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Shipping Safety Management on Polish Inland Waterways

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ABSTRACT

Over the past years, the role of inland waterway transport has increased compared to other modes of transport. The increasing intensity of the inland vessel traffic significantly affects the safety of navigation. The article analyses the main causes of accidents and incidents that occurred on the Odra Waterway and Lower Vistula. The authors have classified those accidents and suggested possible directions for the development of inland waterway management in order to improve its efficiency. Navigationally critical areas in the lower section of the rivers Odra and Vistula have been indicated. These areas should be taken into account in long-term planning of the inland shipping development to ensure transport safety.

KEYWORDS: inland shipping, transport, safety

1. Introduction

Human existence has been associated with water since time immemorial. We draw from its flora, fauna and minerals hidden in the seabed or ocean floor. Each watercraft poses a threat to the marine or inland environment, and vice versa: the environment may create risks to the vessel. The ship route encounters different weather conditions, which to a varying extent affect its safety.

Today, the exploitation of rivers mainly involves the need to comprehensively protect the natural environment and the cultural and historical heritage in riverside areas. Despite the development of safety systems, high-tech navigational equipment, constant training of shipboard personnel, ships still suffer damage from accidents.

Many factors contribute to inland waterway accidents resulting in casualties. These include improper technical condition of the ship or operational management, insufficient personnel qualifications and difficult hydro-meteorological conditions. To enhance safety standards, many countries maintain a register of marine and inland accidents. The data collected in such a register are used for research which includes a detailed risk analysis for the assessment of navigational safety.

2. The operation of the River Information System as an element supporting the inland waterway navigation safety in the Lower Odra River

The obligation to implement River Information System (RIS) includes all inland waterways of international importance and the ports along the waterways which are linked with other waterways of the same standard, i.e. starting from class IV waterway as per the classification of the United Nations Economic Commission for Europe (UN/ECE). The provisions of the RIS Directive, at Member States' discretion, may also be used on inland waterways not covered by this requirement. Requirements and technical specifications for the harmonised river information system, as defined under the RIS Directive, are not mandatory, but recommended in case of the national inland waterways of RIS related requirement, if they are not connected with a network of another Member State. In Poland, most waterways have operating parameters of regional importance. Only less than 6% of their length meets the requirements of inland waterways of international importance (parameters of class IV and higher), i.e. where RIS Directive is to be implemented. These are [1]:

- Lake Dąbie to the border with marine internal waters - 9.5 km,
- The River Odra from Ognica (village) to Przekop Klucz-Ustowo (canal) and further as the Regalica River to its mouth at Lake Dąbie - 44.6 km,
- The River Odra Zachodnia, which includes:
- from the weir in Widuchowa town to the border with marine internal waters along with the side branches - 36.6 km,
- Przekop Klucz-Ustowo, a canal linking the river Odra Wschodnia
- with Odra Zachodnia - 2.7 km.
- River Parnica and Przekop Parnicki from the Odra Zachodnia to the marine internal waters border - 6.9 km.

Therefore, the obligation to implement RIS applies to the lower section of the Odra from Ognica to Szczecin, including Odra Wschodnia, Odra Zachodnia, Dąbie lake and the other waterways of Szczecin waterway junction. The total length of these waterways is 97.3 km. All sections have the parameters of international importance and are linked to each other. The requirement to develop technical specifications for European river information system stems from the necessity to build a harmonised, interoperable and open information system, available without discrimination for all providers and users of the system. For safety reasons, it was assumed that the requirements and technical specifications would be based on the accomplishments in this field by relevant international organisations, such as:

- World Association for Waterborne Transport Infrastructure (PIANC),
- Central Commission for the Navigation of the Rhine (CCNR),
- United Nations Economic Commission for Europe (UNECE).

The framework structure of a harmonised river information system should enable operators and system users to achieve their goals by accomplishing a range of tasks in inland fleet management, based on collected and transmitted data that make up a given service [1]. The River Information System operates within Szczecin Waterway Junction and the waterways of Międzyodrze. The main purposes of the system are to support the shipping safety, develop inland navigation, protect the environment and use the existing navigational infrastructure.

