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DEPARTMENT OF NAVIGATION

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Results of Navigational Average of a Unit in Passenger Transborder Shipping

The article presents passenger transborder shipping with particular respect to the port of Świnoujście. The possibility of navigational average occurrence has been analysed for units handling transborder inshore traffic, passenger evacuation when the average occurs and actions to be undertaken in order to shorten evacuation time to a minimum and minimise consequences of the average.

Skutki wystąpienia awarii nawigacyjnej jednostki w pasażerskiej żegludze transgranicznej

W artykule przedstawiono pasażerską żeglugę transgraniczną ze szczególnym uwzględnieniem portu Świnoujście. Przeanalizowano możliwość wystąpienia awarii nawigacyjnej jednostek obsługujących transgraniczny ruch przybrzeżny, ewakuacji z nich pasażerów w momencie wystąpienia takiej awarii oraz działania, jakie należy podjąć, aby skrócić do minimum czas ewakuacji i zminimalizować jej skutki.

Introduction

Vessel passenger transport can be divided into numerous groups. This division can be defined according to the needs of potential consumers. These needs can be divided into four basic groups:

- carriage service, that is transport from one place to another,
- tourist traffic,
- excursion voyages,
- package offers – sea voyage offers, organised rest on land.

Excursion voyages include among others transport carried out by so-called white-fleet units. The term „white fleet" denotes small passenger craft employed in domestic and foreign short-range transport. This transport can be divided into two groups [2]:

- sightseeing tours,
- shopping trips, aimed at doing shopping free-duty vessels; so-called „mini-shopping".

These voyages concern the region up to 250 km around Szczecin and the Three-City region (Gdańsk-Gdynia-Sopot). As far as 'mini-shopping'is concerned, trips of this kind take place in the region of the Szczecin Lagoon and the mouth of the river Odra in relation to Germany, and in relation to Russian ports in the area of the Wiślany Lagoon. This kind of transport is very popular among tourists and people inhabiting the region.

The following Polish ports can be counted among those that handle passenger transport: Świnoujście, Szczecin, Nowe Warpno, Dziwnów, Kołobrzeg, Gdynię, Gdańsk, Elbląg.

Table 1. shows passenger transport in particular ports in 1996–2000 [11].

Analysis of Table 1 reveals that most passengers are handled in the ports of Świnoujście and Nowe Warpno. This is bound with the large number of links handled by white fleet units with duty-free shops on them. Fig. 1 depicts a considerable increase in the number of passengers handled by these ports. In 2000 the increase was by 29,7% in the port of Świnoujście, and by 77,5% at Nowe Warpno.

Along with a high number of connections there also increases the threat of a serious navigational average involving a passenger unit operating transborder traffic, which is likely to cause a mass accident.

Table 1

Passenger transport in Polish ports 1996–2000

Ports	1996	1997	1998	1999	2000
Gdańsk	97 123	124 544	119 192	121 774	141 700
Gdynia	139 188	182 904	179 129	241 415	264 500
Szczecin	48 057	51 093	85 317	0	0
Świnoujście	868 543	1 136 093	1 181 970	1 698 806	2 203 400
Nowe Warpno	241 722	719 319	823 298	1 040 470	1 846 800
Kołobrzeg	0	312	0	3653	1600
Elbląg	6397	6127	5142	4964	3100
Ustka	–	–	–	5582	3800

Source: Materials of the Szczecin Statistical Office. Centre of Maritime Statistics. Urzędu Statystycznego w Szczecinie. Szczecin 2001.

