Volume XXII 2019
ISSUE no.2
MBNA Publishing House Constanta 2019

Scientific Bulletin of Naval Academy

SBNA PAPER • OPEN ACCESS

The current state of safety onboard oil tankers

To cite this article: R. Bosneagu and M. Rusen, Scientific Bulletin of Naval Academy, Vol. XXII 2019, pg.212-219.

Available online at www.anmb.ro

ISSN: 2392-8956; ISSN-L: 1454-864X

doi: 10.21279/1454-864X-19-I2-025

The current state of safety onboard oil tankers

R. Bosneagu[1] and M. Rusen[2]

[1]Associate Professor, Mircea cel Batran Academy, Constantza, Romania
[2] MA student, Mircea cel Batran Academy, Constantza, Romania

Abstract: Maritime safety is governed by a combination of international rules and regulations. Risk assessment onboard oil tankers involve identifying all the risk factors and quantifying their dimension. The loading/unloading operation on an oil tanker is one of the most dangerous maneuvers due to hazards, such as fuel pollution and fire. Loading a maritime oil tanker at a terminal is a complex activity, requiring a high degree of professional training and organization

Keywords: oil tanker, onboard safety, risks

1. Introduction

Maritime transport, a global industry nowadays, has developed in accordance with the global economy and trade. Today, world maritime transport is a well-defined international community that uses performant fleets, modern communication systems, top professionals, functioning in accordance with the free trade principle [2].

Since its beginning and up to the present, maritime transport has kept pace with the evolution of the world economy, while also making a full and visible contribution to its development.

The sea is a hard environment that exposes the ship, the cargo and the crew to major risks. Marine-related hazards are not always easy to analyze and detect onboard the ship during the daily navigation routine. Well-trained and experienced navigators are aware of the difficult and often changing sea conditions: gales, thick fog, underwater dangers, ice, etc. [1]. These hazards generated by the marine environment, and also many other hazards related to the development and functioning of maritime transport (complex, more extensive and faster ships, dangerous cargoes, complicated ships' operation systems) and crew training must be taken into account during loading/unloading and safety assurance operations onboard oil tankers. The risks of collision, stranding, fire, and explosions, capsizing and sinking of the ship, as well as damage to cargo, hull, and machinery are well known to crew personnel.

Maritime safety is governed by a combination of international rules and regulations, national regulations of flag and port states, port regulations, classification, and insurance rules. International conventions such as SOLAS, STCW, MARPOL, LL, and COLREG play a significant role in this area. This regulatory system, which is supported by the management safety systems of maritime transport companies, is very complicated due to the many actors (and stakeholders) involved. The connection between the actual owner of the ship and the operator or the technical manager of the ship is not entirely clear about maritime transport and, therefore, complicates the implementation of legal instruments [9].

2. Materials and methods

Safety onboard oil tankers depend on a multitude of factors. The starting point in optimizing the prevention of occupational accidents and occupational illnesses in a system is the risk assessment.

Regardless of the workplace, a workshop, a company or a ship, the risk analysis allows the ranking of the risks according to their dimension and the efficient allocation of the resources needed for taking the priority measures.

Risk assessment involves identifying all the risk factors in the analyzed system and quantifying their dimension based on the combination of two parameters: the severity and frequency of the maximum possible consequence on the human body. Partial risk levels are thus obtained for each risk factor, respectively global risk levels for the entire analyzed system.

