SAFTY RULES AND RISK IDENTYFICATION IN MARITIME FREIGHT TRANSPORT

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Abstract

Maritime transport is still one of the most important sectors of transport for large volumes of transported goods. The existing solutions allow on the one hand a high degree of flexibility in the use of this type of transport and on the other hand establish common standards through the use of containers. Maritime container transport is exposed to many risk factors that can have a significant impact on the safe conduction of transport services. Problems in maritime transport affecting particular the proper implementation of intermodal transport processes. The safety of each stage of the maritime transport services and formal or legal procedures related to the compliance of established rules and safety standards may determine the efficiency and effectiveness of logistics processes of many companies, especially those which operate on an international scale. Delays as a result of failure, unit grounding or loss of cargo are implied by a number of factors that can be avoided when the safety management principles are respected. The aim of the article is the presentation of safety rules for maritime freight transport and initial identification of the main risk factors in the process.

Keywords: Maritime transport, security, containers, risks

1. INTRODUCTION

Shipping by sea is often underestimated. It is considered to be slow and to require dedicated and complicated infrastructure, as well as highly specialized staff at its every stage. However, it should be remembered that the unit cost of maritime transport decreases with the increase of the size of a one-off batch, and that is why it is often used. Transport of goods by sea is regulated by a number of legal rules, the fulfilment of which is mandatory in order to ensure the safety of items placed on a ship and of the crew who service the operation or the ship. The international character of maritime freight transport means that it is necessary to introduce regulations and standards of a supranational character that will be observed by all participants of the transportation process [1]. Such an approach significantly reduces the disruptions and risks that may arise in both the organizational and implementation realms. This article presents the main regulations currently in force in maritime freight transport and refers them to the container-based method, which is the most common. In addition, an attempt was made to identify and classify the risks which may occur in maritime freight transport. These factors will be the subject of further development of the concept of a risk management system in maritime freight transport.

2. THE LEGAL ASPECTS OF ENSURING SAFETY IN MARITIME TRANSPORT

Transport of goods by sea is important for the development of the world economy. Sea routes not only play an important role in the process but also influence international relations. Therefore, all accidents and conflicts that occur in the seas and oceans are not only a matter of one country, but often become the issue of the international political and economic situation [1,2]. It is not possible to eliminate hazards and factors that affect the safety of maritime transport completely. However, those accidents and catastrophes were the catalyst for introducing changes within the maritime transport safety rules, which focused mainly on the principles of navigation, selection of ship equipment, its construction and operation [3]. Despite the continuous implementation of new regulations aimed at reducing or eliminating the number of threats which may arise

from maritime transport, disasters still occur and result in loss of life, destruction or loss of transported cargo, and therefore still require further improvement [1,4].

Maritime safety can be defined as the persistent state of nautical conditions, which is above the approved acceptable level, provided that these conditions result from direct navigation and directly affect human activities at sea. The safety of maritime transport can be divided according to the areas it covers under its protection [3]:

- health and safety of people,
- personal safety,
- environmental protection,
- safety of life at sea (e.g. piracy),
- elements included in the land infrastructure and technical equipment of the ship.

With regard to the characteristics of maritime transport, the scope of these conditions also includes issues of protection of marine environment from pollution [5]. The international nature of maritime transport, i.e. a situation in which ship crew, insurers, port operators, pilots and other entities involved in the logistics processes are not associated with the flag flying on the ship, enforces harmonization of legal regulations related to maritime safety. For this purpose, among others, the International Maritime Organization (IMO) has been established, which is designated for global shipping safety. IMO's legislative activities have allowed for the conclusion of a number of conventions aimed at increasing the level of maritime safety in transport and at protecting the aquatic environment [6]. It should be taken into consideration that maritime transport is regulated by laws and rules issued by state legislative bodies, and above all, through international bodies which supervise the safety of transported goods, human life and ecological issues. The most important international bodies regulating the areas of maritime safety include the International Maritime Organization, which is an entity acting for the United Nations. The main task of this organization is to prevent maritime accidents, to protect the aquatic environment, to ensure the safety of personnel associated with maritime transport [6,7]. The International Maritime Organization is responsible for enforcement of the International Convention for the Safety of Life at Sea (SOLAS), the most important and overarching treaty which regulates maritime safety. Chapter XI-2 of the SOLAS Convention on special measures to enhance maritime safety includes the International Ship and Port Facility Security Code (ISPS), which is a mandatory instrument for all countries party to the Convention. The organization has developed and introduced international collision laws and a number of necessary standards for seafarers. Moreover, it developed conventions and codes related to facilitation of maritime traffic, search and rescue operations, levels of load lines and rules for transportation of dangerous goods. The Maritime Safety Committee is the IMO's main technical body for safety-related matters [1,6,7]. **Figure 1** shows the cooperation and inter-dependence of participating entities that shape maritime safety.

