WATER TRANSPORT RISK - COMPARATIVE ANALYSIS

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Abstract

Research on transport risk focuses on adverse events occurring in particular modes of transport. A review of literature and project works indicates that risk analyses are carried out separately for road, rail, air and water transport. A different approach to risk assessment in particular modes of transport results from significant differences occurring in the performance of transport in each of the distinguished transport systems. This procedure is fully justified. However, there is a common approach to risk assessment in water transport that combines inland and maritime transport. The review of publications on water transport risks in recent years indicates that while the scope of research into the risk of maritime transport is very well developed (e.g. [1]), the number of publications devoted to risks in inland transport is small. Meanwhile, the specificity of transport on rivers is completely different from the sea transport. Therefore, it is not possible to use analytical inference from research into the risk of maritime transport for inland transport management. The aim of the article is a comparative analysis of threats occurring in sea and river transport and indication of the need for a different approach to risk assessment in inland waterway transport. A comparative analysis was carried out on the basis of a literature review of 2007 - 2017 and interviews conducted among river vessel owners.

Keywords: water transport, risk assessment, comparative analysis

1. INTRODUCTION

The issue of risk assessment in transport has been the subject of numerous studies in recent decades. Due to the human being presence in the surveyed transport systems, the most important criterion in assessing the carried out transports is humans' safety [2]. Risk management in individual transport systems is therefore aimed primarily at reducing the number of transport accidents and limiting their effects [3].

Risk management in water transport includes maritime and inland waterway transport. In some publications in this area, research devoted to the risk assessment for this mode of transport is compiled under one phrase [4]. This approach seems to be wrong, as the specificity of both types of transport requires a different approach to the conducted analysis. For this reason, the purpose of the article is to show significant differences in both water transport systems, which generate the need to diversify the approach to risk assessment. This objective will be achieved on the basis of a critical analysis of literature sources, comparing adverse events occurring in each of the examined transport systems. Therefore, Chapter 2 will present the results of research into the risk in maritime transport described in the literature. Chapter 3 will conduct a comparative analysis of adverse events occurring in both water transport systems. The final conclusions will be presented in Chapter 4, on the basis of the tests and analyzes carried out.

2. RISK ASSESSMENT IN MARTIME TRANSPORT

The main international institution responsible for the level of maritime safety in the seas and oceans of the world is the International Maritime Organization, which is also a specialized agency of the United Nations Organization (UNO). The major document on risk management in maritime transport is published by International Maritime Organization so-called FSA (Formal Safety Assessment) [5]. This document is intended to support the decision-making process in the aspect of assessing the impact of changes in regulations on the

safety of navigation. FSA is a five-stage process that uses a generally accepted risk management methodology, including: (a) hazard identification; (b) risk assessment; (c) recommendations for decisions making; (d) analysis of economic efficiency; (e) risk control options. The second important organization is the International Association of Marine Aids to Navigation and Lighthouse Authorities IALA. It also deals with maritime safety and methods of risk assessment and its control, but almost exclusively in ports, on waterways (routes) and in other limited water areas. Within the framework of the IALA organization in 2005, two methods for risk assessment and control were published and recommended for use. These are [6,7]: (1) the PAWSA method and (2) the IWRAP method.

Table 1 The scope of research conducted in the area of risk assessment in maritime transport, own study based on [1]

No. group	Subject of study	Scope of research
Group 1	Risk of ship collision	• Determine frequency and cost of collision [8, 9, 10, 11, 12, 13]. • Determine the accident probability [14, 15, 16, 17] and consequences [18, 19]. • Determine the collision risk in a part waterway through a vessel-conflict technique [20]. • Evaluate effect of speed limits [21].
Group 2	Risk of oil spills	• Quantify effect of risk reduction measures on oil spills [22, 23]. • Environmental oil spill risk from ship accidents [15, 24]. • Determine the oil spill probability and consequences [25]. • Determine expected oil spill costs due to maritime accidents [26].
Group 3	General accident risk (other than collision)	• Determine the expected number of accidents / probability and consequences [24, 27, 28, 29]. • Quantify effect of risk reduction measures on accident risk [30, 31].
Group 4	Risk of the ship grounding	• Determine the grounding frequency [32] and consequdences [9]. • Determine the effect of implementing a navigation service of collision and grounding risk [33].
Group 5	Other	• Determine the relative risk of coastal areas and determine risk level is acceptable [34]. • Linear modeling technique to risk analysis of navigation [35]

As it can be seen in **Table 1**, the subject of risk analysis in maritime transport is first of all the assessment of the possibility of an accident occurrence. There are many classifications of navigational accidents identified by various authors and various organizations [4]. The most commonly used is the simplified classification, specifying: (a) collision between ships; (b) ship grounding and (c) collision with fixed obstacles. In order to compare the magnitude of the risk caused by very different marine accidents to people and property, the levels of threats must be expressed in equal measure. It is generally accepted that the measure of the magnitude of the risk is the number of fatal accidents that can happen per unit of time, usually within one year [36].