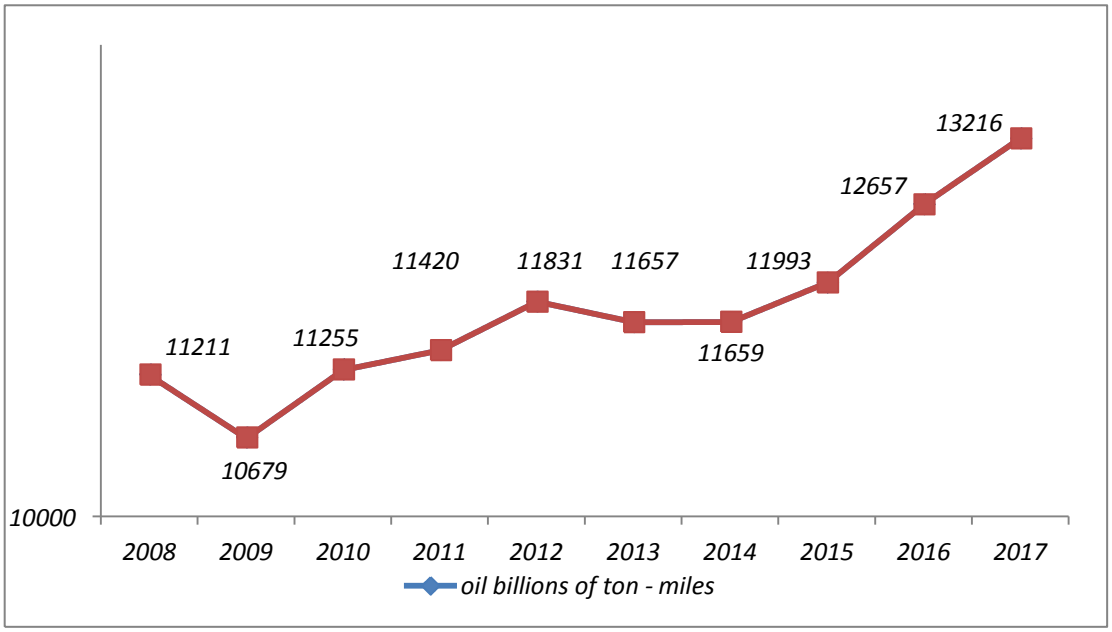
One of the first prevention and protection activities are undertaken onboard the ship is the identification of hazards and the risk assessment for each component of the respective work system: executant, work task, work devices/equipment, and the work environment on jobs/ workstations [3].

3. Results and discussions

Nowadays about two-thirds of oil, crude oil, and processed petroleum products' trade is done with the help of oil tankers. Oil tankers' transport accounts for 30% of the global commodity trade. Oil tankers and tanks of petroleum products account for one-third of the world's commercial fleet, and due to the increasing demand for oil, their number is on a steady rise [18] (Table 1 and Figure 1).

Table 1 World seaborne oil in ton-miles, 2008-2017 (billions of ton-miles)

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
11,211	10,679	11,255	11,420	11,831	11,657	11,659	11,993	12,657	13,216



Graph 1 World seaborne oil in ton-miles, 2008-2017 (billions of ton-miles)