The International Safety Management Code (IMS) is a set of rules developed by IMO in order to organize the administration of safety issues at sea and protection of its environment. The purpose of the code is to implement uniform global standards, guidelines and procedures for safe operation of entities. At present, the implementation of the provisions of the IMS Code is mandatory for all owners of maritime vessels [8]. The IMS Code regulates safety issues related to the means of transport, i.e. vessels and their owners, whereas the European Maritime Safety Agency (EMSA) addresses safety issues related to linear and nodal infrastructure [5].

Based on the general provisions related to the captain's obligations and rights, it can be concluded that from the moment of loading the goods onto the ship, all responsibility for its safety, which is associated with transporting it intact, and as a result of meeting the terms of the contract, is transferred to the captain of the transport vessel. Therefore, any oversight, failure to comply with obligations or a decision which circumvents the basics of safe navigation and transportation of goods may result in legal sanctions imposed successively on the captain of the ship and then on his employer, i.e. the shipowner.

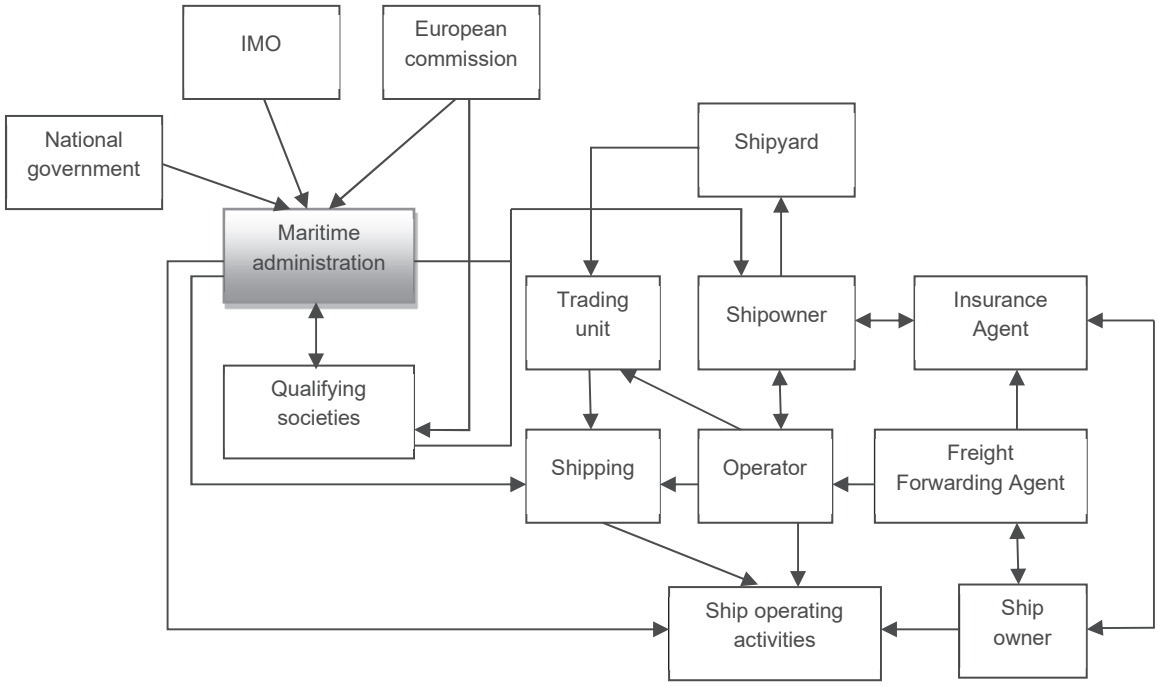

Figure 1 The cooperation and inter-dependence of participating entities in maritime safety [3]