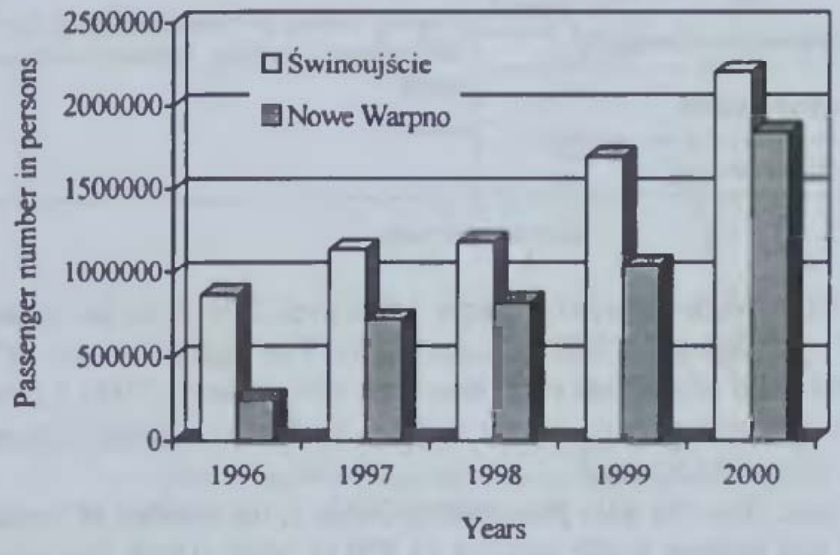

Fig.1. Passenger transport in the ports of Świnoujście and Nowe Warpno in 1996–2000

The port of Świnoujście as a passenger port

The port of Świnoujście is an important knot of passenger shipping. It handles both passenger units in deep-sea shipping (ferries), and units in inshore sea

traffic [2]. After the liquidation on 1st July 1999 of free-duty sale in relations of European-Union member states the attractiveness of inshore traffic to and from Świnoujście has considerably increased; this concerns links to Germany in particular.

Figure 2 presents a diagram of existing passenger connections.

Table 2 brings together lines operated by units calling at the port of Świnoujście.

Table 2

Lines operated by units calling at the port of Świnoujście

Line	Kind of unit operating the line
Świnoujście–Ystad	Seagoing ferries
Świnoujście–Malmo	
Świnoujście–Kopenhaga	
Świnoujście–Ronne (Bornholm)	
Świnoujście–Ahlbeck	Units of Polish, German, Dutch and Danish shipowners operating inshore transborder traffic
Świnoujście–Heringsdorf–Bansin	
Zinnowitz–Świnoujście–Kamminke	
Świnoujście–Saβnitz	
Świnoujście–Uckermunde	

Source: own study

It follows from the data placed in Table 1 that over 50% of all the passenger traffic handled by Polish ports falls to Świnoujście. The highest density of lines handled by ferries and white-fleet excursion craft occurs there. Table 3 presents the traffic of sailing units plying on the fairway in the river Świna region and ferry crossings across the Świna.

As can be seen from the data presented in Table 3, the number of passenger units in inland and inshore traffic totalled 14 470 in 2000, which means an increase by 31% in relation to 1999. Assuming that units of this type sailed throughout the year, this means that they made 40 voyages a day (Świnoujście – German ports or German ports – Świnoujście). Apart from this, considering that the voyages generally take place between 08.00-18.00 hrs and taking into account seasonal irregularity (more voyages in summer), the traffic intensity of these units can reach 6 units per hour, that is about 60 units daily in the summer season [6].