The River Information System consists of four main components comprising receiving information from the environment, data transmission, processing the information gathered and the RIS users. Supervision over the shipping safety is ensured through monitoring and tracking of inland vessels moving in RIS-covered waters. Inland vessels are monitored and tracked by CCTV, radars, automatic identification system (AIS) and differential global positioning system (DGPS). Navigational messages sent to RIS users play an essential role too, informing them of navigational conditions, restrictions on waterways and prevailing hydro-meteorological conditions.

There are four groups of navigation messages for RIS users:

- FTM - fairway and traffic related messages,
- WRM - water related messages,
- WERM - weather related messages,
- ICEM - ice related messages.

Messages are available via the Internet service, an application accessed on the website of the Inland Waterway Shipping Office. Service users also have access to electronic navigational charts available through Inland ENC - Inland Electronic Navigation Chart [2].

2.1. Elements supporting the safety of inland navigation in the Lower Vistula area

The waterway in the Vistula Delta is not covered by traffic control, river information or automatic identification system. The data concerning the inland shipping fleet, vessel traffic, accidents and freight can be obtained from the Central Statistical Office and Regional Waterway Administration in Gdansk (based on lock operations data). It takes, however, a relatively long time to obtain the information. Given the currently use of the navigable route in the Vistula Delta, it seems that this method of obtaining data is sufficient. If vessel traffic intensity increases on this waterway, it will be necessary to introduce a system for continuous monitoring of vessel traffic in the area under consideration [3].

3. Accident statistics in the Lower Odra

According to the Regulation of the Minister of Infrastructure of 28 April 2003 on navigational regulations applicable to inland waterways, a navigational accident is an event associated with a vessel movement or stop that resulted in an injury of a person causing health problems or death, damage to property of substantial value or major failure as defined by environment protection regulations [4]. Each shipping accident is entered in an accident register, which is maintained by the Inland Waterway Shipping Office in Szczecin. The register records information with the following items: date and place of the accident, qualification (kind of) the accident, parties involved, consequences, extent of damage, persons to blame for the accident, final conclusions and number and date of the relevant decision. The article analyses data covering the period from 1990 to 2016. The total number of incidents that were reported and registered in those years is 160. The numbers of incidents in inland waterways managed by the Inland Waterway Shipping Office in Szczecin are shown in Fig. 1.

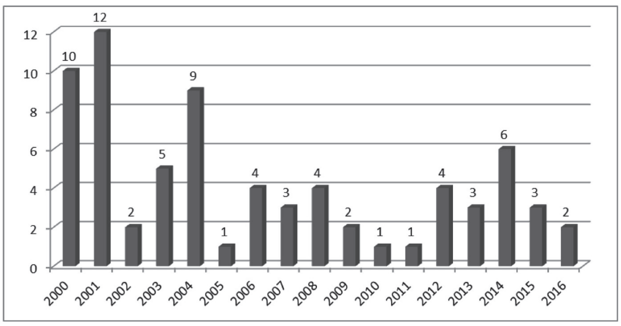

Fig. 1. The numbers of incidents between 2000 and 2016 in the areas managed by the Inland Waterway Shipping Office in Szczecin [own study based on 10]

According to the guidelines in the Journal of Laws (Dz. U.). 2002 No 17 item 161, the Act of 22 January 2001 on the detailed procedures in connection with accidents on inland waterways, such accidents can be divided into the following classes [5]:

- Class 1 - sinking of the ship,
- Class 2 - collision of vessels,
- Class 3 - event leading to death or damage to health,
- Class 4 - environmental pollution,
- Class 5 - damage to water engineering facility (including a bridge),
- Class 6 - damage to a vessel due to a collision with water hydro engineering facility (including aids to navigation),
- Class 7 - fire or explosion on the vessel,
- Class 8 - loss of cargo or equipment elements by a vessel,
- Class 9 - grounding.

97 accidents out of all the registered ones were analysed. The analysis excluded incidents in which only personnel suffered, not watercraft, such as a person falling overboard, robbery, assault or a person's death at work. Most accidents in 1990 - 2016 were those of class.

5 (28 collisions of an inland vessel with a bridge). With 23 events, ranking second, were collisions with other facilities (class 6). In the same period, 17 collisions with another watercraft took place (class 2), four collisions with a berthing structure and 10 entries into fishing gear. Fig. 2 presents the numbers of accidents in the Lower Odra with the breakdown by class.