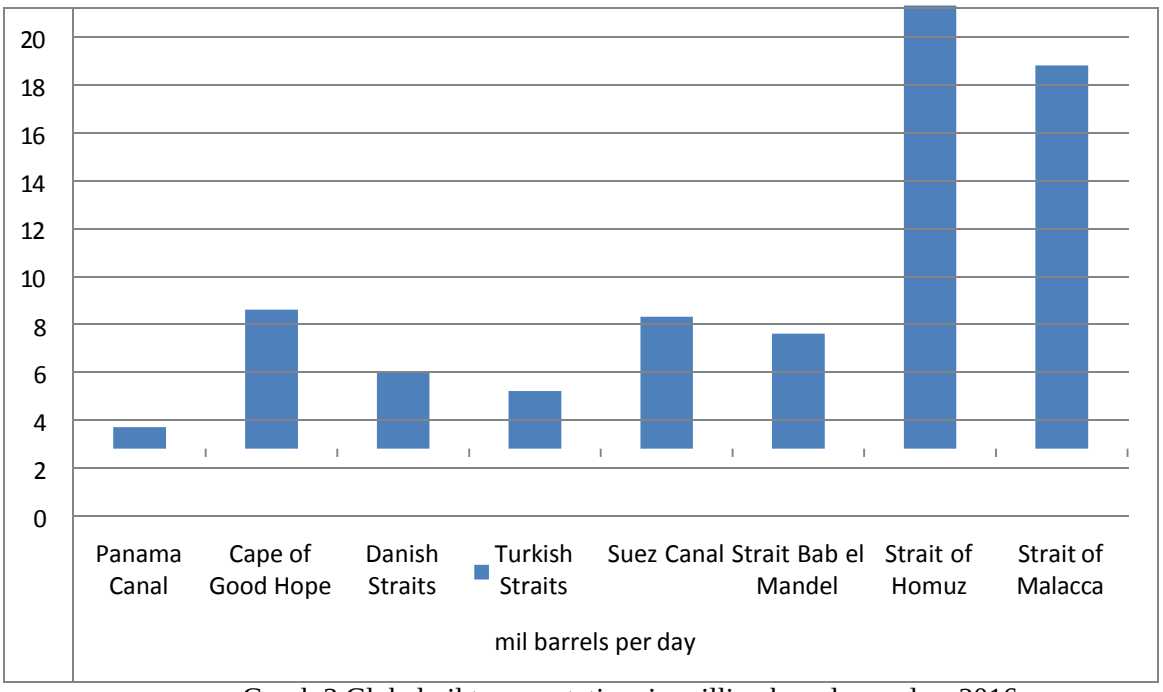
Despite the intense research into alternative energy resources, it is expected that the volume of oil traded by 2030 will double [1].

The main international crude oil transport routes through the main points and the traffic value are, as follows (Table 2 and Graph 2) [8]. These maritime routes are used in direct

relation with the international commodity flow, as a direct result of the demand-supply ratio on the market.

Table 2 Major trade routes for global oil transportation, in million barrels per day, 2016 [21]

Panama Canal	Cape of Good Hope	Danish Straits	Turkish Straits	Suez Canal	Strait Bab el Mandeb	Strait of Hormuz	Strait of Malacca
0.9	5.8	3.2	2.4	5.5	4.8	18.5	16.0