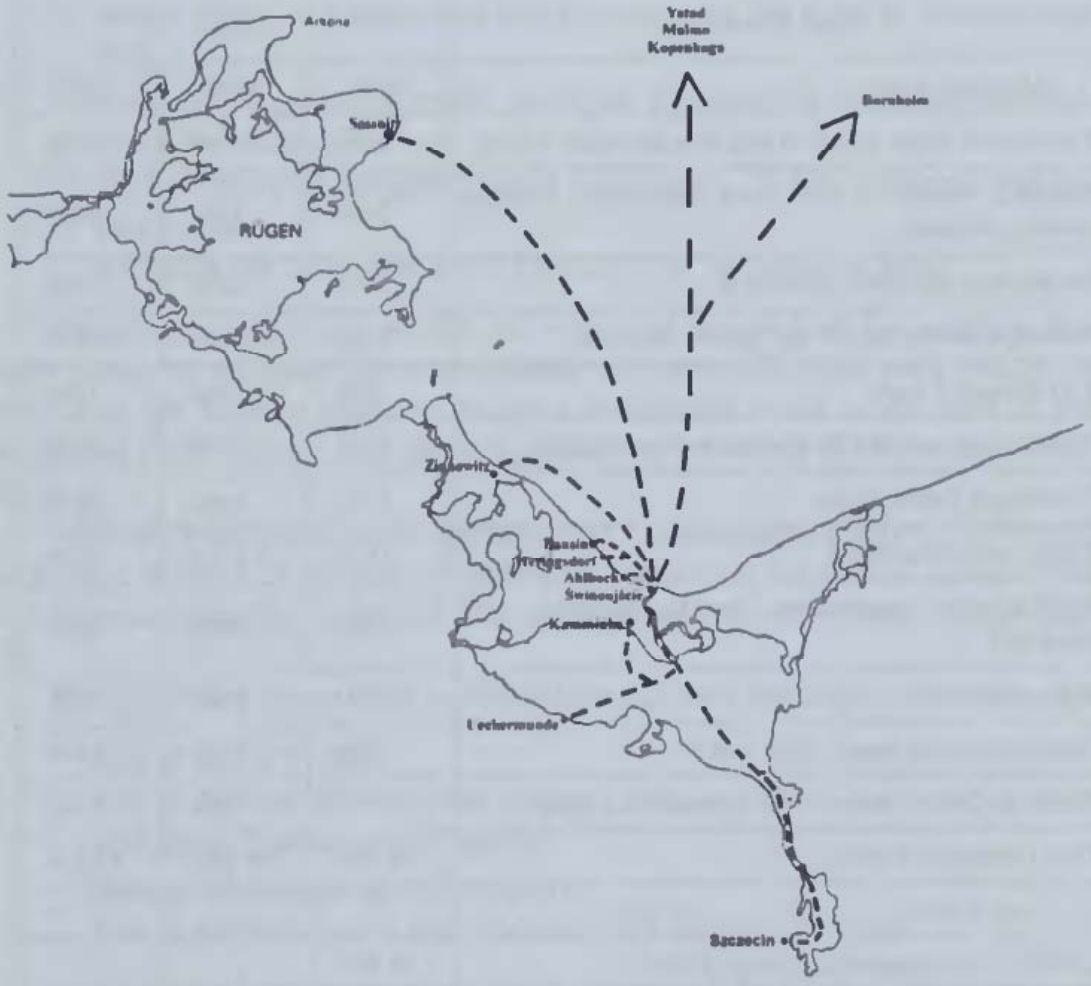

Fig.2. Diagram of passenger lines of Świnoujście port
Source: own study

The ships moor to Władysław IV Quay and PortHol's Quay. They moored to Odratrans Quay to September 2001. These quays, similar as Odratrans Quay, there aren't adapt to correct and safety service of passengers. Their improvisation can be reason of navigational accident and collision.

Table 3

Traffic of units sailing on the fairway in the Świna region and ferry crossings across the Świna

Kind of traffic	Lata		
Alongside traffic	1995	1999	2000
Commercial ships, transit to and from Szczecin, Police	8500	7250	6890
Seagoing vessels to and from Świnoujście (fishing vessels included)	2400	1154	1092
Sea ferries to and from Świnoujście	3400	3836	3882
Passenger fleet in inland and inshore shipping	5126	11 040	14 470
Port excursion craft	489	1500	1500
Difficult-tow sets and barges with own propulsion	5236	1579	2038
Cutters and fishing boats	3290	5566	6818
Yachts and motor-boats	3500	1712	6818
Service tugs (manoeuvres, towing, assisting, ice-breaking)	6500	6500	6000
Men-of-war	1500	1000	1000
Other units (pilot boats, other craft)	8450	8500	8500
Transit to German ports of the Szczeciński Lagoon	–	252	148
Total (alongside traffic)	**48 391**	**49 889**	**52 338**
Cross traffic			
„Wolin" – type passenger – cargo ferries	49 640		
„Fafik" – type passenger ferries	27 010		
„Karsibór" cargo ferries	27 740	26 280	26 280
„Bielik" – type passenger-cargo ferries		59 860	49 640
Separated from alongside traffic	7475	7500	7500
Total (cross traffic)	**111 865**	**93 640**	**83 420**
Total	**160 256**	**143 529**	**135 758**