3. RISK IN INLAND AND MARITIME TRANSPORT

Europe has over 30,000 km of canals and rivers that connect hundreds of major cities and industrial areas. The main network, approximately 10,000 km long, connects the Netherlands, Belgium, Luxembourg, France, Germany and Austria. In Poland, inland freight traffic is concentrated on two main rivers - Odra and Vistula. The analysis of the source data indicates that inland waterway transport in Europe is characterized by a high level of security. An analysis of press publications from the last decade, dedicated to ship-related accidents on rivers, has identified only one serious accident with fatalities. It was an event that took place on 11/09/2016 in Erlangen (Germany) at Main-Donau-Kanal. A cruise ship "Viking Frey" with 47 crew members and 181

passengers on board hit the bridge. Two crew members were killed in the incident. Also in Poland, inland transport remains one of the safest modes of transport. Analysis of Central Statistical Office (GUS) data, presented in **Table 2**, shows that the number of accidents in recent years was small. None of the accidents were related to the carriage of dangerous goods.

Table 2 Number of accidents in inland transport on rivers in Poland in 2010-2017, own study based on the [37]

Year	2010	2011	2012	2013	2014	2015	2016	2017
Number of accidenst	9	5	5	12	10	8	4	6

The analysis performed as a part of the comparison of the risk assessment range in both types of water transport focused on the comparison of the frequency of adverse events set out in **Table 3** and their effects. The analysis was based on information on the occurrence of investigated events on Polish waterways routes. The analysis was based on (a) information published on websites dedicated to inland navigation and (b) information on the fines issued in 2013 - 2017 by the Offices of Inland Navigation.

Table 3 Frequency and effects of adverse events in inland waterway transport

No. group	Subject of study	Scope of research
Group 1	Risk of ship collision	• Low freguency • The effects mainlt concerned repari costs • No deaths
Group 2	Risk of oil spills	• Low freguency • Ecological and financial effects related to activiting preventing ecological disaster
Group 3	General accident risk (other than collision)	• Average frequency • It mainly concerns the collision with infrastructure (bridges, cableways running over the river) • Ship repair costs and damaged infrastructure
Group 4	Risk of the ship grounding	• Average frequency • Towing costs of the ship (effects considerably lower than in the case of sea transport)
Group 5	Other	• Low freguency • Adverse events related to damage or improper operation of infrastructure (sluices) • Flooding of ships with water (partial or leading to the sinking of the unit) as a result of incorrect placement of the cargo on board • Fires on ships (occasionally, effect depending on the rate of fire extinguishing) • Dropping over a crew member (average frequency, effect depending on the size of the damage suffered by the victim)

As a result of the analysis, it can be concluded that, unlike in maritime transport, the greatest risk of occurrence has events related to the ship grounding and collisions with infrastructure (this event is usually not considered in the case of maritime transport). At the same time, it should be noted that events such as ship collisions and the possibility of leaks in maritime transport are the subject of numerous studies and publications. The authors of these studies indicate in their research the high probability of occurrence of these events. Meanwhile, in the

case of inland waterway transport, these events are characterized not only by a low rate of occurrence, but also by relatively low effects (in relation to the effects of maritime transport). At the same time, the analysis of fines from 2013 - 2017 issued by the Offices of Inland Navigation proves that the most frequent offenses include cases in which the ship's captain or crew member did not have the required documents (Article 61 [38]) or did not sail with the required documents (Article 60 [38]). This reflects the low incidence of other adverse events that are the subject of marine transport research.

4. CONCLUSION

It should be noted that research on risk assessment in maritime transport is highly developed. In the databases of scientific journals one can find numerous publications on the subject. [6] presents an analysis of publications from 1974 - 2014 devoted to research on risk assessment in maritime transport. The literature review includes a total of 135 literature items. There are far fewer publications devoted to the risk of inland transport. It can therefore be considered as a research gap. It may result from the fact that spectacular disasters on river ships are very rare and outside the borders of Western civilization. In Europe, the effects of accidents on inland waterways are so low that it is difficult to find information about them in the daily press. However, this does not change the fact that although inland transport is considered as the safest mode of transport, this branch also requires an individualized methodological approach to risk assessment. This method should be aimed at identifying undesirable events that are not necessarily related to transport safety. The purpose of the transport process is timely and complete delivery of the cargo at the agreed costs. This means that the identification of undesirable events should focus on those events that disrupt the achievement of such a defined goal. Today, it should be stated that in the area of research on transport risk, such an approach is lacking. For this reason, it will be the direction of further research carried out by the authors.

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