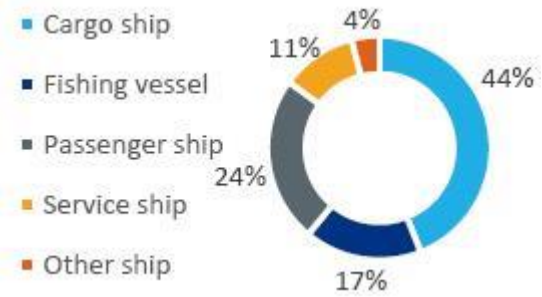

Figure 7. Ship types accidents 2014-2020[2]

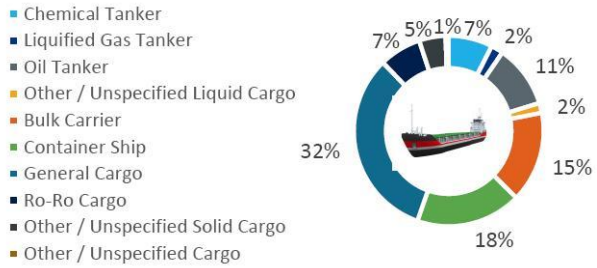

Figure 8. Merchant ship types involved in accidents [2]

According [1] the age of world fleet was dramatically increased. About 40% of ships are of age more than 25 years old.

The heighten ship age is a precondition for accidents. From table 1 was clear that about 40% from world fleet was at age more than 25 years old. First place in this ranking was for general cargo ships leads from oil and chemical tankers and bulk carriers. Take into account that ship was designed to live about 30-35 years we can to claim that a lot of world fleet is till to end of his life. Through ship life cycle her hull condition loss its main property- strength. Possible reason for this was intensive corrosion of plating and hull members although cathode protection. This was precondition for ship accidents and environmental pollutions.

Table 1. Ships age

Ship age category	Total, %
0-4 years old	9.6
5-14 years old	31.9
15-24 years old	18.3
+25 years old	40.2
Total	100

For ship damage analysis was used information about main reasons like grounding(2), collision(1), fire on board(3), capsizing(4) and hull failure(5).

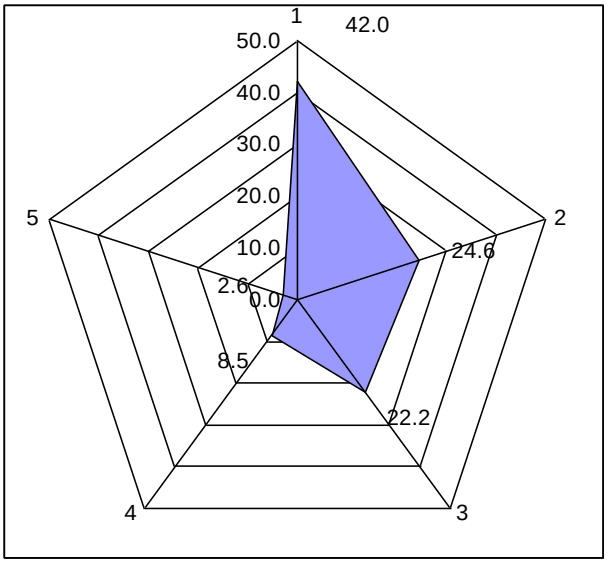

Figure 9. Distribution of ship damages from 1994-2021[3]

Distribution of ship hull damages, on fig.9. shown the most recent damage was from collision, about 42% form all damages. Grounding is second damage reason leading form fire on board and capsizing. With about 3 % are the damages caused by bad hull condition. Their less percent value didn't corresponds for neglecting. Capsizing is probability caused by bad technical condition.

About 60% from causialities was happened in open sea, 43% of accidents are happened when the ship was en route , fig. 11. The main reasons for this are heavy weather condition, human mistakes and bad technical hull condition. The last reason is as a result of ships building quality, age, maintanance, type of cargo and operation area. Other about 35% percent are in port. In loading and discharging the ship was appeared factors for accidents in this area. They were not corresponded with typical accidents. Damages in port waters was involved mainly by cargo loading and discharging , non- correct ballast operations, fire on board and etc.

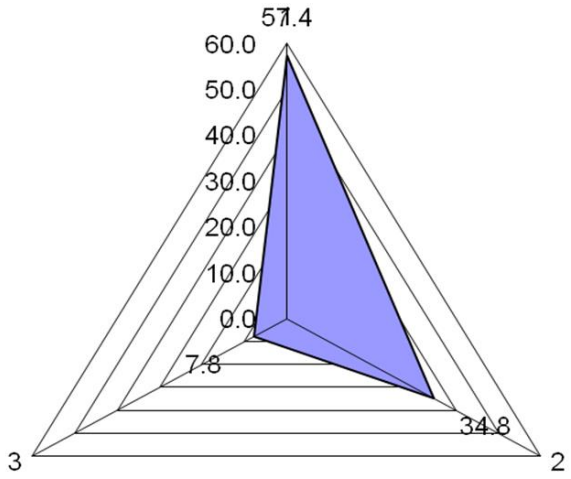

Figure 11. Damages area distribution from 1994-2021 [3]

For a period from 1997-2022 the number of very large causalities with container and passenger vessels take first place, fig.12. and fig.13.

