

Analysis of Maritime Accidents in the Context of Demand for MoB MEDS the Mobile Base of the Marine Emergency Diving Service

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ABSTRACT: The purpose and scope of this paper is to present the demand of Polish waters for the boat MoB MEDS the Mobile Base of the Marine Emergency Diving Service, which would enable necessary underwater works (repairs and inspections) for ships requiring immediate assistance. The MoB MEDS boat could also protect sensitive sea areas against potential oil and / or chemical spills from the ship, which could seriously threaten the safety of human life, the safety of navigation and the protection of the natural environment with its unique ecological values. Mentioned demand is supported by the analysis of selected statistical data on maritime accidents in Polish waters and planned maritime investments.

1 INTRODUCTION

This seems unbelievable considering the technological developments of the last few decades, but it is important to take into account the growing importance of maritime transport globally. Every year the number of merchant ships increases [1] and their dimensions get bigger. According to [11] over 80% of world merchandise trade by volume is carried by sea.

At the same time, despite the continuous development of techniques used in maritime transport, equipping ships with modern devices, implementing new procedures, rules and regulations, including crew training in accordance with new safety standards, the number of recorded accidents in maritime transport is continuously growing, and their effects and consequences may be very serious. Some accidents have had an irreversible impact on the marine environment and have also led to the bankruptcy of their shipowners. Therefore, it is very important to analyze the accidents that have occurred

and to investigate their causes in order to prevent further accidents.

There are many different causes of marine accidents, where the intervention of the MoB MEDS boat would be justified, e.g. collision with another vessel, grounding, loss of control, loss of electrical power (blackout), heavy seas, immobilization by fishing net, human error in manoeuvring, uncontrolled ballast water discharge, and many others. These examples are not exhaustive, but the common factor in each case is the request of immediate assistance.

The boat MoB MEDS discussed in the article could respond to this request and significantly improve the safety level of Polish waters. The ship can be categorized as a diving support vessel (DSV). This group of vessels has been in continuous development since the 1960s due to the demand for this type of vessel in the offshore sector. DSV was intended to support underwater works and deep-water diving. Among the DSV we can distinguish relatively large units (LOA>100m; draft>6,5m) which support oil

platforms and wind farms; medium-sized units (LOA~30m, draft~3m) which also are capable of long-term operation in the open sea; small units (LOA≈10M, draft≈1m) which operate mainly in internal and coastal waters. The boat MoB MEDS discussed in the article belongs to the last group and is intended to operate in the Gulf of Gdańsk, the Vistula Lagoon and nearby navigable canals leading from the sea port of Gdańsk to the sea port of Elbląg.

All the ships listed above are distinguished by good mobility and high speed in operation. Most of them undertake various underwater activities within nearby harbours and anchorages. Due to the main assumption of the vessel (possibility of providing immediate assistance), the owners of described boats operate mainly in a well-defined area and they rarely provide services to other countries or ports. Services which they provide include: inspection and repair of underwater structures (e.g. berths, piers, docks), underwater welding and cutting, recovery of the lost equipment, metal thickness measurements, hull inspections for classification societies and propeller maintenance.

Currently, very few units of this type are equipped with devices to combat oil pollution, but such solutions also exist, e.g. the German company Baltic Taucherei und Bergungsbetrieb Rostock GmbH has several boats equipped with oil spill containment barriers, pumps and oily water tanks. They can effectively support the activities of German Search and Rescue (SAR) units by increasing the fleet of pollution removal vessels. However, the operating areas of such ships are usually limited to nearby internal waters, e.g. within the port of Hamburg.

The analysis of such DSV market carried out within Poland [9] has shown that on most of the navigable waters there is lack of specialized vessels with low draft, which could undertake the required action (divers service and oil/chemical spills combating) in a short period of time. There are a relatively large number of companies providing underwater services, however, the vast majority of them do not have their own vessels, or they have the vessels which does not comply with a number of legal requirements to perform underwater works. Specialized oil-combating vessels are mostly owned by the government (Polish Navy, SAR Service, training/research vessels of the Maritime Institute etc.), but by definition, they cannot perform commercial work.