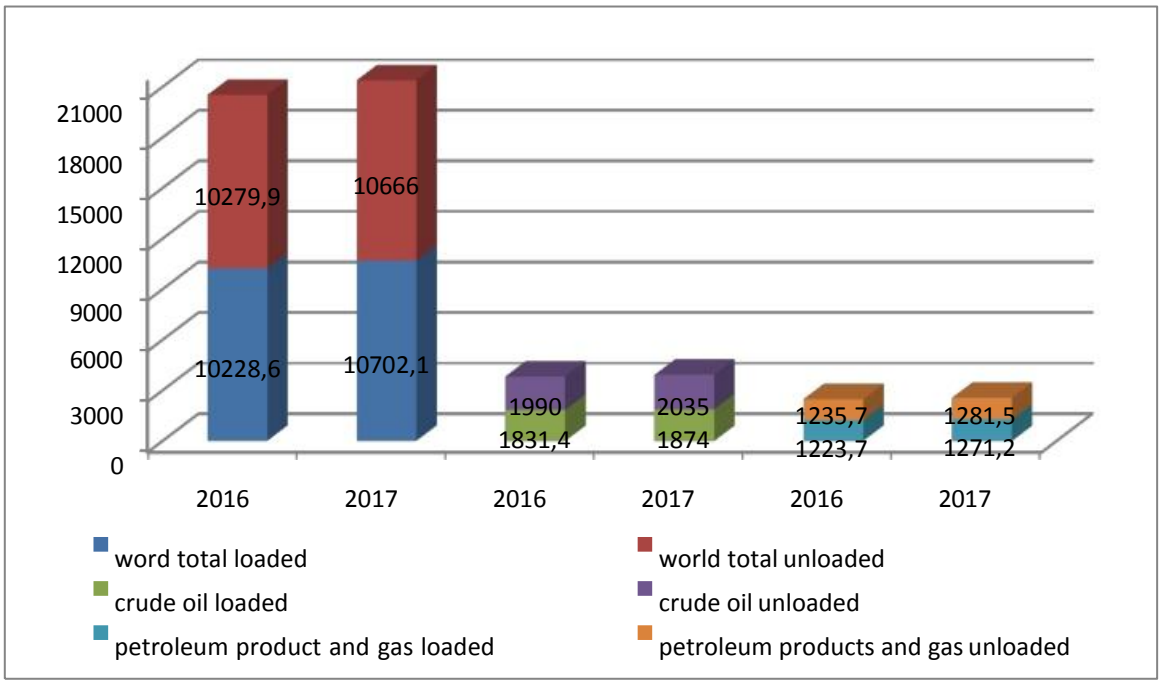


Graph 2 Global oil transportation, in million barrels per day, 2016
Source: https://geopoliticalfutures.com/major-shipping-routes-oil-trade/, accessed 25.02.2019

Nowadays, about two-thirds of the oil, crude oil, and petroleum products' global trade is done with the help of oil tankers. Oil tankers' transport accounts for 30% of the global commodity trade.

Table 3 The volume of seaborne crude oil and petroleum products in 2016 and 2017 [16]

Year		World total	Crude oil	%	Petroleum products and gas	%	% total
2016	Loaded	10,228.6	1,831.4	17.9	1,223.7	12.2	30.1
	Unloaded	10,279.9	1,990.0	19.4	1,235.7	12.0	31.4
2017	Loaded	10,702.1	1,874.9	17.5	1,271.2	11.9	29.4
	Unloaded	10,666.0	2,035.0	19.1	1,281.5	12.0	31.1
2016	Total crude oil and petroleum products and gas loaded and unloaded						30.75
2017	Total crude oil and petroleum products and gas loaded and unloaded						30.25



Graph 3 The volume of seaborne crude oil and petroleum products in 2016 and 2017

According to Review of Maritime Transport 2018, oil tankers are classified into the following types: Very large crude carrier - VLCC (200,000 deadweight tons and above), Suezmax crude tanker (120,000-200,000 deadweight tons), Aframax Crude Tanker (80,000 - 119,999 deadweight tons), Panamax Crude Tanker (60,000 - 79,999 deadweight tons).

Oil tankers and product tankers account for one-third of the world's commercial fleet, and due to the increasing demand for oil, their number is on a steady rise (Table 4 and Figure 4).

Table 4 Share of oil tankers in the 1980-2018 world fleet, in percentage [21]

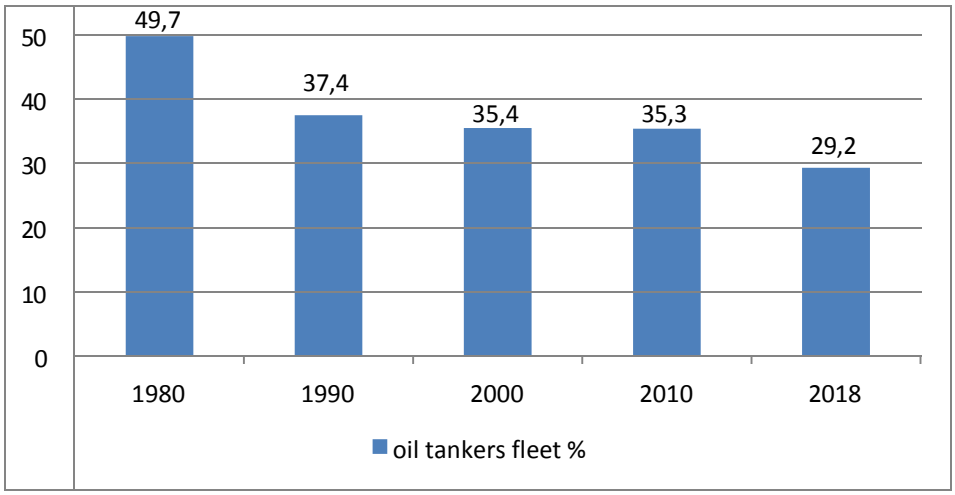
1980	1990	2000	2010	2018
49.7	37.4	35.4	35.3	29.2