Source: Materials of Harbour Master Świnoujście, 2001.

Possibility of navigational average occurrence in the water area of Świnoujście port

The water area of Świnoujście port is characterised by features making it different from other ports. The main causes of this are [6]:

- transit traffic of commercial ships to and from the ports at Szczecin and Police,
- large variety of local traffic subjected to alongside traffic on the Świnoujście-Szczecin fairway,
- total intensity of alongside traffic reaching ca. 52,000 entrances and exits per year,
- traffic on the Municipal Ferry Crossing (ca. 50.000 ferry trips).

There are two regions within the waters of the port of Świnoujście that draw particular attention due to remarkably intense traffic. One such area is the section of the fairway from the entrance breakwater heads to the area of the Municipal Ferry Service. The other region is located within the Municipal Ferry Service.

With such big traffic on the fairway (135,758 passages of units in 2000) and such large number of voyages of units plying between the port of Świnoujście and German ports the likelihood of a serious navigational average is very high [3].

Navigational average is an undesirable occurrence leading to losses like [4]:

- loss of life or health,
- loss or damage of vessel and cargo,
- pollution of natural environment,
- damage of hydrotechnical structure,
- loss of potential profit due to blocking of the port or its part.

In the case of passenger ships especially loss of health and life of passengers and the crew has to be taken account of. The size of these losses depends on numerous factors, the following being the most important [7]:

- number of people on board,
- average site,
- hydrometeorological conditions,
- state and organisation of rescue services,
- age of passengers (children, elderly people),
- quantity, kind, and availability of rescue means,
- kind of damage to the vessel,

- training of the crew,
- passenger training regarding the distribution and location of rescue means and ways of using them.

The majority of passengers have no knowledge about acting in the case of threat to life on the vessel and are in the dark as to where the rescue means are and how to use them, which makes the conduct of an efficient rescue action considerably more difficult.

For these reasons, the losses can be very high in the case of navigational average of a passenger vessel in sea inshore traffic. Moreover, the results of such average will be augmented by the fact that from 200 to 800 persons can be staying on board at the same time, a significant number of children and elderly people included [3].

Literature on the subject provides information on sea accidents within the limits of ports, outer ports, in roads or in the maritime adjacent area. The disaster of the fishing cutter „Brda" in the port of Hantsholm in 1975 can serve as an example, where 11 fishermen lost their lives; or the smashing of the yacht „Centaur" against the heads of Władysławowo port, where two sailors lost their lives, and others were rescued with difficulty [1]. We can also adduce here the similar accidents of s/y „Warszawska Nike" and s/y „Cousteau" in 1993, s/y „Rybitwa" in 1995 and the collision of the tug „Argus" with the m/s „Uniwersytet Jagielloński" in 1998.

As far as the accident of cutter „Brda" and the yacht „Centaur" is concerned, in both cases were smashed against breakwater starblocks in immediate distance from the port quays [1]. Unfortunately, because of unfavourable weather conditions and the occurrence of surf waves it was impossible to reach the drowning people without using rescue helicopters.

The disaster of the British passenger-car ferry „Herald of Free Enterprise" on 8th March 1987 should be recalled here, which after leaving the Belgian port Zeebrugge on the North Sea after passing the port heads capsized to port. 190 lives were lost as a result of this tragedy in spite of immediate rescue action having been undertaken; very cold water considerably contributed to such high personal losses [12].