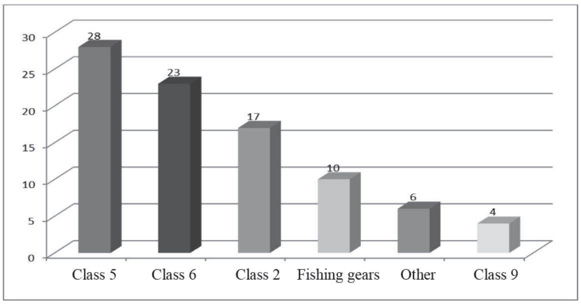

Fig. 2. The numbers of shipping accidents between 2000 and 2016 in the area managed by the Inland Waterway Shipping Office in Szczecin by class [own study based on 10]

The greatest number of events concerns vessel collisions with bridge structures (pier or span). The second largest number of accidents is collisions with other objects, which include fixed elements of navigable routes, such as dolphins, buoys, piers, etc. The category 'other' includes events, whose cause was not described for various reasons e.g. lack of witnesses, or bad weather was the major factor (e.g. strong wind pushing a barge into another vessel or a fixed / floating object). It is worth noting that 10 accidents involved vessels penetrating fishing nets. This type of event is not included in any accident class. The majority of class 5 accidents occurred in Szczecin. Structures that most often suffered from collisions were the bridges: railway bridge at the Central Train Station and Długi Bridge [6]. Fig. 3 presents the numbers of collisions with bridges in the Lower Odra stretch.

Human error is the most common cause of accidents. More than 90% of collisions resulted in blaming the ship crew member responsible for the collision. Causes of these errors naturally have various backgrounds. Regarding the watercraft passage under a bridge span, a collision is most frequently due to improper assessment of bridge clearance height and own ship's under keel clearance. This may result from incorrectly read messages on the updated level of navigable water or inaccurate readout of vessel's draft after loading or unloading. Other sources of human error are bad weather conditions. Strong crosswinds or fog may lead to incorrect manoeuvres, which result in ship's collision with a bridge or overpass [7].

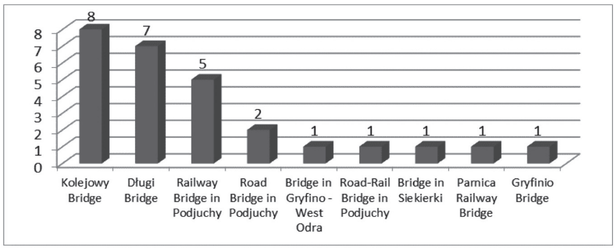

Fig. 3. The number of collisions with the bridges in the Lower Odra [own study based on 10]

3.1. Critical places in the Lower Odra and Szczecin Waterway Junction

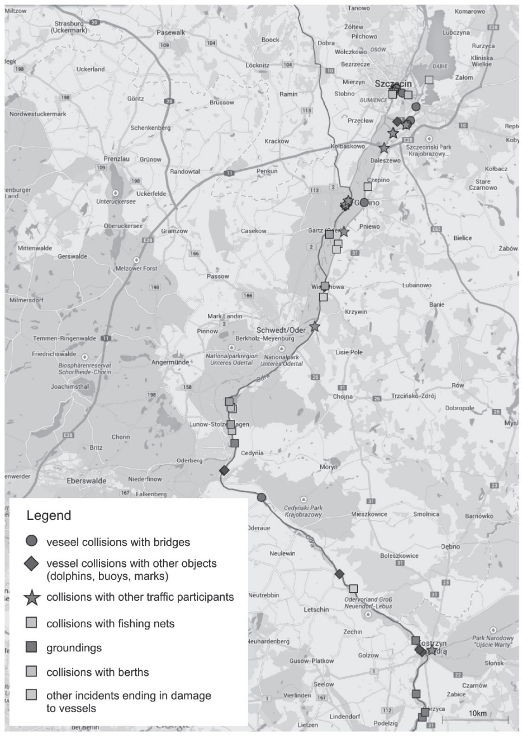

Fig. 4. Locations and types of incidents in the lower section of the river Odra in the years 1990 - 2016 [own study]

The Lower Odra sections feature spots where vessels are particularly vulnerable to a variety of dangerous situations. These are mainly waters around Szczecin Waterway Junction (with the densest vessel traffic, and several bridge structures). Taking into account the route intersections of strategic importance during transport within the city perimeter it is necessary to ensure safety at those areas. Fig. 4 illustrates the critical locations within the Lower Odra and Szczecin Waterway Junction.