PANAMAX, AFRAMAX and SUEZMAX types of oil tankers operate more frequently in coastal areas, which means that the possible consequences of incidents or accidents involving oil spills can be quite high. Therefore, considerable effort is being made to improve the processes associated with life's cycle: design, operation and operational management of the ships.

Regarding the regulations for increasing maritime safety and designing related to construction aspects, they also include the accelerated exclusion of single-hull oil tankers by 2019.

While in the past maritime safety was considered only a matter of international policy, the latest naval accidents resulting in massive environmental pollution (Deep Horizon 2010, Prestige 2002, Erika 1999) altered this perception, showing that only a partnership between all the parties concerned with maritime safety could bring about a change [15].

This partnership-based approach addresses the need to clarify each partner's role (international organizations, states, regional collectives, port authorities, etc.).



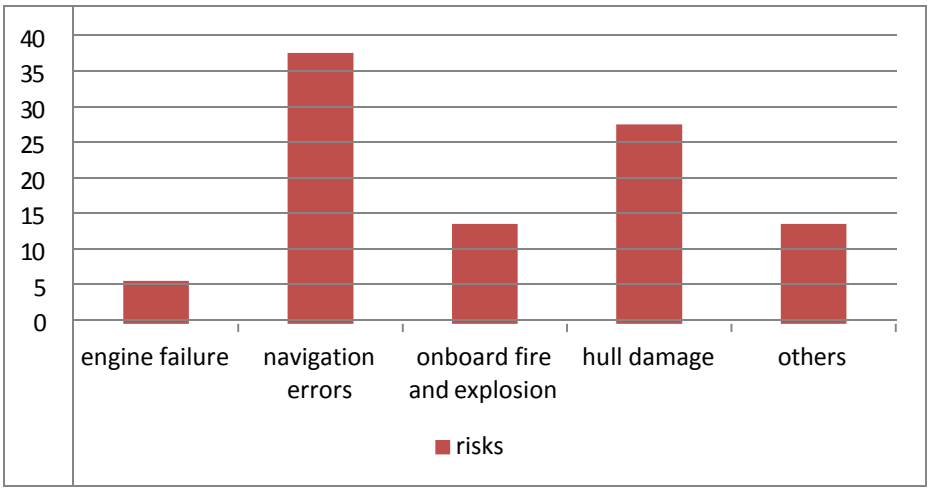
Graph 4 The share of oil tankers in the world fleet 1980-2018, in percentage

The risks associated with the navigation of oil tankers are divided into human factor risks (unfamiliarity with the ship, inadequate training, fatigue, stress, distraction and lack of concentration); ignorance of the navigation area; piracy risks (Table 5 and Graph 5).

Table 5 Frequent causes of risks related to oil tankers' navigation [21]

Engine failure	Navigation errors	Onboard fire and explosion	Hull damage	Others
6	38	14	28	14

Concerning the risks associated with loading/unloading operations on an oil tanker, what must be taken into consideration first is the lack of knowledge of the specific construction elements of this type of ship. Modern software allows for easy and fast calculation, as well as monitoring certain maneuvers needed to increase the security of operations. The loading/unloading maneuvers are the most difficult ones and involve a significant number of risks, and compliance with the procedure must be complete, even when it is adapted to specific changes from time to time.