3. MARITIME CONTAINER TRANSPORT

Maritime container transport is part of intermodal transport [9]. In this case, the loading units are various types of containers, and means of transport include, apart from cars, also railways and/or container ships. Seaports serving container ships have to be highly specialized transhipment points. While transporting loads of such a great scale, it is important to provide adequate infrastructure to ensure the efficiency and safety of the process which uses container ships [10,11].

Containers used in maritime transport are unified structures, which leads to standardization of container dimensions and significantly accelerates and improves transhipment processes between different modes of transport. According to Drewry Maritime Research, the global number of shipment containers is over 33 million TEU (twenty-foot equivalent unit), 93 % of which are dry containers (both standard and special), and the remaining 7 % are refrigerated and tank containers [10]. The entity responsible for initialization and supervision of documents and issue of legal acts regarding containers is the International Organization for Standardization (ISO) [12]. The dimensional data on containers is shown in **Table 1**.

Table 1 Series of standard containers according to ISO standard [11,12]

Type	Measure	Length	Width	Height	Capacity (m^3)	Weight (t)
1A	feet	40	8	8	-	-
	meters	12.90	2.43	2.43	61.0	3.0
1B	feet	30	8	8	-	-
	meters	9.12	2.43	2.43	45.5	2.0
1C	feet	20	8	8	-	-
	meters	6.05	2.43	2.43	30.0	2.0
1D	feet	10	8	8	-	-
	meters	2.99	2.43	2.43	14.3	1.2
1F	feet	5	8	8	-	-
	meters	1.46	2.43	2.43	7.0	1.0

The most popular containers as far as the type of transported cargo is concerned are: standard containers, with an open roof and/or side, tunnel containers, refrigerated containers and tanks [11,12].

Seaports and devices which enable container transhipment between various means of transport and the container ship are further elements of the maritime container transport infrastructure. **Table 2** presents the largest ports in the world based on the number of containers shipped.

Table 2 Largest ports in the world in terms of loading tonnage (mln TEU) [14]

Harbour	2012	2013	2014	2015	2016
Szanghaj (CN)	32.53	33.62	35.29	36.54	37.13
Singapur (SG)	31.65	32.60	33.87	30.92	30.90
Shenzen (CN)	22.94	23.28	24.03	24.20	23.97
Ningbo-Zhoushan (CN)	16.83	17.33	19,45	20.63	21.60
Busan (KR)	17.04	17.69	18.65	19.45	19.85
Hongkong (CN)	23.12	22.35	22.23	20.07	19.81
Guangzhou (CN)	14.74	15.31	16.16	17.22	18.85
Qingdao (CN)	14.50	15.52	16.62	17.47	18.01
Jebel Ali, Dubaj (IN)	13.30	13.64	15.25	15.60	15.73
Tianjin (CN)	12.30	13.01	14.05	14.11	14.49
Klang (MY)	10.00	10.35	10.95	11.89	13.20
Rotterdam (NL)	11.87	11.62	12.30	12.23	12.38

The following types of container ships which can be distinguished in maritime transport due to their dimensions are presented in **Table 3**.