2 METHODOLOGY FOR ANALYSIS OF MARINE ACCIDENTS

State Marine Accident Investigation Commission (SMAIC) is an independent organization, which carries out safety investigations based on maritime accident researches in Poland. It is crucial to be aware of the legal regulations (especially the act dated 31 August 2012, Journal of Laws item 1068, 2012, with further amendments), which limit the number of investigated cases. Some of these limitations are presented below.

Data on accidents at sea cover ships of either Polish or non-Polish nationality when the incident or accident at sea occurred in Polish internal waters or Polish territorial sea. Passenger ro-ro ferries or highspeed passenger ships are also included when the incident or accident occurred outside the internal waters or territorial sea of the EU member state provided that the last port of call of that ship was a Polish Republic's seaport. Besides, these statistics cover ships of gross tonnage below 50, i.e. fishing boats, yachts or tugs.

Maritime chambers adjudicate cases on marine accidents only at the request of the parties concerned or a maritime administration body. Marine accident should be considered as an occurrence or several consecutive occurrences linked directly to the ship's operations, resulting in:

- any loss of life, major serious injury to a person or loss of a person onboard the ship;
- the sinking of the ship, loss of the ship in another way, or damage to the ship seriously affecting its structure, manoeuvrability or operability so that an in-depth repair is required;
- ship's grounding, or any ship's hull contact with the sea bottom, an impact of the ship into a subsea obstacle;
- laying-up or collision of the vessel;
- fire, explosion;
- an impact into a port facility, installation Offshore, hitting a surface or underwater obstacle;
- cargo dislocation;
- damages due to unfavourable weather conditions, damages by ice;
- crack of the hull or suspected damage to the hull, or
- damage by the ship to a port's infrastructure, or to facilities providing access to ports, harbours, installations or offshore structures causing a serious risk to safety of the ships, other ships or persons, or a damage to the natural environment or posing a risk thereof.

The SMAIC is obliged to investigate every 'severe' or 'very severe' marine accident. The Commission does not deal with marine accidents or incidents participated exclusively by vessels of the Naval Forces, Border Guard or Police, 15 meters long fishing boats, leisure yachts—except for very serious accidents; or accidents not participated by maritime ships, at offshore drilling units.

In accordance with Art. 40(1). 2 of the Law on SMAIC, the reports of this organization cannot constitute evidence in criminal proceedings, they do not establish fault or responsibility for causing the accident. They only determine the circumstances and causes of its occurrence to prevent future maritime accidents and incidents. SMAIC has been operating in Poland since 2013, so despite the above described limitations of undertaking research and selected types of accidents (which require underwater work or oil spill prevention), accidents described below are relatively numerous.

However, in practice not all marine casualties are reported (minor marine casualties and incidents are usually concealed to avoid certain legal, administrative and financial consequences) and those that are reported are not always subjected to a

detailed analysis of the effects and causes of the event. As a result, 'Marine Accidents' and 'Incidents' or even less 'Severe Accidents', including those that required underwater diver intervention, are not always reported or they are less frequently presented, even though they represent a significant group in the events recorded by the SMAIC. It is also crucial to be aware that describing mentioned cases is not the duty of the SMAIC. As an example, Table 1. presents data on cases reported to the SMAIC [10] by the type of marine accident. Almost half of the reported accidents (and even 73% in 2017) are not described, mainly due to the previously indicated legal limitations of the organization. A significant number of undertaken studies are terminated without issuing a report, because they resulted from renounced investigations. Investigations carried out by SMAIC are very extensive and insightful, sometimes they require large financial outlays (e. g. recovery of the wreck to determine the damage or the cause of sinking) therefore in many cases they also take a long time. The number of studies undertaken by the commission does not stand out in comparison with other countries.

Table 1. Number of reported marine accidents by consideration

Specification	2016	2017	2018	2019
Number of notifications	90	114	110	144
Investigations not started, investigations renounced or another reason	61	83	44	71
Proceedings initiated	29	31	66	73
Investigations completed	16	21	53	49
Number of abandoned Investigations	15	19	53	49

Source: Statistical Yearbook of Maritime Economy 2020, Data by the State Maritime Accident Investigation Commission, December 2020.