4. Accident statistics in the Lower Vistula

Vessel traffic intensity in the area of the Lower Vistula is much lower compared to the Lower Odra. Consequently, the number of accidents occurring in that area is much smaller. The article analyses data covering the period from 1990 to 2016. The total number of incidents reported and registered in those years was 21. The numbers of accidents in inland waterways managed by the Inland Waterway Shipping Office in Gdańsk are shown in Fig. 5.

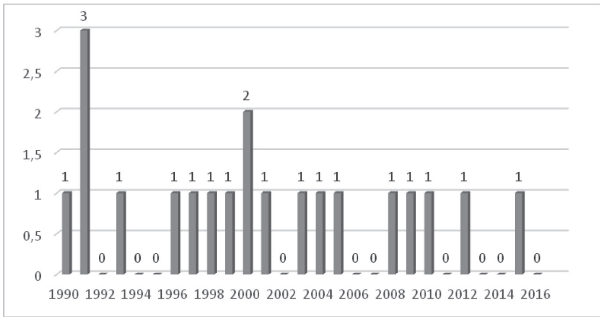

Fig. 5. The number of shipping accidents in the years 1990 - 2017 in the area managed by the Inland Waterway Shipping Office in Gdansk [own study based on 10]

Of all the recorded accidents, the analysis covered all accidents that occurred in 1990-2016. The accidents registered also included those where the identified cause necessitates the extension of previously established classification:

- Class 10 - Damage to a vessel due to a collision with an object located on the bottom (wrecks, remains of bridgework, anchors, steel structures, pipe lines, boulders, fishing nets, military objects, old historical buildings).
- Class 11 - Damage to a vessel by external factors (bridgework elements falling off),
- Class 12 - Collision with natural objects (floating logs, dead animals).

In the area under consideration, in the years 1990-2017 there were 12 accidents that resulted in the damage to hydro engineering structure. Other accidents that occurred with equal frequency of two per year included: vessel sinking, damage due to collision with a hydro engineering structure, damage due to collision with a natural object. Fig. 6 presents the numbers of accidents occurring on the Lower Vistula by class.

The most frequent events occurring in the Lower Vistula were those belonging to class 5. Collisions led to damage of such structures as road and road-rail bridges, pontoon bridges, locks and other technical buildings (not specified). The distribution of events by type of damaged object is shown in Fig. 7.

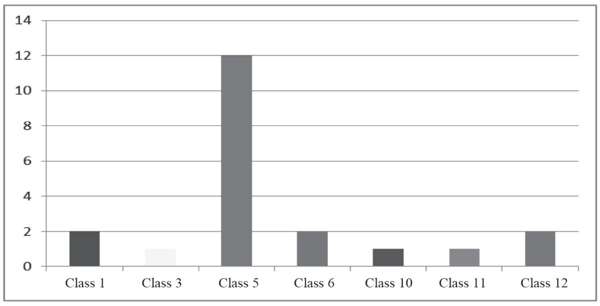

Fig. 6. The numbers of shipping accidents between 1990 and 2017 in the area managed by the Inland Waterway Shipping Office in Gdańsk by class [own study based on 10]

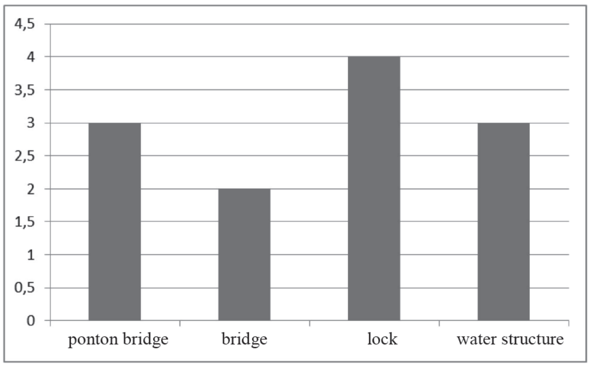

Fig. 7. The number of collisions with different objects in the Lower Vistula [own study based on 10]