Table 3 Size breakdown of container ships [15]

Type	Capacity (TEU)	Length (m)	Overall width (m)	Displacement (m)	Description
Ultra Large Container Vessel (ULCV)	14,501 and bigger	366 and longer	49 and longer	15.2 and longer	Ships 400 m long, 59 m wide, 14.5 m submerged and 18 270 TEU in tonnage, Maersk Triple E ships may pass through the Suez Canal
Nowy Panamax	10,000-14,500	366	49	15.2	Ships bigger than Panamaax class. Due to their size they are not able to pass through the old locks of the Panama Canal.
Post-Panamax	5,101-10,000	366	49	15.2	
Panamax	3,001-5,100	294.13	32.31	39.5	Size of ships limited to the original dimensions of the Panama Canal locks [15].
Feedermax	2,001-3,000				Container ships, smaller ones used mainly to transport containers over shorter distances.
Feeder	1,001-2,000				

Currently operating container ships have an average capacity of about 10,000 TEU, which gives significant possibilities to carry a large amount of cargo with only one unit. Annually, ships transport around 120 million containers, shaping the global turnover to be counted in billions of US dollars [9].

Maritime container transport requires well-developed port infrastructure as well as availability of other modes of transport. The port area must provide properly prepared water areas to manoeuvre, dock and load vessels.

In addition, the ports used for loading container ships must have appropriate facilities for fast and safe loading and unloading of goods.

4. IDENTIFICATION OF RISKS IN MARITIME CONTAINER TRANSPORT

Maritime container transport is exposed to many risks that can have a significant impact on the implementation of the transport contracts. For the purposes of this article, these threats were divided into internal and external categories. Internal factors include all deficiencies or irregularities which result from negligence caused by human factors, loading errors, inappropriate crew training as well as technical specifications of the ship or transported containers. Identification of risk factors which result from internal threats is carried out by analysing the process of loading and unloading the vessel, as well as technical issues related to the ship that may affect safety. Loading and unloading are important logistics processes for intermodal container transport. In the world's largest ports, container handling is carried out under time pressure, which is prone to accidents and irregularities [5,8,11]. This translates into destruction or damage of the cargo, as well as threats to the port service crew. It should be emphasized that among the possible causes of disasters or marine incidents, human error plays the largest part. The technical status, the design of the vessel and its maintenance record form another group of internal factors that affect the safety of maritime container transport. The ship must comply with the highest safety standards and should be subject to regular checks aimed at detection of any deviations from the required standards, which could help to prevent future disasters. The ship's superstructure, which is usually of large volume and mass, constitutes a significant percentage of the weight of the whole ship. Therefore, its proper location and design is paramount. Incorrect distribution of the centre of gravity can negatively affect the stability, and thus the safety of the vessel. In addition, cargo hold structures are considered to be important elements of the ship structure which determine transport safety. The correct design, placement and capacity of the cargo hold has an impact on the stability of the ship and its behaviour during bad weather conditions. Failures of the vessel and its instrumentation are a significant, though less frequent, reason for marine incidents. Failure of the engine, control systems or other infrastructure elements may have serious consequences, including those that can completely immobilize the unit or cause a major catastrophe [16].

External threats that affect the safety of transported goods are those whose occurrence results from the direct influence of factors that are not within the power of the shipowner and/or of the crew or the technical condition of the vessel. Here, we can include the group of external risk factors in maritime transport, including all issues independent of the human error factor. The group of external factors can be divided into the following categories [17]:

- hydrometeorological factors - i.e. all phenomena which occur in the atmosphere, i.e. weather conditions in which the transport takes place,
- geographical conditions - topography (seabed, bays and straits) in which the ship moves,
- navigation conditions - indirectly related to hydrometeorological factors in which the vessel moves,
- terrorism - all acts of terrorism and piracy which may take place in the international waters.

Maritime container transport is exposed to these factors, and one of the means of early warning against their occurrence is the use of security systems that are aimed at an improvement of accuracy in navigation, monitoring and prevention of unwanted incidents which may arise along the entire shipping route [3,13]. Safety management systems are currently based mainly on electronic methods of data exchange between various entities involved in the organization and implementation of maritime transport.

5. CONCLUSION

Enforcement of safety of maritime transport is a problem of international importance. Threats to maritime transport can be systematized and recognized in various areas, yet they are mainly of a cognitive nature. Legislative activities are aimed at increasing the level of transport safety. For the efficient and effective

implementation of sea freight transport processes, it is important to identify and evaluate risk factors so that procedures can be prepared on that basis which will ensure rapid action to be undertaken in order to minimize potential risks.

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