According to [2] in the 2014-2019 period the number of 19418 marine casualties and incidents in Europe was reported and only in 833 cases, an investigation has been launched. The data collected by the European Maritime Safety Agency (EMSA) has its methodological limitations - their publication contains statistics on marine casualties and incidents which involve ships flying a flag of one of the EU Member State or occur within EU Member States' territorial sea or internal waters or involve other substantial interests of EU Member States.

Table 2. Accidents by location

Location of accident	2016	2017	2018	2019
Total	90	114	66	73
Ports (total)	29	45	35	38
Gdańsk	5	5	4	12
Gdynia	6	10	11	6
Szczecin	4	8	12	5
Świnoujście	2	6	5	8
Other ports	12	16	3	7
Open sea	23	28	16	17
Bays and lagoons	28	32	5	-
Rivers	3	5	-	-
Others (canals, straits, ports roadsteads etc.)	7	4	10	18

Source: Statistical Yearbook of Maritime Economy 2020, Data by the State Maritime Accident Investigation Commission, December 2020.

Table 2. summarizes marine accidents by location in the 2016-2019 period [10]. Specified categories, such as ports, bays and lagoons, rivers, canals, strait ports, etc. mostly represent shallow waters. Each year they are the vast majority of an accident in all. Neither Vistula Lagoon nor Szczecin Lagoon is specified separately, but they are probably included in the 'Bays and lagoons', where during four years as many as 65 sea accidents were registered.

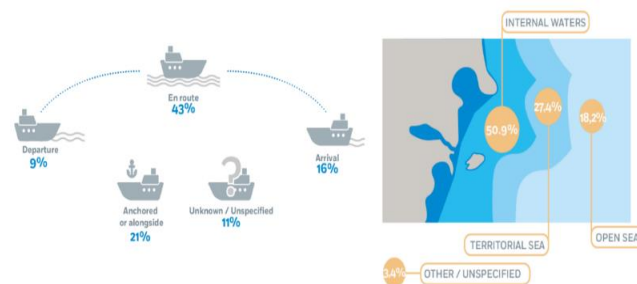


Figure 1. Distribution of voyage segments and location of occurrences. Source: European Maritime Safety Agency, Annual Overview of Marine Casualties and Incidents 2020

The concept of MoB MEDS the Mobile Base of Maritime Emergency Diving Services is to operate in such areas (especially those inaccessible to other rescue vessels with greater draft). Figure 1. shows that in Europe more than a half of the maritime accidents occur in internal waters, and even 27.4% of them occur in the territorial sea (belt of coastal waters extending at most 12 nautical miles from the baseline of a coastal state [12]).

The subcategory of port and coastal waters accounts for 46% of cases (summing up departures, arrivals and anchored or alongside vessels). As many as 43% of accidents occur in route, so assistance often doesn't reach the ship on time.

Table 3. Cause of accident

Location of accident	2016	2017	2018	2019
Error in navigation or manoeuvring	90	114	66	73
Loss of control	29	45	35	38
Damages of appliances	5	5	4	12
Short circuit, fire, setting fire by accidents	6	10	11	6
Bad weather conditions	4	8	12	5
Hull leakage	2	6	5	8
Mechanical defects	12	16	3	7
Immobilization by fishing net	23	28	16	17

Source: Statistical Yearbook of Maritime Economy 2020, Data by the State Maritime Accident Investigation Commission, December 2020.

Table 3. provides different causes of accidents. Between 2016 and 2019 in Poland there were 343 accidents caused by an error in navigation or manoeuvring, 147 losses of control, 84 cases of immobilization by the fishing net and 21 hull leakage. It may be assumed that a significant part of the reported marine accidents analysed here could require underwater inspection by specialized divers. Almost every case of those listed in Table 3. can develop into series of consecutive events: loss of control of the vessel, contact with the bottom, and eventually hull and propeller damage. Some of these

scenarios also end with oil spillage and ship loss. Detailed reports of SMAIC provide such examples.

Table 4. shows data on oil pollution clean-up operations in particular years by the Polish Maritime Search and Rescue Service. SAR vessels, similarly to the ambulance service, are dedicated to saving lives, but not necessarily to salvage property. There is nothing more valuable than human life, but very often those abandoned, damaged ships sink with their fuel or dangerous cargo onboard and they became a serious threat to the environment. In many cases, an immediate repair could prevent further, larger spills, which leads directly to significant reductions of further environmental protection costs.