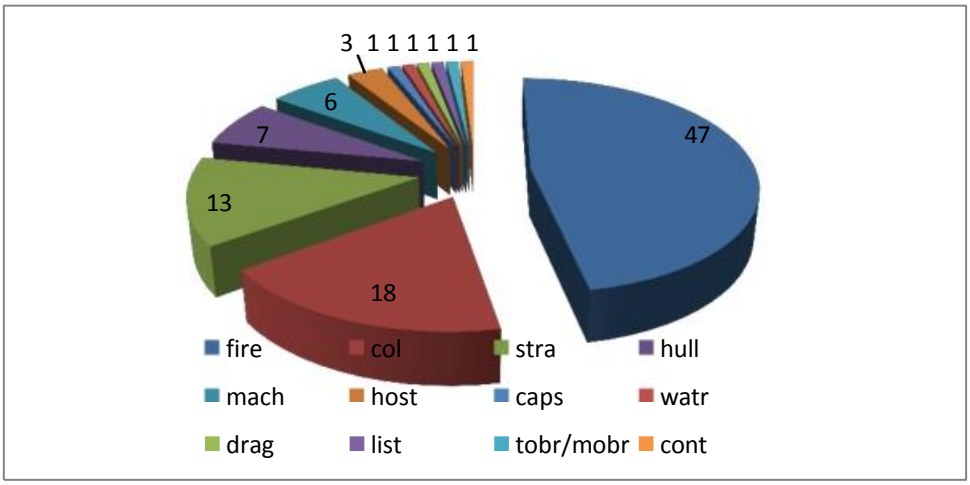
Graph 5 Major risks associated with oil products' seaborne trade
Source: https://www.marineinsight.com accessed 12.03.2019

The risks associated with loading/unloading of an oil tanker are quantified according to recent research as follows: collision, fire aboard, stranding, damage to the hull, damage to main and secondary machines, hostile acts, ship's capsizing, water hole, damage related to anchorage, damage during towing and mooring maneuvers, due to contracts, listing (Table 6 and Graph 6) [21].

Table 6 Risks associated with oil tankers' operations

Fire	Collision	Stra...	Hull...	Mach	Host	Caps	Watr	Drag	List	Tobr-mobr	Cont
47	18	13	7	6	3	1	1	1	1	1	1

where: fire - fire or explosion; drag - dragging anchor; coll - collision risk; list - listing; stra - stranding; tobr/mobr - towing and mooring; hull - loss of the integrity of the ship's hull; host - hostile acts; caps - capsizing; cont – contact; watr - water hole; mach - damage to main or secondary machinery.



Graph 6 Risks associated with oil tankers' operations

Conclusions

As an economic activity, modern maritime transport cannot be limited to measures for achieving profitability - a fundamental condition it asserts itself as an objective necessity for the development of human society in the concrete geographical, economic and political terms of our world and our age. At the current technical state of our civilization, no other means of transport, other than the ships, can provide traffic over the seas and oceans for the billions of tons of goods joining the international trade cycle annually.

The need for a thorough knowledge of the ships' maneuvering qualities is even more evident these days, considering the impetuous development of the merchant fleet over the last few years.

Even if modern devices and equipment are installed onboard oil tankers, and there is a theoretical basis, the knowledge from experience gained from generations of sailors still exists, the ships' management is deepened by practice, by updating and putting into practice the accumulated theoretical basis.

In order to limit onboard accidents and to limit the effects of fatigue, the company resorts to a series of measures and drills in order to: achieve automation of the ship's crew, efficiently organize the procedures aboard, optimize the resources available to captains, establishing an efficient passengers' control, as well as an effective communication.

Loading of an oil tanker is a maneuver that requires a lot of attention from the watch team, as well as from the maneuver team. The terminal requirements regarding the managerial crew's experience for the execution of this maneuver are: the captain should have a minimum 12-month experience, or the second mate should have a minimum 24-month experience.

The loading/unloading maneuver to/from an oil tanker is one of the most dangerous maneuvers due to hazards, such as marine pollution with fuel and fire. The personnel involved in this operation must know the procedures, the entire loading system to avoid any accident and must, therefore, be involved in the ship's and individual's safety.