The most typical cases of navigational average in inshore vessel traffic are [9]:

- the vessel striking a shore element, embracing:
  - running aground,
  - collision with a hydrotechnical structure,
- collision with another unit.

Both cases are important, it follows from the analysis of accidents [7] that

average of the former kind occurs more frequently.

Analysing the causes of the unit's hitting the shore one can state that human factor is responsible in 85% of cases [8].

Navigational average consisting in the vessel striking a shore element (shoal, hydrotechnical structure) may occur along the vessel's route on the fairway. On analysing research conducted in the world [7] the conclusion may be drawn that the location of making a turn by the unit the water area part with increased probability of average.

It was found out that the frequency of averages during making a turn due to human factor totals $2 \cdot 10^{-4}$. Some sources even give higher values for the average of running aground, caused by manoeuvring errors (even up to $1 \cdot 10^{-3}$). Yet these values pertain to the total number of averages without specifying human errors. This is why average probability $2 \cdot 10^{-4}$ accepted by IMTA (International Marine Transit Association) will be assumed for further considerations [7].

Hence, probability of average p_A in one voyage is equal to:

$$p_A = 2 \cdot 10^{-4}$$

Considering a definite number of voyages the total probability of average occurrence increases with the number of voyages [5] according to the dependence:

$$P_A = 1-(1-p_A)^N$$

where:

P_A – total probability of average occurrence for N voyages
p_A – average probability in one voyage
N – number of voyages

As follows from Table 3, the traffic intensity of units increases from year to year. The difference between 1999 and 2000 was over 3,000 units. Assuming that this growth remains in the next few years, the following values are obtained by the application of the formula given, presented in Table 3.

The results presented in Table 3 show beyond doubt that average probability approaches 1. This means the possibility of average occurrence very soon.

The probability is quite real, exemplified by the May 2001 – accident, when the free-duty vessel m/s „Rosa Weneda" ran aground in the Szczecin Lagoon. Fortunately, no threat to life and health of passengers occurred; rescue action was undertaken and after **three hours** 109 passengers were taken over by units of Polish Vessel Rescue.

Table 3

Probability of navigational average
of inshore passenger shipping units entering Świnoujście

Year	Number of voyages	Probability of averages
1995	8526	0.818295
1999	14 876	0.948978
2000	18 352	0.974543
2001	21 352	0.986030
2002	24 352	0.992333
2003	27 352	0.995793

Source: own research

Consequences of the average

In cases of serious average, likely to cause sinking of the unit, it is a priority task of the captain and the crew to evacuate from the unit in the shortest possible time of the largest possible number of passengers. In the case of passenger units that are operated at present their sinking time will be much shorter than in the case of larger units that succumb to the same average. Passenger evacuation should take place in the shortest possible time [2].

In that time all passengers

- must be informed about the average,
- must betake themselves to the locations with personal rescue means like lifebelts, rescue overalls etc.,
- put on rescue means
- get evacuated to the rescue units or other rescue centres.

All vessels operating the transborder inshore traffic certainly have the right certificates that confirm their fulfilment of safety requirements. In all probability they are not sufficient to ensure safety to all persons present on the unit in the case of serious average.

SOLAS 74 Convention [10] allows 30 minutes for leaving the vessel. This time is unrealistic in practice, mainly because of the following [2]:

- in the case of such small units the sinking time may be much shorter,
- it is real only when the passengers have been trained before, not when

they have not undergone such training,
- it is highly probable that panic arises on the unit, impossible to be mastered by a small crew,
- a high percentage of passengers is constituted by elderly people and children, who must be helped to put on the rescue means,
- crew members are not always properly trained to prevent the danger and then act in the right way when it does occur.

As can be seen from remarks mentioned in many cases it is not possible even within 30 minutes to help all people on the vessel to put on rescue means and next evacuate them to the rescue units. The time is also too short for the rescue units to reach the sinking vessel on time and take over the people there after receiving the alarm signal. Losses like loss of life must be taken into account.