Outlays may exceed several thousands of dollars per ton of spill clean-up. In estimating such cost, it is important to take into account independent variables (spill size, season, oil type, time for a spill to reach shore), which may significantly increase it [3, 5].

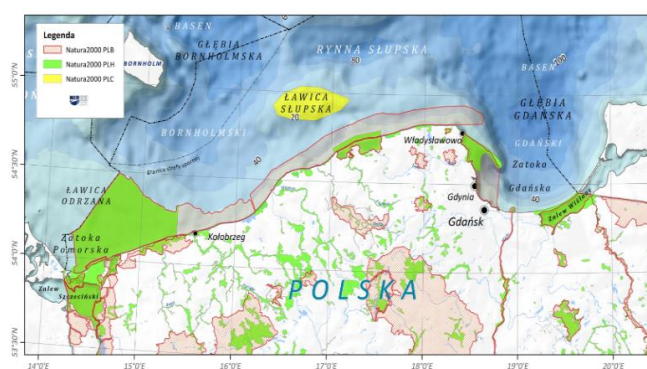


Figure 2. Natura 2000 areas in the Pomerania. Source: National Marine Fisheries Research Institute MIR, 2017.

The Mobile Base of the Marine Emergency Diving Service MoB MEDS in addition to underwater work can also deal with oil spill prevention. After preventing the area from further spread of the spill, specialized divers would be able to repair the hull. In the case of a spill, there is often the matter of dealing with huge amounts of oil – one of the largest was as much as 287 thousand tonnes of oil spilled into the sea about 18 Nm from the coast of Tobago, after the ‘Atlantic Empress’ collision in 1979. Despite the relative increase of the safety level, the list of major oil spills [4] also includes accident from 2018 – oil tanker ‘Sanchi’ collision led to a 113,000 tonnes oil spill.

Table 4. Hazardous incidents and pollution fought by the maritime search and rescue service SAR

Year	Port	Number of incidents with pollutants	Pollutant	Amount of chemicals removed, in tonnes m ³
2016	Gdynia	1	petroleum – derived substances	-
	Krynica Morska	1	petroleum – derived substances	-
	Świnoujście	3	petroleum – derived substances	14,5
2017	Gdynia	1	oil-like substances	37,0
	Świnoujście	2	oil-like substances	2,0
2018	Darłowo	1	oily waters	-
	Gdynia	1	oily waters	-
	Świnoujście	1	oily waters	0,2
2019	Kamień Pomorski	1	spill from a ship	-
	Łeba	1	oily spill	-

Source: Statistical Yearbook of Maritime Economy 2020, Data of the Polish Maritime Search and Rescue Service, Gdynia, December 2020.

Even though there were no accidents on such scale in Polish waters, the possibility of their occurrence in the future should not be dismissed. In cases of such massive spills, most countries are not prepared to react appropriately to mitigate the consequences. It is also worth taking into account the fact that a significant part of Polish coastal waters is under the special legal protection of Natura 2000. Every marine accident potentially means an oil spill that can cause serious consequences to the ecosystem of the ‘marine environment. Such areas include the Vistula Lagoon, the Gulf of Gdańsk, the Vistula estuary, Orłowo Cliffs and rock reefs, the Bay of Puck, the Słupsk Lagoon, the Szczecin Lagoon, the Oder estuary and coastal waters of the Baltic Sea.

3 ANALYSIS OF TRAFFIC AND PLANNED MARITIME INVESTMENTS IN THE CONTEXT OF SAFETY LEVEL

The intensity of coastal traffic directly affects the safety of navigation. Busy ports such as Singapore or Rotterdam need to have highly developed navigational infrastructure (numerous fairways, emergency anchorages, VTS support, TSS) and logistics that enable efficient and safe transshipment operations. As shown earlier, a significant number of accidents occur in port waters, so the readiness of specialized rescue units is also an important aspect.

The number of arriving ships and transhipped cargo in Poland is continuously growing. Among 20800 vessels that arrived in 2019, 2468 of them were tankers, which should be considered as a potential risk of massive oil/chemical spill [10].