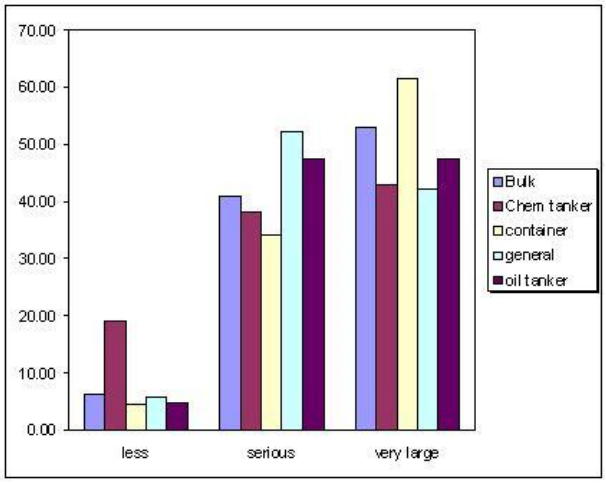

Figure 12. Type of damage statistics 1997-2022

The very large causalities in ,,special" fleet passenger vessels take first place, after that are towing vessels. In less causalities ranking the number of fishing vessels causalities in smallest, Ro- Pax vessels take first place, fig.13.

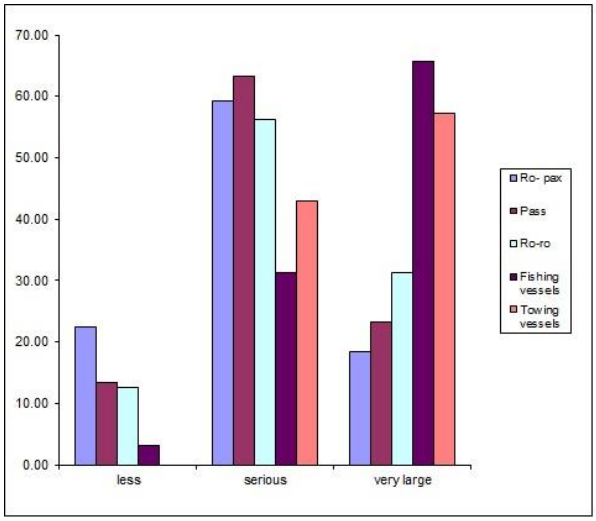

Figure 13. Type of damage statistics 1997-2022

The probably density distribution of main damage was presented by Fisher distribution, fig. 14.

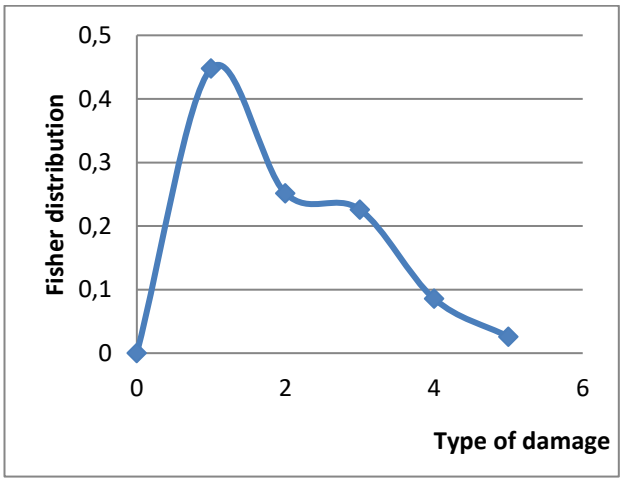

Figure 14. Damage density distribution by Fisher

Density Fisher distribution is independence curve. It shows damage reasons independence one another. The curve is non- symmetrical and it is positive skewed.

4 CONCLUSION.

Collision, grounding and fire on board are the most often ship damages in relation with human mistake, heavy weather and bad hull technical condition.

The most frequent ship damage and causalities are happened in open sea.

A lot of ships involved in accidents are at age of more than 25 years. This is serious reason for taking into account about condition of world fleet.

General cargo ships are involved in 32% of the marine causalities, while container vessels take 18%, following by bilk carriers with 15%. LNG tanker and chemical takers are involved in 7% of the accidents, following by oil tankers.

Most often very large accidents are involved at container vessels and bulk carriers. Serious accidents are often in general cargo ships and chemical tankers, following by bulk carriers.

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REFERENCES.

[1] Electronic Quality Shipping Information System, The 2020 world merchant fleet, 2020;
[2] European Maritime Association, Annual overview of marine causalities and incidents,2021;
[3] IMO, Global Integrated Shipping Information System,
[4] Kramar, V., Rodkina, A., Ivanova, O., Chernyi, S., Zinchenko, A., 2021, Analisys technology and cathodic protection for hull structure of ships and floating facilities, Inventions, 6,74, https://doi.org/10.3390/inventions6040074;
[5] Papanikolaou, A., Bitha, K., Eliopoulou, Ventikos, N., 2015, Statistical analysis of ship accidents that occurred in the period 1990--2012 and assessment of safety level of ship types, Maritime Technology and Engineering, Lisbon, DOI: 10.1201/b17494-31
[6] Shanty, Y., Supomo, H., Nugroho, S., 2021, Cause of ship accident: A literature review,
[7] https://www.chemcote.com.au/tank-lining-protective-coatings/;
[8] https://www.dreamstime.com/photos-images/corrosion-ship-hull.html ;
[9] https://www.fleetmon.com/maritime-news/2019/24977/norwegian-cargo-ship-breached-collision-german-con/;
[10] https://remotion.no/applications/hull-crack-repairs/;