Figure 3 presents a diagram of passenger evacuation showing tracks to reach the rescue means, like lifebelts. No detailed analysis is necessary to prove that that the system, in the case of serious average, does not ensure that all the passengers will reach the rescue means in a sufficiently short time. Assuming that the time to put on the lifebelt is 30 seconds and that half the passengers are able to do it, then with 600 passengers aboard evacuation time will total about 40 minutes.

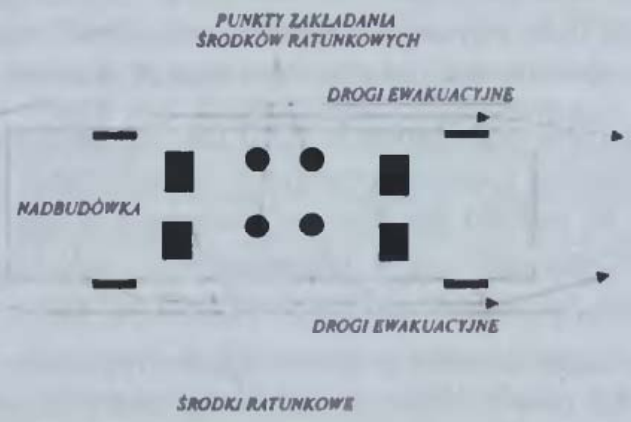

Fig. 3. Example of a passenger evacuation diagram.
Source: own study

Consideration must also be paid to the season and weather conditions in which the average takes place. In the winter period hypothermia is a particular threat due to low water temperature and losses may occur in very short time.

In the case of mass accident, in order to evacuate the threatened people, what is required is a planned rescue action aimed at reaching high efficiency measured by the number of survivors taken over in a time unit [1]. In the case of

a close-to-port area, which creates very complex hydrometeorological conditions due to direction and speed disturbances of the surface wind and sea current, and also the battering of waves occurring in the area, the evacuation of passengers can be very difficult. In a case like this rescue helicopters should be used apart from water units and technical means of shore rescue stations. The distribution of rescue air forces is the cause why the rescue tasks will be conducted from Darłówko airport (158 km away) only after 60 minutes from reporting the accident, and from the airport at Babie Doły [1] (280 km away) only after 95 minutes.

Summary

- The considerations carried out in the paper provide grounds for the statement that a serious average of a passenger unit in inshore traffic has to be taken account of. The probability of average P_A= 0.97 (for a one-year period) indicates that the matter is serious. In addition, the results of such average will be augmented by the fact that there up to 600 persons aboard with a high percentage of children and elderly people.
- In the case of serious average resulting in the sinking of the unit it will be a priority task of the master and the crew to evacuate the largest possible number of passengers from the unit in the shortest possible time. In the case of units currently operated in transborder inshore shipping, passenger evacuation must take no more than 30 minutes.
- Although these units probably fulfil the requirements of regulations in force respecting technical conditions and equipment with rescue means, it should be realised that they are inadequate in case of serious navigational average; hence, it is indispensable to undertake proper measures to minimise the number and results of such averages.
- Maritime administration ought to tighten requirements and control of units of this type lest there should be repeated a situation like the one of February 2001 when an inspection on a German unit it was found out that there were rescue means without current certificate.
- Shipowners of units ought to work out instructions of passenger evacuation from the unit. This should embrace problems of perfect crew training, passenger evacuation tracks and access to rescue means. They also ought to see to increasing the safety of units, so that passengers can stay aboard as long as possible (which concerns mainly the winter period) and the rescue units have ample time to reach the damaged vessel and take over the passengers.

- Account must be taken of the fact that the rescue services prepared to evacuate small groups of people from the damaged units in the shortest possible time will never be properly prepared for mass accidents.
- In the case of mass accidents rescue actions ought to embrace evacuation by water, land and air rescue means.

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