Table 5. Cargo traffic in seaports by category (loaded and unloaded cargo in thousand tons)

Year	Liquefied gas	Crude oil	Oil products	Other liquid bulk
2016	1010,7	9986,5	775,5	1327,4
2017	1650,5	11186,7	7131,5	1381,8
2018	2414,0	13085,3	7019,4	1280,4
2019	3050,3	15660,5	6447,6	1672,8

Source: Statistical Yearbook of Maritime Economy 2020.

Transshipment of liquefied gases has increased 3 times, crude oil 1,5 times in 2016-2019 period. Cargo traffic is increasing and will continue to increase - further planned investments will develop the maritime economy. These include, but are not limited to:

- Central Port in Gdańsk – the project of the development of the next deep-water part of the port in the direction of the Gdańsk Bay including the construction of several different terminals: ro-ro, chemical, LNG, cereal, passenger and cruise terminals (approximately 410 ha). The first terminals may be ready as soon as 2029. [6]
- Outer Port in Gdynia – the project involves the construction of a new port pier that will include a container terminal, the new quays will be able to handle the largest vessels that can enter the Baltic Sea (LOA ≈ 400m and draft up to 16m). The estimated annual handling capacity of the terminal is 2.5 million TEU. Planned completion of construction and equipping of the Outer Port is 2028 [7]
- Świnoujście LNG terminal expansion – the terminal has been in operation since 2016, but the owner already has further development plans including: additional regasification installation, third LNG process storage tank, LNG-to-Rail transshipment installation and the second jetty for loading/unloading of LNG carriers and bunker vessels.
- FSRU terminal at the Port of Gdańsk – in September 2020 representatives of GAZ-SYSTEM, the Port of Gdańsk and the Maritime Office in Gdynia signed a letter of intent regarding cooperation in the construction of a floating storage and regasification unit. This project will undoubtedly have an impact on the development of this cargo traffic in the region.
- Offshore wind farms – in January 2021 the concept already received legal support – President of Poland has signed the Offshore Act into law, which regulates the development of 10.9 GW wind farms in the Baltic Sea. The investment will be operational or under development by 2027.
- Crosscut of the Vistula Spit – due to the specifics of the basin and justifiable demand for using the discussed boat in the lagoon, the investment is discussed below in more detail.
- Investment of crosscutting the Vistula Spit has started in 2019, but this idea has been considered for a long time in terms of various economic and environmental aspects.

The project includes the construction of a sheltering harbour on the side of the Gulf of Gdańsk, construction of a channel with locks, a new road system with movable steel bridges with a vertical axis of rotation, which will allow passage over the channel in front of the lock and behind the lock; construction of an artificial island on the Vistula Lagoon.

The investment seems to be important for many reasons. One of the most significant is that it will shorten the water route to inland ports such as Elbląg, Tolkmicko, Frombork and it will separate the economic aspects from the political one [8, 9]. Planned and currently conducted crosscut and dredging of the fairways will make it possible to increase the economic activity of the communes, in

particular the development of trade and tourism. It will enable vessels with draft up to 4m, length 100m and width 20m to enter the port of Elbląg.

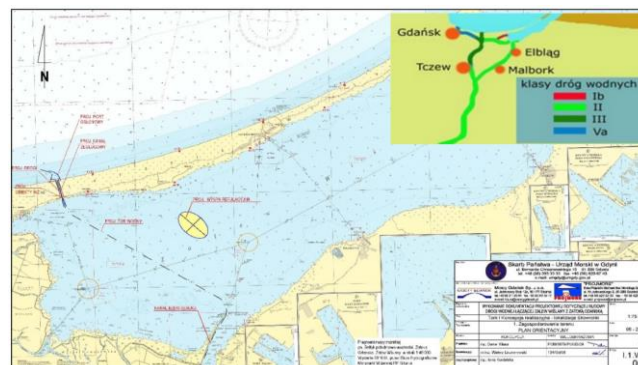


Figure 3. Map from project documentation of connecting Vistula Lagoon with Gdańsk Bay and Elbląg Canal. Source: Maritime Office in Gdynia, Internal materials

In the Vistula Delta and on the Vistula Lagoon the main obstacle to navigation is depth limitation, air draft under obstacles (bridges, power lines) and for larger vessels also width of the fairway [Rutkowski, 2010 & 2020]. Despite planned dredging of the fairway to the port of Elbląg, the remaining part of the lagoon will still be inaccessible for vessels with a draught of over 4 m. After the completion of the investment, the traffic is expected to increase, however, many rescue vessels that secure underwater works and prevent from oil spills will not be able to enter the Lagoon due to mentioned limitations.