The most common causes of accidents in the examined area of the Lower Vistula are: technical failure, natural conditions and human error, the latter resulting from both involuntary actions to avoid collisions and conscious actions, such as failure to observe navigational regulations. Identified causes have been related to 21 events. The most common consequences of personnel errors turned out to be collisions with hydro engineering objects. Technical failures, as in the case of human error, mostly led to the damage to objects and the vessels involved. Weather conditions (wind and visibility) caused two accidents resulting in a collision with objects in water or above (boulder, tree branch). Based on the analysis of the whole list, we can note that the most common cause-effect pattern in the examined cases is human error causing a collision with a hydro engineering object.

4.1. Critical places in the Lower Vistula

A major difficulty for navigating in the examined area a debris accumulating and moving down river, which at medium and high water is hidden under the water surface. Too small radiuses of bends at lock approaches and at intersections with road and rail routes (bridges) create conditions that are favourable for undesired events. The lack of standardized aids to navigation marking the navigable route and failure to deepen the airway by removing obstructions (rocks, tree branches, wrecks, bridge remains) leads to vessel damage [8].

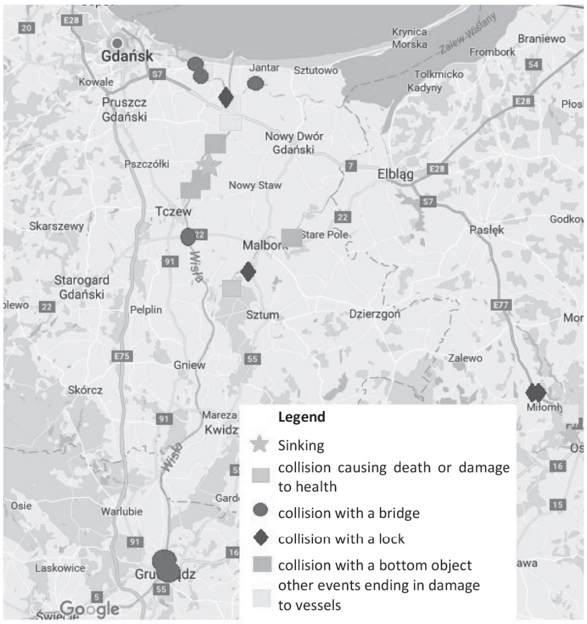

Fig. 8. Locations and types of incidents in the lower section of the River Odra in the years 1990 - 2016 [own study based on 10]

5. Conclusion

There are a number of dangers that affect freight transport on inland waterways. An event involving a cargo vessel is a risk to the cargo carried and direct and/or indirect participants. In addition to the ship's crew, the people that may suffer are participants of the other modes of transport (road and rail passengers, pedestrians). Szczecin Waterway Junction comprises eight bridge crossings which, as historical data show, are most vulnerable to an occurrence of a dangerous event. It seems purposeful to increase the level of safety at these points, to eliminate risk of transport disaster, which could impede the transport processes in Szczecin. In order to do so, the existing aids to navigation can be utilized. Inland Shipping Office has 31 CCTV cameras installed on most Odra bridges from the village of Ognica to the river mouth at Lake Dąbie. To implement comprehensive use of video surveillance of inland waterway vessels, it is necessary to develop new methods of analysis, which will include vessel movement parameters and water area parameters. An additional argument for using video cameras for this purpose is a possibility of displaying the situation around the vessel as real images, unlike ECDIS or AIS offering only 2D graphic representation. The third dimension is important if we consider a specific situation such as vessel's transition under a bridge span, where the ship's air draft is vital safety information for this type of manoeuvre [9]. Risk management is a complex process, often burdened with much uncertainty. The magnitude of possible accident consequences requires that risk management should be implemented with great care and the use of all available modern methods and measures. The lack of legal regulations in the area of risk management aimed at Polish inland waterways leads to obvious lack of information on that issue and creates difficulties in estimating the current level of risk and potential reduction of safety. Safety management should fill the gap in Polish publications on risk management in inland waterways and trigger a debate on regulations addressing this important area of human activity.

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