The difficulty of this maneuver lies in planning the approach according to the hydro-meteorological conditions in the area and the risk of hydrocarbon pollution.

Ship loading at an oil terminal is a complex task, which, therefore, requires a very high degree of organization. Watch officers must ensure that loading is done under the plan, and they must be able to solve all the problems that occur during the operation.

References

[1] Arslan, Ö., Zorba, Y., & Svetak, J. Fault, *Tree Analysis of Tanker Accidents during Loading and Unloading Operations at the Tanker Terminals*. Journal of ETA Maritime Science, 6(1), 3-16, 2018;

[2] Bosneagu, R., *Maritime Geo-economy*, Ex Ponto Publishing House, 2017, in Romanian;

[3]Corduneanu, D., Popa, C., *The Economy of Romanian Naval Transports in the period 1950 – 1990*, "Mircea cel Batran" Naval Academy Scientific Bulletin, Volume XXI – 2018, Issue 2, ISSN 1454 - 864X, Constantza, 2018;

[4]Goerlandt, F., & Montewka, J., *A framework for risk analysis of maritime transportation systems: a case study for oil spill from tankers in a ship–ship collision*. Safety Science, 76, 42-66, 2018; 2015

[5] Toacă, I., *Exploitation of oil tankers [Exploatarea tancurilor petroliere]* vol.I-II, Muntenia Publishing House, Constantza, 1995, in Romanian;

[6] Kristiansen, S., *Maritime transportation: safety management and risk analysis,Routledge, 2013*

[7] Lupu, S., Corduneanu, D., *Romanian Riverine Transports in the Twentieth Century*, "Mircea cel Batran" Naval Academy Scientific Bulletin, Volume XXI – 2018, Issue 2, ISSN 1454 - 864X, Constanta, 2018;

[8] Martins, M., R., & Maturana, M., C., Application of Bayesian Belief Networks to the Human Reliability Analysis of an Oil Tanker Operation Focusing on Collision Accidents. Reliability Engineering & System Safety, 110, 89-109, 2013;

[9] Zhang, H, et al., *Research on parameter design of tank stabilizers of the ship*, Proceedings of the 10th World Congress on Intelligent Control and Automation, Beijing, 2012, pp. 2109- 2112;

[10] Zhang, H, et al., *Design and simulation research of anti-rolling tanks system*, 2014 International Conference on Computer Technologies in Physical and Engineering Applications (ICCTPEA), St. Petersburg, 2014, pp. 213-214;

[11] Wang, H., et.al. *Mooring safety of parallel-connected FLNG and LNG carrier system in deep sea*, 2015 International Conference on Transportation Information and Safety (ICTIS), Wuhan, 2015, pp. 611-616;

[12] https://geopoliticalfutures.com/major-shipping-routes-oil-trade;

[13]***International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, 2016 Edition;

[14]***International Maritime Dangerous Goods Code, 2018 Edition, Volume 1;

[15]***International Safety Guide for Oil Tankers and Terminals, Fifth Edition;

[16]***OCIMF, Annual Report 2018;

[17]***Tank Cleaning Guide, 2016 edition;

[18]***Tanker Safety Guide, Fourth edition;

[19]***Technica, *Risk assessment of emergency evacuation from offshore installations*, Technica Consulting Scientists and Engineers. Report No. F 158. London, 2003;
[20]***Review of Maritime Transport 2018, UNCTAD, Geneva, Switzerland;
[21]***http://www.marineinsight.com;
[22]***http://www.marinetraffic.com;
[23]***http://www.ocimf.org/;
[24]***http://www.hsmarin.com;
[25]***http://www.petroleumreview.ro;
[26]***http://www.poweroilandgas;
[27]***http://www.mejorimagen.eu;
[28]***http://www.yumpu.com;
[29]***http://geoawesomeness.com.