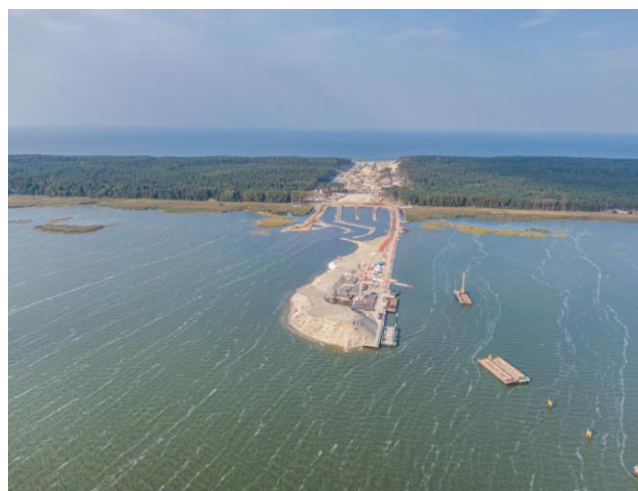


Figure 4. Work in progress in October 2020. Source: NDI Group (one of the contractors of the investment) report, October 2020

The greatest threats associated with oil and chemical spills always affect the fishing industry, tourism, water resources used for both industrial and sanitary purposes and as a source of drinking water. It is also worth mentioning that the Vistula Lagoon is under the legal protection of 'Natura 2000'. The best way to combat hazards, including those caused by oil and chemical spills, is to prevent them.

Effective measures which should be taken may include improving maritime pilotage techniques, training ships' crews and shore-based personnel involved in transshipment operations, stricter enforcement of regulations on pollution of the marine

environment, and also above all - preparing for possible spills through regular drills and presence of specialist vessels. Such units undoubtedly include SAR maritime rescue vessels, but also commercial units such as the Mobile Base of the Marine Emergency Diving Service Mob MEDS.

Taking into consideration the expected significant increase in cargo transportation in the coming years it seems reasonable to have such boats, which would enable divers to quickly reach ships in case of emergency situation.

4 CONCLUSIONS

The statistics on maritime accidents described earlier may be disturbing. In the vicinity of the Polish waters there are already large plants or dangerous areas such as the Gdańsk Refinery, the Oil Port in Gdańsk, Świnoujście LNG terminal and numerous smaller bunker stations located in different harbours. Traffic intensity, as shown earlier, is constantly increasing and will probably increase even more after completing investments or plans such as crosscut of the Vistula Spit, a new waterway connecting the Gulf of Gdańsk with a port of Elbląg, Central Port expansion, an outer seaport in Gdynia, FSRU terminal, offshore wind farms and Świnoujście LNG terminal expansion. Therefore, it can be assumed that the occurrence of any maritime accident involving a ship carrying petroleum products, liquified gases or dangerous cargo in containers may be incalculable in its consequences and long-term effects.

Conducted research also showed that many of the analysed accidents could have been avoided or reduced in effects if required assistance had arrived earlier. It is also worth mentioning that regardless of the region of the world, from where information on accidents were collected, a significant number of them took place in internal and coastal waters limited by the depth and width of the area, where larger vessels, including specialist SAR Maritime Search & Rescue units could not reach or where reaching them required a long sea voyage from another area.

Many ships have to stay for a long time waiting for assistance or have to be towed to the place where they can get such assistance. It always leads to a significant increase in the risk of such operations, deterioration of the ship's emergency situation and the possibility of an uncontrolled spill of fuel or other toxic substances. From this point of view, the need for other specialized vessels such as MoB MEDS, which

is the Mobile Base of Marine Emergency Diving Service, operating in shallow coastal and inland waters also seems justified.

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The Scientific Underwater Research Association SeaQuest was reactivated in December 2020. From the very beginning (since December 2020) the SeaQuest members via Gdynia Maritime University in cooperation with PC Divers have been actively involved in research activities participating in conceptual research and development studies on market analysis for MoB MEDS boat being the Mobile Base of Marine Emergency Diving Service.

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